# The Impact of Media Literacy in Adolescence and Young Adulthood.

**- Correlative and Experimental Investigations on the Influence of Media Literacy on Cognitive and Political Variables, and on Knowledge Acquisition from Media –**

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**Vorwort**

**Summary**

This thesis consists of three studies investigating the influence media literacy has on political variables, cognitive variables, and learning. Adolescents from 13 years of age and young adults are included in the studies. This thesis is divided into three chapters. Study I and II are one comprehensive study, but will be presented separately for better readability. Chapter I provides the reader with background knowledge for the original studies presented in chapter II includes information about media use, different conceptualizations of media literacy and its development over the lifetime, as well as media literacy's impact on cognitive and political variables. Additionally, current literature on the comparison of the learning outcomes of different kinds of texts (written, auditory, and audiovisual) is presented, with a differentiation between text-based information and inferences. In chapter II, the original studies are placed in the current state of research and presented in detail. In chapter III, a critical discussion of the studies is conducted, and a general model of the influence media literacy has on the investigated cognitive and political factors is presented, followed by a conclusion of the research.

The theoretical foundation of this thesis is three models of media literacy proposed by Groeben (2002, 2004), Hobbs (1997), and Potter (1998, 2016). These three models are similar in that they define media literacy as a multifactorial construct with skills that develop further in the course of life. Their ideas are integrated and developed further, leading to our own model of media literacy. It encompasses five scales: *media sign literacy, distinction between reality and fiction, knowledge of media law, knowledge of media effects,* and *production skills.* Thereupon, the assessment tool Würzburg Media Literacy Test (WMK; Würzburger Medienkompetenztest) is designed.

There is evidence that media use and media literacy influence socio-political factors. Young adults name the internet as the main source of information on political topics (see Pasek et al., 2006), and knowledge demonstrably fosters political participation (Delli Carpini & Keeter, 1996). However, the kind of participation activity regarded is important (Quintelier & Vissers, 2008), as sometimes real-life participation is supplemented by online activities (Quan-Haase & Wellman, 2002). Media literacy is the key to evaluating the quality of information from media. Whether or not a direct link between media literacy and political interest exists has, as far as I know, not yet been investigated. Several studies have shown that precursors and subcomponents of media literacy have the capacity to influence cognitive variables. For instance, children with higher media sign literacy possess better reading proficiency (Nieding et al., 2017) and are better at collecting information and drawing inferences from hypermedia and films (Diergarten

et al., 2017) as compared to children with low literacy. These precursors and subcomponents are more efficient in processing medial sign systems, reducing cognitive load, and consequently, liberating cognitive capacity for other mental tasks (Sweller, 1988). Paino and Renzulli (2012) showed that highly computer-proficient adolescents exhibit better mathematics and reading abilities. Different types of media influence the learning process differently, and the learning process can be enhanced by combining these different types of media, if the material is prepared according to the research findings and Mayer's (2002) cognitive theory of multimedia learning. Similarly, a reduction in cognitive load takes place and more resources can be invested in the learning process itself (Mayer & Moreno, 2003; Sweller, 1988). It is not easy to answer the question of whether one medium is superior for learning to another. Generally, adults learn best from written texts (e.g., Byrne & Curtis, 2000), and audiovisual and auditory texts are comparable (e.g., Hayes et al., 1986); however, there is little research regarding the comparison of the latter two.

Study I examined whether media literacy has a positive impact on interest in politics and the political self-concept. A sample of 101 13-to 20-year-olds was drawn. The control variables were intelligence, socio-economic status (SES), openness to experiences, perspective-taking, age, and sex. Additionally, an evaluation of the WMK was conducted, which indicated good construct validity and excellent overall reliability. Media literacy was positively associated with interest in politics, political self-concept, and perspective-taking but not with openness. In hierarchical regressions and path analysis, a direct influence of media literacy and openness on interest in politics could be found. Political self-concept was solely influenced by interest in politics. Although media literacy had no direct influence on political self-concept, it influenced its precursor interest in politics and was thus expected to have distal influence. The results of the first study confirm previous findings (e.g., Vecchione & Caprara, 2009), where political self-concept is regarded as a precursor of political participation. In conclusion, the findings of study I suggested that by stimulating political interest, media literacy could, mediated through political self-concept, foster political participation.

Study II (which was conducted on the same sample as study I) was concerned with the question of whether highly media-literate adolescent and young adult participants exhibit better academic skills (mathematics; reading) and academic achievement (grades) compared to less media-literate participants. Additionally, to obtain information about potential development during adolescence, a group of 50 13-year-olds was compared with a group of 51 19-year-olds in terms of their media literacy. The control variables were intelligence, SES, sex, and age. The

results showed that a significant development of media literacy took place during adolescence ($\Delta M = .17$), agreeing with Potter's (1998, 2013) development theory of media literacy. Media literacy was significantly correlated with reading skills and school grades. Regarding adults, media literacy was also significantly correlated with mathematical skills; the association was greater than that with reading skills. However, no connection with mathematical skills was found for adolescents. To control for the influence of age and intelligence, which were both associated with media literacy, hierarchical regressions and path analyses were conducted. The results revealed that media literacy had a greater impact on grades and academic abilities than intelligence. These results are in line with those obtained by Paino and Renzulli (2012).

Study III investigated whether media literacy helps young adults to better learn from three kinds of media, a written, an auditory, and an audio-visual text, and which medium achieves the best learning results. Three groups of 91 young adults were compared (written, auditory, and audio-visual text) in terms of their learning outcomes. These outcomes were conceptualized as directly stated information in the text (assessed by text-based questions) and inferential learning (inference questions). A computer-based short version of the WMK was applied to assess media literacy, which should be optimized in the future. The control variables were intelligence, verbal ability, media usage, prior knowledge, and SES. In hierarchical regression, media literacy turned out to be a significant predictor of text inferences, even when other relevant variables, such as intelligence, were controlled for. Inferences foster the building of the situation model, which is believed by many authors to be true comprehension of a text (Zwaan & Radvansky, 1998). The outcomes of study III support Ohler's (1994) assumption that media literacy fosters the creation of a more elaborated situational model. Text-based questions were only influenced by prior knowledge. As assumed by Potter (1998, 2016), the media literacy of young adults in the Western world suffices to extract relevant facts from educational learning material. Both subjects were best in the written text condition for text-based and inference question results. Audiovisual and auditory texts showed no significant differences. The written text condition did not excel in the auditory text condition for inferences. The results accord with those obtained by, for instance, Byrne and Curtis (2000).

Taken together, these studies show that media literacy can influence several cognitive and political variables. It stimulates political interest, reading comprehension, school grades, and mathematical abilities in young adults, as well as drawing inferences from different kinds of texts. Additionally, media literacy develops further during adolescence.

**Zusammenfassung**

Diese Doktorarbeit besteht aus drei Studien, welche den Einfluss von Medienkompetenz auf politische Variablen, kognitive Variablen und auf Lernen untersuchen. Hierzu wurden Jugendliche ab 13 Jahren und junge Erwachsene rekrutiert. Bei Studie I und II handelt es sich um eine groß angelegte Studie, welche der Lesbarkeit wegen als separate Untersuchungen dargestellt wird. Diese Doktorarbeit ist in drei Kapitel unterteilt. Das erste Kapitel liefert das notwendige Hintergrundwissen für die originären Forschungsstudien des zweiten Kapitels. Dies beinhaltet Informationen zur Mediennutzung, unterschiedlichen Konzeptionen von Medienkompetenz und deren Entwicklung im Verlauf des Lebens, sowie der Einfluss von Medienkompetenz auf kognitive und politische Variablen. Darüber hinaus wird die aktuelle Literatur zur Lernwirksamkeit verschiedener Textarten (schriftlich, auditiv, audiovisuell) dargelegt, wobei zwischen Textoberfläche und Inferenzen unterschieden wird. Im zweiten Kapitel werden die originären Studien zunächst in die aktuelle Literatur eingeordnet und darauffolgend detailliert dargestellt. Im dritten Kapitel erfolgen anschließend die kritische Diskussion der Studien, sowie mein Versuch, ein übergreifendes Wirkungsmodell der Medienkompetenz auf die untersuchten kognitiven und politischen Faktoren zu entwerfen. Zum Schluss versuche ich ein finales Fazit meiner Forschung zu ziehen.

Als theoretische Grundlage dieser Dissertation dienen die drei Modelle der Mediakompetenz von Groeben (2002, 2004), Hobbs (1997), und Potter (1998, 2016). Alle haben gemeinsam, dass sie Mediankompetenz als multifaktoriell, mit sich über die Lebenszeit weiterentwickelnden Fertigkeiten, konzeptualisieren. Die Ideen dieser Modelle wurden integriert und zu einem eigenen Modell der Mediankompetenz weiterentwickelt. Es beinhaltet fünf Skalen: Mediale Zeichenkompetenz, Realitäts-Fiktionsunterscheidung, Wissen über Medienrecht, Wissen über Medieneffekte, und Produktionsfertigkeiten. Hieraus wurde das Erhebungsinstrument WMK (Würzburger Medienkompetenztest) entwickelt.

Es gibt Hinweise, dass Mediennutzung und –kompetenz politische Faktoren beeinflussen. Junge Erwachsene nennen das Internet als primäre Informationsquelle über Politik (z.B. Pasek, Kenski, Romer & Jamieson, 2006), wobei Wissen nachweißlich politische Teilhabe fördert (Delli Carpini & Keeter, 1996). Hier kommt es jedoch darauf an, wie politische Partizipation definiert wird (z.B. Quintelier & Vissers, 2008), da lebensweltliche Partizipation auch durch Online-Aktivitäten ersetzt werden kann (Quan-Haase & Wellman, 2002). Medienkompetenz stellt den Schlüssel zur Bewertung der Qualität von Informationen aus den Medien dar. Ob

allerdings eine direkte Verbindung zwischen Medienkompetenz und Politikinteresse besteht, wurde meines Wissens bisher noch nicht untersucht.

Es wurde bereits in mehreren Studien gezeigt, dass Vorläuferfähigkeiten und Teilkomponenten von Medienkompetenz kognitive Variablen positiv beeinflussen. So weißen beispielsweise Kinder mit höherer medialer Zeichenkompetenz im Vergleich zu Altersgenossen mit geringer medialer Zeichenkompetenz bessere Lesefertigkeiten auf (Nieding et al., 2017) und können besser Informationen und Inferenzen aus Hypertexten und Filmen ziehen (Diergarten et al., 2017). Dies könnte darin begründet liegen, dass diese Kinder mediale Zeichen effizienter verarbeiten und hierdurch die kognitive Belastung reduzieren, was ihnen mehr Kapazität für andere kognitive Aufgaben freiräumt (Sweller, 1988). Paino und Renzulli (2012) konnten zeigen, dass adoleszente Schüler mit hoher Computerkompetenz bessere mathematische und Lesefertigkeiten aufweisen. Verschiedene Medien beeinflussen das Lernen unterschiedlich und der Lernprozess kann durch die Kombination von Medien verbessert werden, wenn diese den Prinzipien der Kognitiven Theorie des Multimedialen Lernens von Mayer (2002) folgt. Hierdurch kommt es ebenso zu einer Reduktion der kognitiven Belastung, wodurch mehr Ressourcen in den Lernprozess investiert werden können (Sweller, 1988, Mayer & Moreno, 2003). Die Frage nach der generellen Überlegenheit eines Lernmediums lässt sich nicht pauschal beantworten. Im Allgemeinen lernen Erwachsene am besten von geschriebenen Texten (z.B. Byrne & Curtis, 2000), auditive und audiovisuelle Texte liegen gleichauf (Hayes, Kelly, & Mandel, 1986). Allerdings existieren wenige Studien, die sich mit einem Vergleich der beiden letzteren befassen.

Die erste Studie dieser Dissertation untersuchte, ob sich Medienkompetenz positiv auf das Politikinteresse und das politische Selbstkonzept, auswirkt. Es wurde eine Stichprobe von 101 13- bis 20-Jährigen gezogen. Als Kontrollvariablen wurden Intelligenz, sozio-ökonomischer Status, Offenheit für Erfahrungen, Perspektivenübernahme, Alter und Geschlecht berücksichtigt. Zusätzlich fand eine Evaluation des WMK statt, welche gute Ergebnisse bezüglich seiner Konstruktvalidität und eine exzellente Gesamtrealiabilität ergab. Medienkompetenz korrelierte positiv mit Politikinteresse, dem politische Selbstkonzept und Perspektivenübernahme, aber nicht mit Offenheit für Erfahrungen. Hierarchische Regressionen und Pfadanalysen ergaben einen direkten Einfluss der Medienkompetenz und Offenheit auf das Politikinteresse. Das politische Selbstkonzept wurde nur durch das Politikinteresse beeinflusst. Auch wenn Medienkompetenz sich nicht direkt auf das politische Selbstkonzept auswirkte, so hat es doch dessen Vorläufer Politikinteresse modifiziert und könnte so distal wirken. Die

Befunde dieser Studie bestätigen früherer Ergebnisse (z.B. Vecchione & Caprara, 2009), wenn man das politische Selbstkonzept als Vorläufer politischer Partizipation auffasst. Die Resultate von Deary und Kollegen (2008), dass intelligentere Menschen mehr Politikinteresse und politische Partizipation berichten, konnten nicht repliziert werden. Möglicherweise spielt hier das Bildungsniveau, vor allem verbale Fähigkeiten und eine Ausbildung in Sozialwissenschaften, eine größere Rolle als Intelligenz (vgl. Hillygus, 2005). Zusammenfassend zeigten die Ergebnisse von Studie I, dass Medienkompetenz durch die Förderung von Politikinteresse, vermittelt über das politische Selbstkonzept, politische Partizipation begünstigen kann.

Studie II, welche an der gleichen Stichprobe wie Studie I durchgeführt wurde, befasste sich mit der Frage, ob Jugendliche und junge Erwachsene mit hoher Medienkompetenz, verglichen mit solchen mit geringer Medienkompetenz, bessere akademische Fertigkeiten (Mathematik; Lesen) und akademische Leistungen (Noten) aufweisen. Darüber hinaus wurde eine Gruppe von 50 13-Jährigen mit einer Gruppe von 51 19-Jährigen bezüglich ihrer Medienkompetenz verglichen, um eine Aussage über potentielle Veränderungen in der Pubertät treffen zu können. Als Kontrollvariablen dienten Intelligenz, sozio-ökonomischer Status, Alter und Geschlecht. Die Ergebnisse zeigten, dass in Übereinstimmung mit Potters (1998, 2013) Entwicklungstheorie der Medienkompetenz während der Adoleszenz eine signifikante Zunahme der Medienkompetenz stattfand ($\Delta M = .17$). Es ergaben sich Korrelationen von Medienkompetenz mit mathematischen und Lesefertigkeiten und mit Schulnoten. Bei den Erwachsenen fand sich auch ein signifikanter Zusammenhang mit mathematischen Fertigkeiten, welcher höher als der mit Lesefertigkeiten war. Bei den Jugendlichen fand sich keine Verbindung zwischen Medienkompetenz und mathematischen Fertigkeiten. Um den Einfluss des Alters und der Intelligenz, welche beide mit Medienkompetenz korrelierten, zu kontrollieren, wurden hierarchische Regressionen und Pfadanalysen angewandt. Analog zu Paino und Renzullis (2012) Studie ergaben sie, dass Medienkompetenz einen größeren Einfluss auf die Schulnoten und akademischen Fertigkeiten hatte als Intelligenz.

In der dritten Studie wurde untersucht, ob Medienkompetenz jungen Erwachsenen dabei hilft, besser von drei verschiedenen Textarten zu lernen. Es wurden ein schriftlicher, ein auditiver und ein audiovisueller Text bezüglich der jeweiligen Lernwirksamkeit untersucht. Als Lernergebnisse wurden das direkte Textwissen durch textbasierte Fragen, sowie das Inferenzwissen durch Inferenzfragen, erfasst. Es wurde eine Stichprobe von insgesamt 91 jungen Erwachsenen in drei Gruppen aufgeteilt und bezüglich ihrer Lernergebnisse verglichen.

Eine Gruppe erhielt den schriftlichen, die zweite den auditiven und die dritte den audiovisuellen Text. Eine computerbasierte Kurzversion des WMK wurde zur Messung der Medienkompetenz eingesetzt, welche sich als optimierungsfähig herausstellte. Zusätzlich wurden Intelligenz, verbale Fähigkeiten, Mediennutzung, Vorwissen und SÖS als Kontrollvariablen erhoben. Die Auswertung durch hierarchische Regressionen ergab, dass Medienkompetenz ein signifikanter Prädiktor für Textinferenzen darzustellen scheint, selbst wenn andere relevante Variablen, wie etwa die Intelligenz, statistisch kontrolliert werden. Inferenzen unterstützen den Aufbau eines Situationsmodells, welches oft als wirkliches Textverständnis aufgefasst wird (z.B. Zwaan & Radvansky, 1998). Die Ergebnisse der dritten Studie unterstützen Ohlers (1994) Annahme, dass Medienkompetenz den Aufbau eines elaborierteren Situationsmodells fördert. Die textbasierten Fragen wurden nur durch das Vorwissen vorhergesagt. Möglicherweise trifft Potters (1998, 2016) Annahme zu, dass Erwachsene in der westlichen Welt über ausreichend basale Medienkompetenz verfügen, um relevante Informationen aus Lernmaterialien herauszuziehen. Die Versuchsteilnehmer schnitten bei den textbasierten und den Inferenzfragen am besten bei dem schriftlichen Text ab. Der schriftliche Text zeigte bei den Inferenzfragen keine signifikante Überlegenheit im Vergleich zu dem auditiven Text. Der audiovisuelle und der auditive Text erzielten für beide Fragensorten vergleichbare Ergebnisse. Die Ergebnisse stimmen mit der Literatur überein (z.B. Byrne & Curtis, 2000).

Zusammenfassend zeigten die Studien, dass Medienkompetenz die Fähigkeit hat verschiedene kognitive und nicht-kognitive Variablen zu beeinflussen. Es stimuliert Politikinteresse, verbessert Perspektivenübernahme, Leseverständnis, mathematische Fähigkeiten bei Erwachsenen, Schulnoten und die Bildung von Inferenzen von unterschiedlichen Textarten. Medienkompetenz scheint sich in der Adoleszenz weiterzuentwickeln.

# Contents

# Introduction

*Whoever controls the media, controls the mind.*

(Jim Morrison)

*People think that if they read something in the newspaper or see it on TV, it has to be true.*

(Tammy Faye Bakker)

As the quotations above show, beliefs about media and their potential influence, especially their harms, are widespread. Whenever a new medium is introduced, critics and optimists debate until the true effects on society become visible. This thesis explores the influence that a competent use of media, called media literacy, has on cognitive and political variables. Before I turn to media literacy, media use and media's impact are also of relevance. Our age is shaped by the omnipresent media; in particular, young people spend more time with mobile and stationary media than the generations before (Feierabend et al., 2018; Lenhart et al., 2015). The 2010 UNESCO monograph *Media Literacy and New Humanism* described the twenty-first century as strongly impacted by fast-evolving media (Peréz Tornero & Varis, 2010).

The media indeed have much influence. They change societies, shape norms, and can even act as catalysts for political upheaval (Marzouki et al., 2012). To participate in contemporary democracy, one must engage in the digital world (Kahn & Kellner, 2004), and classical forms of engagement (such as voting) have become less relevant as people can now express their political views through "liking" and sharing on social media or online petitions (Mihailidis & Thevenin, 2013). Especially with regard to young people's cognitive development, concerns about negative media effects are immense (Bushman & Huesmann, 2012; Cantor, 2012; Koolstra et al., 1997). Scientific research has addressed media effects to evaluate whether the concerns are legitimate. Desirable influences have similarly been confirmed. New media users have been found to exhibit several positive attributes—for example, active members of social networking sites show better attentional control, verbal ability, working memory, and academic attainment (Alloway & Alloway, 2012; Alloway et al., 2013). Adolescents who spend more time online exhibit better reading literacy (Jackson, von Eye, Fitzgerald, Witt, & Zhao, 2011; Jackson, von Eye, Witt, Zhao, & Fitzgerald, 2011), and video gamers score better on tasks involving visual-spatial perception and control of attention (Ferguson, 2007; Green & Bavelier, 2003, 2006, 2007; Ventura et al., 2012).

1

The contradictive studies have clarified that the answer to whether media are "good or bad" cannot be obtained easily. Rather, it seems as if factors in an individual decide upon media's impact. An important question could be how a consumer uses the medium. Does he or she know how to use it safely? What are potential risks; for instance, how can content be distorted or manipulated? How can serious news be identified? A key competence in making these evaluations is media literacy. It is defined as an ability that allows a consumer to critically examine and use media. As this is not an innate faculty, it must be acquired in the course of life. Potter (1998) proposed how media literacy develops from childhood to adulthood. At first, fundamental skills are acquired; later, from adolescence onward, advanced skills evolve (chapter I.2.3.). Many studies have investigated media literacy or some subcomponents in children. However, information on older age groups is still lacking. Nevertheless, several studies have focused on its effects. It can be trained and has several positive effects: ameliorating harmful health behaviors (Bergsma & Carney, 2008); making adolescents less susceptible to alcohol advertisements (Goldberg et al., 2006); reducing tobacco use (Chen et al., 2013), aggression (Cantor & Wilson, 2003), and concerns about body shape (Wilksch, 2009); and promoting critical thinking and understanding of the pervasive intent of media (Austin, 1997). As the so-called "new media," such as e-books, smartphones, the internet, and tablets, are introduced to the education system to enhance learning (e.g., Bennett et al., 2012), acquiring competence in these media has gained general acceptance as an essential educational goal (Peréz Tornero & Varis, 2010).

This thesis relies on established theories and developmental models of media literacy to conceptualize the construct of media literacy. Additionally, studies on the effects of media literacy on cognitive and socio-political variables are used to examine the potential influence media literacy has on these variables.

**Outline of this thesis**

This thesis is divided into three chapters. First, a theoretical part provides the reader with sufficient background information to place the studies in the second chapter of the current research. In chapter II, three original studies are presented and discussed. Studies II and I are conducted on the same sample. These are hereafter referred to as separate studies to make reading easier. Study III builds on the first two. The last chapter compares, evaluates, and critically discusses the studies of chapter II.

As background information, chapter I is initially concerned with media use in two countries: the USA and Germany. Theoretical information on several models of media literacy is discussed, and the thinking behind the own model, the Würzburger Medienkompetenztest (WMK), which is evaluated and used in the studies in chapter II, is presented. This is followed by an outline of the development of media literacy from childhood onward. After that, the influence media and media literacy have on information processing and drawing inferences from different kinds of texts is studied. Learning from multimedia through Mayer's (2005) cognitive theory of multimedia learning is also included in chapter I. Afterward, research on the comparison of learning outcomes from three different kinds of text is summarized. Political factors, interest in politics and political self-concept, and their relation to media literacy are presented. The connection between media literacy and political participation has long been established and is expounded first. After that, political efficacy, in its association with media literacy and political participation, is presented, as I believe it is another mediating factor between the latter two.

In chapter II, three empirical studies and their findings are presented. In study I, a sample of 13- to 20-year-olds is investigated regarding the impact media has on interest in politics and self-concept of competence on political topics. Additionally, an evaluation of the media literacy assessment tool is conducted, which turns out to be satisfactory. The results show that media literacy influences interest in politics in the statistical model; however, there is no association with the political self-concept. It is discussed whether the influence might indirectly occur through interest. Study II is concerned with the association between media literacy and school grades, mathematical ability, and reading ability. The sample mentioned above consists of two age groups: 13-year-olds are compared with 19-year-olds to decide upon the development of media literacy taking place in adolescence. Significant development is observed during this age. Media literacy is positively correlated with all cognitive variables. In hierarchical regressions, media literacy shows a greater influence than intelligence. However, it has no impact on mathematical skills in adolescents. Study III investigates the influence of media literacy on learning from three kinds of texts in young adults. The memory of text surface and situation model is assessed separately for a written, an auditory, and an audiovisual text. A comparison of the learning outcomes between the texts is conducted. In hierarchical regression analyses, media literacy is a significant predictor of inferences but not for the text base, even when controlling for intelligence and verbal abilities. Both text-based and inference questions are best answered in the written text conditions, while no significant difference occurs between

audiovisual and auditory texts. Additionally, a short version of the media literacy assessment tool is tested, which shows that better adaption should take place.

Finally, chapter III summarizes and integrates the findings of the three studies from chapter II, given the theoretical background of chapter I. A general discussion of the findings and the methods of the three studies is conducted after a short summary of each study is presented. First, the studies are compared in terms of the included variables and their outcomes. After that, a general model is deduced on the basis of Mayer's (2005) cognitive theory of multimedia learning, with the aim to explain how media literacy can influence cognitive processes in all three studies. This is followed by a critical examination of the methods used in the studies, focusing on the assessment of media literacy, intelligence, and the design of the studies. After that, I discuss the included covariates and propose further covariates that can be considered in future research, which are built upon the findings of this thesis and will allow a better generalization of these results. Finally, an overall conclusion and outlook are drawn.

# I.     Theoretical Part

## 1. Media Possession and Use in Adolescence and Adulthood

In the following section, media possession and use in adolescents and adults are examined more closely. The patterns and frequencies of the use are presented, to indicate the extensive amount of time spent with media, emphasizing why it is important to gain literacy in the contact with these media. All types of media are considered: classical ones, such as books, and digital media. An exemplary comparison between US-American and German media consumption patterns— as two Westernized countries with different cultures—is drawn. Germany is selected as the samples in the empirical part of this thesis are German, allowing a classification of the results. Many studies on media effects and literacy are conducted with US-American participants, making a comparison with the participants of this research relevant for this thesis. Surveys about media use try to evaluate several things, such as how many people use a certain medium daily, how long they do so, and the average time spent with a medium or an activity each day. Censuses about media use often have two limitations: First, when time spent with a medium is assessed and multitasking and parallel use are not considered. Thus, the results can sometimes be misleading. If a person were, for instance, reading while listening to music for one hour, two hours of media consumption would result. Second, consuming media does not exclude the option to pursue an additional activity (e.g., listening to the radio while doing the wash-up). For

these reasons, the findings of the surveys have to be interpreted carefully. This thesis first presents the data related to adolescents, followed by the statements made about adults. Finally, adults and adolescents of the two cultures are contrasted.

### 1.1. Adolescents' Media Possession and Use Patterns

### 1.1.1. Media Possession and Use Patterns of US-American Adolescents

In 2015, the *Common Sense* foundation, an independent nonprofit organization that aims to support children to thrive in the media society, carried out a census that polled 2658 US-American children and adolescents from 8 to 18 years of age about their media possession and activities (Rideout, 2015). The analysis was divided into two age groups, *tweens* (8–12 years; N = 1259) and *teens* (13–18 years; N = 1399). A survey from 2015 was chosen, as the studies in chapter II were conducted around that time.

As a first result, 83% of the complete sample stated having internet access, indicating that a great percentage of young US-Americans are present online. The findings concerning the 13- to 18-year-olds were presented in detail. There seemed to be a huge difference in media possession with respect to the SES of the parents. When families with an income of 100,000 or more dollars per annum were compared with those with an income of 35,000 or less dollars per year, the digital inequality became evident: In the high-income group, 92% of the adolescents reported having a laptop at home and 62% even possessed their own systems, whereas only 54% of those from less wealthy families confirmed having a laptop in the family; 25% owned one themselves. When the complete adolescent sample was regarded, 77% had at least one laptop in the household, and 45% possessed their own device. In addition, 78% of the teenagers from high-income families ascertained having their own smartphones, which was true for only 51% from the less wealthy group (the mean for the whole sample lay by 67%). Concerning tablets, the difference was not as pronounced as with other media; 89% of the better-off families and 71% of the less-affluent families had a tablet at home. The value for the complete adolescent sample reached 73%. No results regarding personal ownership among adolescents were reported. The findings about the inequality of possession can very likely be explained by the fact that money is necessary to purchase media devices, which are often expensive. Overall, the US-American households appeared to be well-provided with media devices.

Concerning US-American teenagers' media use, they reported consuming on average 8:56 (hours:minutes) hours of entertainment media on any given day. This excludes the time they spend at school utilizing media (e.g., media use in the classroom) or media use for homework.

The media entertainment activities comprised playing computer, video, or mobile games; watching TV, online videos, or movies; reading; using the internet; listening to music; and using social media. Of the US-American teenagers, 57% spent more than four hours with screen media. However, there were huge differences between individuals; for instance, 6% did not engage in screen media on any given day, 17% used them for a maximum of 2 h, 31% used them for 4–8 h, and 26% used them for more than eight hours.

Mobile devices accounted for 46% of screen time among teenagers, showing the importance of new media. Only 50% of the TV- or video-viewing time involved using a traditional television or at a set broadcasting time. Most of the remaining time was spent on platforms such as YouTube (22%) or with other devices for watching TV (14%). In the teenager sample, 39% of time spent with digital screen media was devoted to passive consumption, such as reading or watching videos; 26% to communication (e.g., writing e-mails or messages on social networking sites); 25% to interactive consumption, such as playing games or using an internet browser; and 3% to the creation of digital art or music (the remaining 7% of activities remained unclassified).

There were substantial differences in the amount of time spent with media with respect to demographic factors. The first variable was family income, which has already been demonstrated to influence media possession. Concerning use, it became apparent that adolescents from families with a lower income engaged more with media (10:35 hours), although they possessed fewer devices than those from high-income families, who spent 7:50 hours online. However, there seemed to be no difference in the kind of use. The educational level of the parents was also of relevance. In analogy to family income, teenagers from families where the parents graduated from high school spend more time with media (9:39 hours) compared to those from parents with a college degree, who spend 7:49 hours a day using media (screen and other media). No dissimilarity in the type of use was found between the groups.

A further difference was found between the sexes. Both stated enjoying music and using social media; however, while 27% of the male adolescents mentioned playing video games as their favorite media activity, which is what they did, on average, for 56 min daily, only 2% of the females preferred it, resulting in an average of seven minutes of video gaming per day. In contrast, female adolescents spent 1:32 hours on social media every day, while boys spent only 52 min. Females also consumed more books than males (33 min of reading compared to 23 min

per day) and stated enjoying it more (41% of females stated to enjoy reading "a lot," while only 19% of the males did).

As the results of the *Common Sense* census suggest, the daily environment of young US-Americans is strongly impacted by media, and their use quite naturally belongs to the life of adolescents from all social classes. SES influences not only the number of owned devices but also the use patterns. Adolescents vary widely in their kind and amount of use, but watching TV, listening to music, and using social networking sites are very popular among all young US-Americans.

### 1.1.2. Media Possession and Use Patterns of German Adolescents

Since 1998, the Medienpädagogischer Forschungsverbund Südwest (south-west media-pedagogic research consortium), in cooperation with the Südwestrundfunk (south-west broadcasting), has been conducting annual media use studies of German adolescents [JIM study; adolescents, information, (multi-) media-study; *J*ugendliche, *I*nformation, and (Multi-) *M*edia)]. The results of the JIM study of 2017 are presented in this thesis. It considered 1200 adolescents between 12 and 19 years of age (Feierabend et al., 2017).

With regard to media possession, 99% of German adolescents reported having internet access, 99% a smartphone, 98% a stationary PC or laptop, 96% a TV, and 69% a tablet in the household. These numbers indicate that young Germans are well-equipped with media; in several cases, a saturation level is reached. Many teenagers held their own devices: 97% owned a smartphone, 69% a computer or laptop, 53% a TV, 17% even a TV with internet access, and 29% a tablet. Students' educational levels seem to play a role in the use of some devices. Those who attended *Gymnasium* more likely stated having a laptop (56% compared to 45% of those who attended *Hauptschule* or *Realschule*[1]), a radio (54% vs. 46%), an MP3-player (45% vs. 36%), and an e-book reader (15% vs. 6%). In contrast, students from a lower educational level (*Hauptschule* or *Realschule*) more probably owned a television (61% compared to 49% in *Gymnasium*) and a stationary game console (53% vs. 44%).

With regard to German adolescents' media use in their leisure time, most reported using the internet on a daily basis (89%; several times a week (stw): 98%), as well as the smartphone

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[1] *Hauptschule, Realschule,* and *Gymnasium* are secondary schools in Germany. Hauptschule offers lower secondary education (Level 2) according to the International Standard Classification of Education, while Realschule leads to an intermediate qualification. Gymnasium offers the highest qualification that enables a student to attend university.

(93%; stw: 97%), listening to music (83 %; stw: 95 %), watching online videos (62 %; stw: 86 %) or TV (45%; stw: 75%), and listening to the radio (55%; stw: 73%). There was a significant sex difference in media use; compared to females, more male adolescents consumed online videos (92% vs. 80%) and digital games (83% vs. 41%) at least several times a week, whereas females stated using the radio (76% vs. 70%) and books (49% vs. 32%) more often than males. Since 2007, the ratio of the adolescents who regularly read a book has remained stable at about 40%. In 2017, both the sex and education level of students were of importance. Of those attending *Realschule* or *Hauptschule*, only 28% reported reading at least several times per week, while about half of the *Gymnasium* students read regularly (48%). In addition, e-books were only used by 6% several times a week. On average, German adolescents between 12 and 19 years of age spent about 63 min reading on a working day, while girls read for about 80 min.

The internet was most frequently accessed through smartphones (81%). Computer (8%), laptop (6%), or tablet (4%) were far behind in popularity. Both sexes spent equal proportions of their time on the internet searching for information (28–32% of the time online) and entertainment (11–12%), but girls put more emphasis on communication (e.g., social networking sites) (46% vs. 31%), while boys spent more time playing games than girls (30% vs. 9%). Many of the communication services were used at least several times a week. WhatsApp was most commonly utilized: 94% of the 12- to 19-year-olds did so. Instagram was used regularly by 57%, Snapchat by 49%, and Facebook by only 25%.

In the last 14 days prior to the survey, TV was watched using a stationary television by 92%, through a smartphone by 21%, through the internet by 19%, and through a tablet by 7%. When asked which kinds of activities concerning television the participants were engaged in at least several times per week, 55% reported having watched programs at a fixed broadcasting time on television, 19% used media libraries of the broadcasters on the internet, 14% watched programs on YouTube, 11% viewed recorded shows, and 10% followed live-streams on the internet. Overall, 65% bound themselves to the given broadcasting time, while 34% chose independent formats.

On average, German adolescents own numerous devices and spend much time with modern media. Watching TV and listening to music are still the most popular leisure-time activities, but social networking sites are also accessed daily. A difference in use and possession is found with regard to education level and sex.

### 1.1.3. Summary and Comparison between US-American and German Adolescents' Media Use and Possession

Young people from both countries possessed a great variety of media devices, and their leisure time was characterized by the use of these devices. Germans held a greater number of devices in the households, while US-Americans reported more screen time. In both countries, sex differences existed, with males playing more computer games and females spending more reading time. However, German girls read far more (80 min on a working day) than US-Americans (33 min). Adolescents from families with a lower income owned fewer devices but spent more time with screen media. The kinds of use did not differ. The education level of the students themselves proved to influence media possession and use in the German cohort. Those with less education more likely held a TV and game console; additionally, they reported less reading time. Adolescents from both countries shared preferences for listening to music, watching online videos, and using social media almost every day.

### 1.2. Adults' Media Possession and Use Patterns

In contrast to the data concerning children's or adolescents' media possession and use patterns, less systemized information is available for adults. Surveys have often focused on one class of media (e.g., social networking sites), or they include adolescents as well, without making a distinction to adults. The findings available from different studies will be summarized in the following section.

### 1.2.1. Media Possession and Use Patterns of US-American Adults

A study conducted in 2009 with 800 US-American adolescents and 2,253 adults concentrated on social media and mobile internet use (Lenhart et al., 2010). A summary of the findings about adults is outlined in this section. Regarding media possession of all adults, 93% indicated owning a mobile phone, and 74% used the internet; among the young adults (18 to 29 years of age), almost all did (93%). Even 38% of adults above 65 years of age were online. Respecting media possession, adults were asked to indicate which of the following seven devices they owned: mobile phones, laptops and desktops, MP3 players, gaming devices, and e-book readers. On average, adults owned about three devices, young adults about 4, 30- to 64-year-olds 3, and adults 65 years or older owned about 1.5 media devices. At the time the study was conducted, stationary desktop PCs were still more popular than laptops (58% vs. 46% ownership), but as early as 2007 to 2009, an apparent trend in the reverse direction was visible. Laptops (66%) were already preferred to desktop computers (53%) by those under 30. All media possession rates have increased with educational level and income.

The analyses of media use patterns showed that social networking sites were very popular among adults: 47% reported having at least one profile, and 52% of this group possessed two or more profiles. Among young adults, 72% even affirmed using social networking sites; only 39% of those over 30 years did. Young adults differed from older ones. Profile owners of the younger cohort were more likely to possess a profile on Myspace (66% compared to 36% for those 30 years or older) but less likely to have one on LinkedIn (7% compared to 19%), which is professionally oriented. This suggests that the incentives for using social networking sites differ between young and older adults. Younger ones stress social communication and self-portrayal in a private context, whereas older ones regard these services as a means to foster their careers. Of the younger cohort, 81% indicated having wireless internet access, whereas only 63% of the 30-to 49-year-olds and 34% of those 50 years or older accessed the internet wirelessly. Sex, education level, and revenues influenced wireless internet use: While men were more likely to use a laptop for wirelessly accessing the Worldwide Web, women more often used their mobile phone or other devices. Both access methods were positively correlated with income and education level.

A more recent study conducted with 1,802 adult internet users about activities on the internet was conducted in 2012 by the Pew Research Center's Internet & American Life Project (Duggan & Brenn, 2013). The results indicated that similar to the findings in 2009, young adults under 30 years of age were more likely to hold a social network account (83%) than any other adult cohort. Women were more likely to engage in social networks (71%) than men (62%); the education level brought no difference. Household income, however, was important. People with an annual income of 30,000 dollars or less were more likely to hold an account (72%) than those with an income of 30,000 or more per year (65–66%).

In summary, back in 2009, a large proportion of US-American adults used the internet and social networks, almost all possessing several modern devices to access the internet. Younger adults owned more devices and spent more time online than older adults. SES and sex similarly influenced the kind of use. Wireless tools, such as laptops, were already gaining popularity.

### 1.2.2. Media Possession and Use Patterns of German Adults

Most studies assessing adults' media use in Germany include adolescents from 14 years of age. Whenever possible, data for adults older than 18 years are extracted from the surveys to allow a comparison between adolescents' and adults' media possession and use.

Considering media possession, a telephone survey was conducted in 2017 commissioned through a merger of seven German private television stations (Adler et al., 2017), interrogating 1231 participants between 14 and 69 years of age. Of all households, 94% had a TV, 88% had a smartphone, 79% a laptop, 57% a tablet, 55% a stationary computer, 40% a gaming console, 26% an e-book-reader, 15% a smartwatch, and 4% even reported having a pair of virtual reality glasses.

Since 1997, the two public broadcasting institutions ARD and ZDF have been annually conducting a study assessing German adults' internet use. In 2017, 2000 people from 14 years of age were asked about the number of activities they perform on the internet and the amount of time spent on these (Koch & Frees, 2017). In many cases, specific information about the 14- to 18-year-old group could not be excluded, as it was not always stated explicitly. However, age clusters were reported, allowing the reader to obtain a detailed picture of adult media use. Whenever available, the results for the different age clusters are presented. Of the complete sample, 90% were internet users, and 72% accessed the internet daily. Over 90% of these 39-year-old or younger were online daily; in the older age groups, the value declined to 44% for those over 64 years of age. Being employed or unemployed was an important factor. Of those who worked, 82% accessed the internet daily, whereas only 49% of the unemployed did. The average time spent on the internet each day amounted to 149 min. When the different age groups were regarded separately, it became evident that young people spent far more time online than older ones. On average, 14- to 29-year-olds spent 274 min online (these results included the 14- to 19-year-olds, who spent 270 min online), 30- to 49-year-olds spent 183 min, the group of 50- to 69-year-olds spent 98 min, and the group of 70 years or older spent 36 min.

The kinds of use were divided into three clusters: medial internet use (e.g., watching a movie online), individual communication, and other activities (e.g., shopping or gaming). The youngest group (14 to 29 years of age) spend 116 min for medial internet use, 102 min for communication, and 103 for other activities. The values for the 14- to 29-year-old group amounted to 134 min for medial internet use, 89 min for communication, and 87 min for other activities. Those between 30 and 49 years of age passed 51 min with medial applications, 77 min with communication, and 93 min with other activities. The next group (50 to 69 years of age) only invested 11 min for medial internet use, but 40 min for communicating and almost 1 hour (58 min) for uncategorized activities. Older adults above 69 years of age showed 9 min of medial internet use, 12 min of communication, and 18 min of other activities.

In summary, young adults spent far more time online and put more emphasis on using the internet for entertainment, whereas those over 30 years of age stressed practical activities, such as information-seeking or online banking. This became more apparent for the older participants.

When online video use was considered, 53% of the complete sample confirmed to engage in this activity; 33% used video portals, such as YouTube; 23% used video-streaming services; 22% confirmed watching programs live or time-shifted (10% live and 14% time-shifted), and 8% used video podcasts. Overall, 22% of German adults watched at least one program broadcasted by a television station online.

The internet was accessed en route by 30% of the complete sample. Women were less likely to do so than men (25% vs. 36%). Age was also relevant. Of those between 14 and 29 years of age, 63% accessed the internet outside their own house, while only 41% of the 30- to 49-year-olds, 14% of those between 50 and 69 years of age, and 1% of the older ones did. Of the social media, WhatsApp was most popular; 64% stated using it at least once a week, followed by Facebook (33%), Instagram (9%), and Snapchat (6%).

When asked which medium was used on the previous day, 78% of the complete sample admitted having watched TV, 49% listened to UKW radio, 38% used their smartphone, 28% listened to audio radio, 19% used a stationary PC, 15% a laptop, and 8% a tablet. In some areas, younger adults differed from the rest. They were less likely to have watched TV (61%) or listened to UKW radio (29%), but 81% stated having used their smartphone and 22% their laptop.

Taken together, the Germans younger than 30 years of age showed a greater affinity to the internet and internet-based applications, which was reflected in their media use. They were less inclined to use classical media, such as television or radio, than the older participants; the smartphone was by far the most popular device. However, television remained in second place.

### 1.2.3. Summary and Comparison between US-American and German Adults' Media Use and Possession

US-American adults were already well-supplied with media devices several years ago. Almost all reported owning a mobile phone and having access to the internet. The popularity of laptops, compared to stationary PCs, and WLAN was rising. Adults younger than 30 in particular used wireless devices, and nearly all of them used the internet. About half of all adults held at least one profile on a social networking site, and three quarters of young adults did so. The sexes showed differences in their media use. Males more likely accessed the internet

through a laptop, while females used their mobile phone or other devices; they were also more likely to have an account on a social networking site. A higher SES and education level similarly predicted the use of a laptop or a mobile phone as a means of accessing the internet and holding a profile on a social networking site.

Most recent data suggest that German adults hold a wide range of media devices and almost all use the internet. Nearly all young adults (39 years of age or younger) access the internet daily, whereas older adults are far less likely to do so. Age is the most important influencing factor, as adults younger than 30 years spend more time online, pursue different activities (more entertainment than practical applications), and are more likely to watch online videos and access the internet en route. They are also more likely to have an account on a social networking site as compared to older adults. They are also less likely to watch TV or listen to the radio but more likely to use "new" media devices, such as smartphones or laptops. It should not be disregarded, however, that even adults over 70 years of age access the internet and own a smartphone. The only sex difference occurs with regard to the likelihood of accessing the internet en route, which is higher among females. Being unemployed decreases the probability of using the internet.

A comparison of data from 2009 and 2017 has to be made with caution, as a time difference of eight years exists between the surveys. Thus, no direct comparison, but a statement about perceivable trends, is made. Adults in both countries regularly used the internet and owned several devices. In both cases, younger people possessed more and spent more time using the current media. Sex was only a small moderating factor, whereas socio-demographic factors, such as SES, education level, or unemployment, influenced the amount of internet use. Overall, the most important factor for US-American and German adults was age.

### 1.3. Summary and Comparison between Adolescents' and Adults' Media Use and Possession

In the USA and Germany, the majority of the population possesses several media devices and accesses the internet regularly. As a general finding, younger people spend more time online than older people and pursue more entertainment-oriented activities. For both adolescents and adults, a lower SES implies the likelihood to own fewer devices but to spend more time with screen media. Sex differences also occur independent of age, with females putting more emphasis on communication than males. Adolescents do not differ much from young adults in their use of the internet, only that the latter spends lesser time on the internet for mere entertainment. From 30 years of age onward, differences increase. Older adults spend less time with new media and hold fewer devices. They are more likely to use "traditional"

media, such as a TV or radio. When media effects and media literacy are investigated, the age and composition of the sample have to be chosen carefully, as several factors influence a person's media use. In the empirical studies of this thesis, adolescents and young adults are chosen as the samples. As the differences in media use suggest, the results cannot be generalized to older adults.

The previous section clearly showed how much our everyday life is shaped by media. As they play such a crucial role, it is decisive how effective and critical a recipient's interaction with the media is. Although the results for adults date several years back for the USA, the level of households provided with several media is already great.

In the following section, a definition and classification of media, as well as the introduction of three important conceptualizations of media literacy, which culminate in a derivation of our own model and test of media literacy, is provided. Finally, a short introduction to the development of media literacy is outlined.

## 2. Media Literacy

In the previous section, the media use patterns of adolescents and adults in Germany and the USA were examined. Frequent use does not imply a high competence of use but rather shows that it is important how time with media is used constructively. This section focuses on media literacy as a construct to determine the quality of use. It is especially important for this work, as media literacy is the main construct investigated in this thesis. All three studies in the empirical part (chapter II.3.) are concerned with media literacy and its relation to other variables. First, I summarize three suitable models of media literacy, and then describe the development of different aspects of media literacy from early childhood. This information builds the basis for our own model of media literacy, which will be explained in detail. From this model, our own media literacy test is constructed. This section explains exactly what is assessed when I later talk about media literacy. Additionally, note that, in general, each study about media literacy uses its own definition and test, restricting comparability.

Life in Westernized countries is characterized by omnipresent media and rapid development in the technical field (Peréz Tornero & Varis, 2010). Nowadays, even very young children are confronted with screen media, and there are applications for tablets specifically designed for this age group (e.g., the 3D version of the book *The Very Hungry Caterpillar*). This trend becomes more pronounced during adolescence, where a significant part of communication

occurs through media devices, such as smartphones or social networks (chapter I.1.). Media do not just shape leisure time; often, computer proficiency is requested in schools (e.g., when preparing a presentation). In adult life, almost every job confronts employees with media (e.g., when communicating through e-mail or simply when using a telephone). Therefore, if a person in our society wants to participate in everyday life, it is necessary to acquire a competent use of contemporary media. To ensure this, UNESCO recognized media literacy as an international educational goal (Peréz Tornero & Varis, 2010). In Germany, the Ministry of Education and Art has agreed to integrate media literacy into the curriculum (Kultusministerkonferenz, 2012). However, the quality and quantity of media literacy training vary widely; it is up to each school to decide exactly what students are to be taught.

Before introducing several conceptualizations of media literacy, deriving our own model, and summarizing the development of media literacy, the terms *medium* and *media literacy* are defined.

### 2.1. Definitions of *Media* and *Media Literacy*

Due to the everyday occurrence of the terms *medium* and *media*, a definition is often forgone. As *media literacy* cannot be understood without having a clear picture of what media are, a short essay will follow. A common approach is to classify media into three categories based on the application of technical devices in primary, secondary, and tertiary media (e.g., Ohler & Nieding, 2014). Primary media do not require technical devices for either the transmitter or the recipient (e.g., a letter or cave painting). Media are denoted as secondary if their production, not their reception, requires a device, as is the case with printed newspapers. For the last category, the tertiary media, a technical apparatus is necessary for both production and reception (e.g., when communicating through a smartphone or social media). Another possibility for classification is categorization based on the degree of abstraction. Written media are purely symbol-based and thus are located on the abstract pole, while drawings, diagrams, or video are closer to natural perception; virtual reality formats offer the most perception-congruent display in relation to the present-day state of technology (e.g., Ohler & Nieding, 2005; Sachs-Hombach, 2003). Further options for categorization are interactive vs. non-interactive media, individual vs. mass media, and transmission vs. storage media.

From the multitude of conceptualizations of media, the preliminary definition by Ohler and Nieding (2005) is reverted to, as it concisely includes all aspects of media by referring to them as "systems of external representation that are internally organized by sign systems" (p. 455).

Hence, a medium immanently consists of a symbol system, such as a book based on orthographic symbols, to be called a medium. Furthermore, internal and external representations must be delimited. Internal representations describe a person's mental representations, while external representations are represented through a material device (Scaife & Rogers, 1996), such as a book, picture, map, TV, or PC. Internal representations are a necessary precondition for understanding external representations. If a symbol, such as a letter, cannot be mentally represented, it cannot be used as a means of communication. By using external representation, mental processes can be externalized, providing the working memory with more capacity for other cognitive processes (Ohler & Nieding, 2005); for example, creating a shopping list instead of memorizing all items by heart. In his habilitation treatise, Baacke (1973) laid the foundation of the construct of *media literacy*, without naming it explicitly (e.g., Groeben, 2004; Kübler, 1996; Vollbrecht, 1999). Despite much research in this area, there is, to date, no common definition. Most definitions agree that media literacy is a multimodal construct that changes over time as sets of knowledge or skills enable consumers to critically examine and use media (e.g., Hobbs, 1997; Martens, 2010). In 2010, UNESCO described media literacy as "the process of assimilating and using the codes involved in the contemporary media system as well as the operative skills needed to properly use the technological systems on which these codes are based" (Peréz Tornero & Varis, 2010, p. 29). The authors regarded two aspects as decisive: the knowledge and use of contemporary symbol systems and the skills required to handle technical systems (e.g., a PC) effectively, as these devices are the foundation of symbol systems. Thus, a symbol system always depends on technical conditions. According to Hobbs (1997), the two main components of media literacy are media sign literacy—that is, the skill required to understand the sign system used within a medium—and the ability to use, analyze, evaluate, and communicate diverse media messages (see 2.2.3.).

In the following section, three models will be introduced exemplarily that are especially suitable as a basis for our own research because of their comprehensive character and the inclusion of a developmental psychology approach. Subsequently, these models will be compared with our own model and an assessment tool will proposed.

## 2.2. Models of Media Literacy

In this section, the media literacy models proposed by Groeben (2002, 2004), Potter (1998, 2016), and Hobbs (1997) are summarized and compared. These approaches are not media-specific but are applicable to both traditional and contemporary media. This is relevant, as my

research includes a great variety of media. This section begins with Groeben's (2002, 2004) model, which is relevant for the German-speaking area, and proposes seven dimensions of media literacy. I aim at clearly identifying the areas of competence and their implications, while leaving the approach open for further developments in media. Potter's (1998, 2016) concept of media literacy assumes different domains and describes the process of acquiring distinct skills. The conceptualization by Hobbs (1997) is, in turn, strongly shaped by a pedagogical perspective; the author describes a final state but regards the components interactionalistic and pays attention to developmental processes. Resulting from the comparison of the models mentioned above, our own model of media literacy, including implications for assessment tools, is presented.

### 2.2.1. Groeben's Model

In his normative and descriptive essay, Groeben (2002, 2004) postulated seven integrative dimensions of media literacy, aiming at the optimization of differentiation and integration (Groeben, 2002, p. 165). He focused on a medium level of abstraction, guaranteeing his depictions of the dimensions of a high rate of determinateness without losing extensional openness to include newly developed media.

The first dimension encompasses *media knowledge* and *awareness of mediality*, which, when taking a process perspective, forms the precondition for all the following dimensions. *Media knowledge* originally embraces all findings of research on media. Groeben confined it to rational and realistic knowledge for daily use. This implies a consumer's knowledge about determining the judicial, economic, and political factors of different media systems; the commercial function of certain programs; and a (rudimentary) consciousness about problematic media effects. *Awareness of mediality* covers a user's knowledge of the difference between (everyday) reality and medial staging. Groeben (2002) postulated that this has to be newly learned for every novel medium. He cited an example where when the cinema was introduced, the audience fled full of fear from a fast-approaching locomotive, a behavior that will not occur anymore today (p. 166). According to him, this adaption has so far always taken place for every medium; hence, he sees no reason for an alarm that an adaption could fail. He classified *awareness of mediality* into three categories; each requires a decision between medial construction and everyday reality. Groeben named the first category *mediality vs. reality*, which implies realizing that an event is only taking place in the media, not in reality (such as the approaching train in cinema). *Reality vs. fictionality*, in contrast, is concerned with the differentiation between programs (e.g., scripted-reality formats in contrast to documentaries).

It is not about how accurately a media message represents reality, but about whether the content of the message is real or not. The last distinction is called *para-sociality vs. ortho-sociality*, which discriminates between the role an actor incorporates and their actual personality. The development of this ability will be examined further in chapter I.2.3.

The next dimension, *media-specific reception patterns*, extends from technological-instrumental skills to more complex (mainly cognitive) processing schemata. It covers the constructive handling of media, as well as the adequate evaluation of a processing strategy that has to be adapted continuously both for every medium and within each medium. One example is the interior differentiation of different types of texts in print media.

According to Groeben's approach, the next dimension, *media-related enjoyment*, has often been neglected. Yet, this component is decisive for the uptake and maintenance of media reception and hence for appreciative consumption. In Groeben's opinion, past research has focused too much on the cognitive component, disregarding the emotional and motivational components.

The classical core of many conceptualizations of media literacy is *media-related critical faculty*. A user should not be overwhelmed by the various media offers but be able to form their own opinion, which should be rationally justifiable. It is fundamental to realize which position the author or the sponsor of a message holds and to, subsequently, compare it with one's own attitudes and beliefs.

Furthermore, media literacy implies selecting an adequate medium for one's own needs, goals, and the respective problem. Groeben (2002) surmised that this "selection competence" also contains "orientation competence" (p. 175) due to the multifarious media offer. If someone is able to choose an adequate medium, they should also be able to orient themselves in media society. He called this dimension *selection/combination of media use*. According to Groeben, an individual can only be capable of acting in society if they systematically direct their media consumption (between media and within a medium); that is, they can only adept it to their needs, problems, and claims. In order for the information to not be derived from only one channel or source, risking one-dimensionality, a user should gather additional information from different sources and compare the contents. One example would be to not rely on the same daily newspaper but to read other newspapers or to gather additional information on the internet. Groeben believed that when an individual combination of media has been created, successful media socialization has taken place.

Media use is not limited to reception; for a purposeful handling of media, practical skills, referred to as *(productive) participation patterns*, are relevant as well. They involve activities in classical print media as well as participation in active design processes on the internet (e.g., authoring e-mails, uploading photos on social networks, or sharing music videos).

Hence, communication itself (such as taking part in a discussion forum) is participation and should not be confused with Groeben's last dimension of *follow-up communication*. It involves the communicative exchange and the analysis of media messages. These components are also important for promoting the previously mentioned dimensions, especially for critical faculty, media-related enjoyment, and awareness of mediality. Additionally, empirical data support that especially children profit from the exchange with a caregiver when processing consumed media (e.g., when learning from television) (Salomon, 1977).

However, Groeben's explanations often remain vague, and the structure of his text can be didactically optimized, making it easier for a reader to deviate from his dimensions. Moreover, he partly slid from a scientific derivation into dogmatic, such as when depicting "mortal fear" that allegedly occurs during the reception of the movie with the locomotive and when stating that there is "no need to worry" about the adaption to new media (Groeben 2002, p. 166). Although he repeatedly referred to an empirical verification for his model, so far (July 2022), to the best of my knowledge, it has not occurred. Similarly, the models by Potter (1998, 2016) and Hobbs (1997) have not yet been empirically confirmed. As all three models include a high theoretical explanatory value, they are often discussed in the literature and were integrated in this work. Although Groeben emphasizes experience, he does not stress developmental psychology aspects in his model. This perspective will be implemented in Potter's (1998, 2016) model of media literacy, which will be introduced in the following section.

### 2.2.2. Potter's Model

To facilitate the comprehension of the model, Potter's definition of media literacy is introduced first. He perceived media literacy as „a set of perspectives that we actively use to expose ourselves to mass media to process and interpret the meaning of the messages we encounter" (Potter, 2016, p. 24). The basis of our perspectives are our knowledge structures; three qualities are necessary for their development: *tools*, meaning our skills; *raw material*, which is information obtained from the media and real world; and *willingness* to further develop our perspectives. Perspectives are necessary for *processing and interpreting* the meanings of media messages. The mere perception happens automatically, while interpreting messages

requires more mental capacity. When processing a message, we use our knowledge structures to ascribe meaning to it. For instance, the identification of a word or letters occurs automatically in most adults. This happens faster if the knowledge structures are more organized, as the meaning of a symbol can be found more rapidly. When understanding a sentence, the complete context has to be considered; this forms part of the *interpretation*. However, Potter did not specify what exactly he meant by "perspectives," where they come from, how they are built in detail, and what kind of influence we can have on them. His explanations remain unspecific and vague. As a specification for the perspectives, he called upon an analogy that lacks a scientific–psychological distinction. In his attempt to combine a psychological approach with a pedagogical approach, much emphasis was put on the latter. Instead of going into the details about the cognitive components, Potter provided recommendations for action.

Potter (1998, 2016) regarded media literacy as characterized by two properties. First, it is multidimensional because the adoption and assembly of knowledge does not merely take place in the cognitive domain, but similarly in an emotional, aesthetic, and moral domain. The focus of each domain is comprehension. The *cognitive domain* comprises cognitive processes, such as understanding symbol systems up to a more complex understanding of why and how a message is produced. This category also includes factual knowledge (e.g., names, dates, and definitions). The purport of the *emotional domain* is the ability to identify symbols that signal specific emotions and to empathically understand these emotions during reception. The *aesthetic domain* is concerned with the ability of a user to appreciate, understand, and enjoy the artistic aspect of a message; it is very similar to Groeben's (2002) media-related enjoyment. The difference is that the knowledge about how a message is produced falls into this category. The *moral domain* describes the ability to identify or infer the moral values that underlie a message. The second characteristic of media literacy is that it forms a *continuum*, not a category. One cannot be media literate or not; rather, according to Potter (2016), it is comparable to a kind of thermometer that reflects the current degree of media literacy. This implies that there is no zero point or reachable maximum, as further development is always possible; it is a continuous, lifelong process of knowledge acquisition. People with a higher level of media literacy should manifest wide, strongly pronounced perspectives, whereby they can use their abilities to interpret media messages within their knowledge structure and with the aid of different dimensions. Individual disparities in media literacy are comparatively greater due to differences in the amount and quality of knowledge structures. A person with little literacy therefore displays fewer perspectives, which are in turn held by knowledge structures that

contain less information and are poorly arranged. This person is less able to understand media, appreciate their advantages, and protect themselves from potential harmful influences. Often, these people are habitually unwilling or hesitant to utilize their abilities, which, therefore, remain underdeveloped and are consequently more difficult to be applied successfully. Potter (1998, 2016) advocated a clear practical approach. Although he admitted that media literacy develops further due to maturing processes in the intellectual, emotional, and moral areas, a deliberate practice has to take place. This does not solely involve media exposure, but media messages must be actively manipulated. The goal of media literacy should be to gain control over the interpretation of media messages so that media are not consumed uncritically. In his model, Potter (1998) held a developmental psychology perspective. According to him, *rudimentary skills* evolve during childhood, which form the basis for later development. They encompass *exposure skills,* which describe the selection and use of a need-specific medium (comparable to Groeben's dimension *selection and combination*), *recognizing symbols* (i.e., the ability to comprehend the symbols used in diverse media, e.g., understanding pictures for what they are or identify an advertisement jingle). A further component is *recognizing patterns*, the combination of different symbols, which becomes more difficult with a growing number of symbols. For instance, the comprehension of a film plot requires the montage of different scenes in succession. Finally, these symbols and structures have to be *matched with meaning*. This can be the understanding that certain montage principles, such as flashbacks, point-of-view shots, or simultaneous actions, are presented as a crosscutting sequence. These skills are rarely applied individually but most often in combination (e.g., Potter, 1998). In reference to Nieding et al. (2016), this ability is further called media *sign literacy*. Many consumers remain at this level, as it is already functional in daily life. In adolescents, a user should acquire higher-level *advanced skills* and actively develop elaborated knowledge structures (e.g., Potter, 2013, p. 25). Advanced skills include *experiential exploring,* which describes seeking out different forms of content and novel emotional, moral, and aesthetic experiences. This means that a user expands their spectrum of media. If someone habitually watches situation comedy programs, they could start consuming news, sport reports, or documentaries and read niche magazines and books about unusual topics. When confronted with completely new content, people become aware of the variety of human existence (e.g., Potter, 2016, p. 29). Another aspect is *critical appreciation*, the comprehension of the context of a message as well as the construction of a critical judgement. People at this stage are able to make profound judgements about the quality of a media message and its author (comparable with *media-related critical faculty* in Groeben's

model). The last stage is *social responsability*, the ability to judge whether a media message is constructive for society and to realize the impact of one's own action on society (Potter, 2016, p. 29). One example of the application of advanced skills is the ability to understand the persuasive intent of an advertisement. Young adolescents are expected to identify any discrepancy between the message and the reality of the product, to be aware of the symbolic nature of commercials, to be aware that an external source or sponsor lies behind each media message, and to comprehend that the commercial seeks to reach a certain target audience (Robertson & Rossiter, 1974). One has to remark on Potter's (1998, 2016) model that (as stated above) the model's description is highly unspecific. Especially with regard to the developmental derivation, his explanations remain on the surface; his text lacks empirical verification for the existence of the alleged facets of media literacy. However, no derivation of advanced skills takes place; they are presented descriptively. His domains are only once substantiated with reference to the conception of another author, not by empirical data. Potter's approach is, in many ways, rather a pedagogic-descriptive one than a psychological model. It is useful for the conceptualization of educational interventions and training; otherwise, empirical data need to be supplemented to make them applicable to psychological research. Nevertheless, it is very often used and cited in the Anglo-Saxon world as it addresses many important components of media literacy; therefore, it is integrated in this work as well. In the next section, Hobbs' (1997) model, which was conceptualized for school education, will be elaborated.

### 2.2.3. Hobbs' Model

In her model, Hobbs (1997) attempted to extend the previously prevailing *literacy* approach because language has often been the sole recognized significant sign system, especially in the school system. She acknowledged its worth but pledged that other symbol systems that are used for the expression and exchange of meaning should be considered similarly. With the change in the media landscape in the twentieth century, the role of language and written words has been relativized. Language should be additionally appreciated because it is related to other symbolic means of expression, such as pictures, music, and electronic communication. There is more to it than just the acquisition of decoding, comprehension, and production skills independent of the context; literacy should always be imbedded in culture and context, in which writing and reading take place. Following Aufderheide (1993), Hobbs regarded four processes as fundamental for media literacy—*access*, *analyze*, *evaluate*, and *communicate*; they are explained below. All processes are built on media sign literacy, which is presupposed as basic

(in accordance with Potter's *rudimentary skills*). It is about depicting how people obtain new skills in symbol systems, such as language (e.g., Hobbs, 1997).

*Accessing* describes the ability to decode symbols and establish a vast vocabulary (comparable to *recognizing symbols and patterns*, Potter). It is also about the location, organization, and storage of information. It can be varying procedures in one medium, such as searching for information in different book sections, or the use of varied sources from different media (see Potter's *exposure skills,* the higher level of *experiential exploring*; Groeben's *selection and combination*). *Accessing* also includes the use of technologies such as films or PC (similar to the basic level of Groeben's *media-specific reception patterns*). According to Hobbs (1997), this literacy was often referred to as *information literacy* or *superhighway skills* at the time of the composition of her essay.

By *analyzing*, Hobbs characterized the skills necessary for an interpretive comprehension of media messages. It encompasses the ability to apply categories, concepts, and ideas advisedly, similarly to determining the genre of a work. A user should be able to draw inferences about causes and effects, as well as identify the intent of the author and their viewpoint. On a secondary level, *analyzing* also incorporates detecting the historical, political, economic, or aesthetic context in which a message arose (similar to the basal component of *critical appreciation* by Potter and *media-related critical faculty* by Groeben).

*Evaluating* describes judging the relevance and worth of a message by the user, as well as integrating previous knowledge in the interpretation of a media message (similar to the more complex aspects of *critical appreciation* by Potter and *media-related critical faculty* by Groeben). Predictions about further results or logical conclusions should be made, and the aesthetic quality of the message should be appreciated (similar to Groeben's *media-related enjoyment*). While analytical skills are based on the ability to understand something and to advisedly deploy conceptual knowledge outside of our own perspectives, evaluating skills implies reverting to already existing knowledge, worldviews, attitudes, and values of a person.

Hobbs (1997) stated that the ability to *communicate* constitutes the core of the traditional literacy approach (see Groeben's *productive participation patterns*); reading and writing are always highly appreciated in the education system. Communication skills vary widely and are, to a certain degree, media-specific. General skills include the ability to understand the target audience of a message, the effective administration of symbols to transport the meaning of a message, and the organization of a string of ideas, as well as to gain and maintain the interest

and attention of the recipients. Media-specific skills in regard to printed works include being able to write a letter and spell words, use correct grammar, and edit and revise one's own work based on the feedback. In every medium, such as films, talking, or audio recordings, similar processes take place.

According to Hobbs (1997), it is reasonable to expand the concept of a "text" if it is applicable to a broad range of media. She regarded the integration of new media in school lessons as a possibility to improve written language using transfer processes, as the analysis of media messages helps students to develop new skills and arouses their interest in and curiosity about reading and writing. She considered it inevitable to not just decipher messages in class but to differentially analyze, evaluate, and create them, because this ability will be necessary for survival in the information age. This is a lifelong process; even young children can conceptually analyze and evaluate media, already at an age in which they just start with the mastery of decoding and comprehension skills for print media. Later, higher cognitive skills can be integrated; this motivates students to gain access to further abilities, for instance, to crack the code of printed words or movie recordings. Hobbs (1997) assumed that students develop more complex expectations about future messages when analyzing several different media messages, raising their demands; hence, on a societal level, a higher quality of mass media is produced.

In summary, Hobbs (2011b) emphasized the *empowerment* perspective, an approach that primarily aims to equip young users with tools to operate independently and self-directed in the medial world. She did not want to change students' existing opinions or to take aimed actions against negative media effects. Her concept of media literacy is oriented toward an individual's capacity to act and its autonomous development. The required skills should be imparted to students in class (Hobbs, 2011b). Although a competence-oriented stance is to be regarded positively, this approach bears a weakness, as Hobb's argumentation implies the tendency to marginalize negative media effects, which has already been criticized (Potter, 2011). Additionally, her model is tailored to school and teaching and, therefore, is somewhat conditionally implementable for conceptualization with adults. The model has its worth, as Hobbs was highly familiar with the US-American education system and works closely with schools. Therefore, she knew the current state of students' media literacy, could observe the development of media literacy's components, had dealt with a multitude of media literacy training and their effects (e.g., Hobbs & Frost, 2003; Hobbs, 2005, 2011b), and always aimed at a connection between the school curriculum and the capacity to act in society (e.g., Hobbs,

2011a; Hobbs et al., 2013). Her approach, like the models by Potter and Groeben, has not yet been empirically confirmed.

### 2.2.4. Summary of the Three Models of Media Literacy

In the previous section, three comprehensive models of conceptualizing media literacy were introduced. In terms of their content, all three agree on many points. Both Groeben (2002, 2004) and Potter (1998) emphasized a need-oriented media selection that should be supplemented with additional media over time. In accordance with Hobbs (1997), they accentuate a critical examination of media contents and the relevance of being acquainted with the framework of the creation and the author of a message. An appreciation of aesthetic and media enjoyment should not be missed. Finally, all three authors pledged for an active analysis and independent production of media content. Groeben focused on the description of the target state in adulthood, while Potter and Hobbs emphasized the developmental aspect. All models introduced have so far not been empirically confirmed, which causes a limitation of their informative value. As many components overlap and further important models and findings exist, a model for our own research is conceptualized, which is subsequently empirically tested on the basis of an instrument derived from that model. The derivation of this model is depicted after the development of media literacy is introduced.

### 2.3. Development of Media Literacy

The development of the competence to understand different components of media literacy and various media sign systems, as well as their active use, is examined separately below. Study I in the empirical section (chapter II.3.1.) presents the development of media literacy from adolescence to young adulthood, where research is still missing. A closer look at the development of media literacy's component is also taken. This chapter provides information on earlier development.

### 2.3.1. Media Sign Literacy

Hobbs (1997) described media sign literacy as the skill of understanding the sign system used in a medium. There is evidence that the first component of media literacy to develop in toddlers is media sign literacy. In this context, *representational insight* (DeLoache, 1995; DeLoache et al., 1998) is required. It refers to the ability to mentally represent an object and to understand that it can be used as a stand-in for something else. Comprehending the twofold nature of pictures—that is, understanding that a picture is more than a two-dimensional, flat item but depicts something else—is a first step toward developing an understanding of external

systems of representation. For a long time, it was assumed that this process is innate (Hochberg & Brooks, 1962). More recent studies have refuted this assumption, as children in Western cultures acquire *representational insight* earlier than children elsewhere who are less exposed to pictures (Callaghan et al., 2012; Walker et al., 2013). Prior to this stage, young children did not understand that pictures serve as symbols and instead treated them as objects in themselves (DeLoache et al., 1998; Pierroutsakos & DeLoache, 2003). Studies conducted in Western cultures showed that representational insight is acquired at about 18 months. For instance, while 9-month-old infants attempt to grasp an object on the screen, children aged between 15 and 19 months begin to point at the image (Pierroutsakos & Troseth, 2003). They also realize that the name of an object can similarly refer to the stand-in (Preissler & Carey, 2004). Even at this age, the ability is not fully developed, as the child has not yet learned the exact relation between a photograph and its referent. One example is that even 3-year-olds assume that photographs formerly taken change when the represented scene is changed afterward, for instance, when a ball is first placed on the lap of a doll and is removed and replaced next to her feet after the photo is taken (Donnelly et al., 2013). Flavell et al. (1990) found that children of the same age surmised that when a television is turned upside down, the depicted popcorn would spill out.

### 2.3.2. Distinguishing between Reality and Fiction

According to Potter (2010), a further step taken during childhood is the ability to differentiate between fiction and nonfiction, as well as among program formats, which includes recognizing advertisements. The findings confirm that the comprehension of the representational features of films constitutes a precondition for the awareness of different program formats (Diergarten et al., 2014; Nieding et al., 2006; Wright et al., 1994). Two-year-olds seem to have rudimentary knowledge that what they see on TV does not influence the real world (Hayne et al., 2003). Just because a child can recognize a program format does not mean that it understands what the format implies. For instance, 4-year-olds are able to distinguish advertisements from other programs, but it is not until about the age of eight that they realize its persuasive intention; before that age, they regard advertisements as mere information (Nieding et al., 2006). Preschoolers distinguish between reality and fiction on the basis of format (e.g., filmed or animated) and ignore the content (e.g., Downs & Oliver, 2009). For more complex judgements of fiction, they require an understanding of factuality—that is, the ability to determine whether a depicted movie scene is a mere construction for television or corresponds to events in the real world (Diergarten et al., 2014; Wright et al., 1994). For example, Munk et al. (2012) found that only 60% of 8-year-olds' judgements of factuality are

accurate, and many 12-year-olds even have problems comprehending that news is a media construction or accurately placing the so-called "reality" formats (van der Voort, 1986). The emergence of scripted reality formats in recent years has exacerbated this problem, as young adults in some cases even find it difficult to distinguish between reality and fiction (Feierabend et al., 2014). Koolstra (2007) showed that adults even make the so-called *fiction-to-news* confusion, interpreting fictional content as real news, an effect that is especially pronounced in heavy TV viewers.

### 2.3.3. Comprehending Visual Production and Editing Techniques of TV

There are certain film-cut conventions and montage principles that are followed when scenes are combined. These techniques are called *visual formal features* of a film (Rice et al., 1986) and allow the creation of a coherent perception of action (e.g., Nieding & Ritterfeld, 2008). Montage describes the process of editing a series of short stories into a sequence to condense space, time, or information (Bordwell, 2005). Young consumers must learn to understand the visual production and editing techniques of filmic symbol systems. This is crucial for comprehending content; these techniques are also used to compress space and time or to emphasize certain information, making this the most essential component of film literacy.

The film-cut conventions that align a film to natural perception are referred to as the *continuity system*. The ability to comprehend film cuts depends not only on the age of the child but also on the complexity of the cuts. These editing rules were classified into three categories (orders) by d'Ydewalle and Vanderbeeken (1990). First-order techniques are mainly perceptual, implying only a two-dimensional space; they allow for a soft transition from one scene to another (d'Ydewalle & Vanderbeeken, 1990). Examples include zooms or Cut-Ins (close-up shots). These techniques demand comparatively little mental effort from the recipient (Nieding & Ritterfeld, 2008). A way to break first-order editing rules is, for instance, to change the angle of the camera, which can appear as an interruption in the perception of motion.

Second-order editing rules describe perceptual and post-perceptual activities within a three-dimensional space. They rely on the ability of a recipient to create the spatial schema of a scene. This schema leads to expectations regarding the next shot (d'Ydewalle & Vanderbeeken, 1990). One rule in this category is the "180-degree rule." It describes a rule concerning the on-screen spatial relationship between a character and another character or object within a scene.
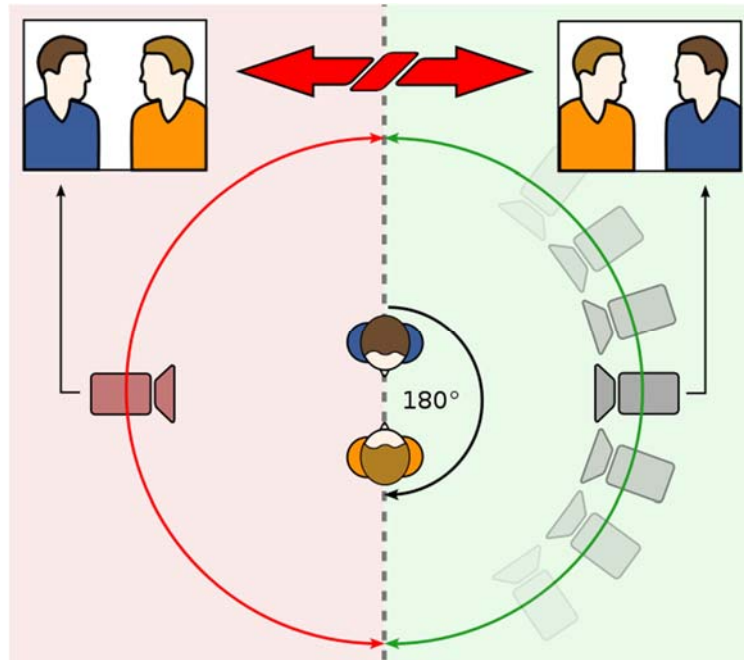
*Figure 1*. Jumping the line: This schematic shows the axis between two characters and the 180° arc on which cameras may be positioned (right side). When cutting from the green arc (right) to the red arc (left), the characters switch places on the screen. © Grm_wnr source https://commons.wikimedia.org/wiki/File:180_degree_rule.svg

An imaginary axis is laid between the two characters, or the object and the character. By keeping the camera on one side of this axis between two characters, the first character is always framed right from the second character. If the camera is moved over this line, it is called "crossing the line" or "jumping the line" (Fig. 1). Shifting to the other side of the axis, the characters on a cut appear to have reversed the order from left to right, which might confuse the recipient.

Third-order editing rules require cognitive activities to follow the narrative continuity of the film, as they refer to the narrative of the film and the continuity of sequences of events (d'Ydewalle & Vanderbeeken, 1990). An example of a third-order rule is back-flashes, where scenes of the past of the filmic action are placed between two scenes of the present of the filmic action (Nieding & Ohler, 2008).

Kirkorian et al. (2012) compared 1- and 4-year-olds and adults with respect to the processing of film cuts and found that infants needed the longest time to re-orientate in a new scene. Children's understanding of editing techniques advances significantly between the ages of four and ten years. Techniques such as cut-ins are grasped first, as these correspond to our

natural perception and therefore pose fewer cognitive demands than techniques such as flashbacks or cross-cutting, which require the ability to form more complex situation models (e.g., Munk et al., 2012).

Is this development a byproduct of cognitive development, depending on experience, or is it innate? Hobbs et al. (1988) found in an early study with adult African tribal villagers who had little experience with television that they were able to comprehend the narrative of a film, even when it included several "point of view" editing techniques. "Point of view" editing techniques record a scene as it would be seen by a certain character in a film. Often, a scene with the mimic reaction of the character follows. In other cases, an indirect point of view technique is used. Recently, Ildirar and Schwan (2015) showed that Turkish adult first-time viewers could notice pictorial (object identity), causal (chain of action), and conceptual (links between objects and gaze direction) commonalities, as they equal natural perception and cognition. However, the understanding of these similarities was rather fragile, and first-time viewers did not draw profound inferences, showing that the underlying comprehension of the constitution of a film as a coherent narrative did not exist (Ildirar & Schwan, 2015). The familiarity with the presented topic determines whether a film is understood by first-time viewers, rather than the commonality to natural perception (Schwan & Ildirar, 2010).

In the next section, the use of more interactive media computers and tablets will be depicted.

### 2.3.4.  Use of Computers and Tablets

As in the case of television, young children now come in contact with computers and tablets from an early age, which becomes highly relevant from the age of about three years (Iene Miene Media, 2012, cited in Bus et al., 2015). Touchscreen devices, in particular, are popular with children, as their finger-based interface allows even very young children to perform simple tasks (Neumann & Neumann, 2014). Between three and six years, children's speed and accuracy in tapping and dragging improves significantly (Vatavu et al., 2015) and their skill in using pointing devices (such as a computer mouse) improves continuously between the ages of four and twelve (Joiner et al., 1998). However, as far as I am aware, there is no research concerning the development of computer literacy in adolescence. Only two comparison studies were conducted in 2013 and 2018, both of which were international computer and information literacy studies carried out by the International Association for the Evaluation of Educational Achievement. The 2018 study compared the CIL of 46,561 eight graders from 14 international educational systems and found significant country-specific differences (Eickelmann et al.,

2019). The authors devised a 5-level scale of ICL in which the lowest level represented rudimentary, mainly receptive, skills, while the highest level represented the skill to evaluate and organize self-obtained information and to be able to produce messages that are formally and contently demanding. A key finding was that merely using digital devices does not foster sophisticated digital skills in adolescents. The results showed that 18% of the international sample failed to reach the lowest scale, and 25% reached the lowest scale. Another 21% achieved the next two levels on the scale, which implies that these students could independently gather information or manage knowledge with a computer. The highest level of the CIL scale was only reached by 2% of the participants in the study (Eickelmann et al., 2019). Additionally, media literacy was significantly correlated with the parents' SES. Overall, the differences in CIL between the countries was smaller than those within countries (Eickelmann et al., 2019).

### 2.3.5. Video Games

Another medium widely used by young people is video games. Although much of the existing research has focused on their negative outcomes, video games also have known benefits in promoting a form of literacy that seems important for our digital society (for an overview, see Granic et al., 2014; Nieding et al., 2016). Although not yet defined (Gee, 2003; Kress, 2003; Leu, 2001), a fundamental aspect of this literacy is the capacity to understand user interface metaphors (e.g., being able to identify the icon that represents the "help" option) (Nieding et al., 2016). However, as far as I am aware, there is no measure for *game literacy*. Thus, literacy on video game use is discussed in this thesis. A substrate of the extensive summary of Granic et al. (2014) on the positive impact of playing video games will be presented in the following section. More recent studies will be supplemented and integrated. First, cognitive benefits will be presented, followed by emotional, social, and motivational benefits.

A wide range of studies have focused on the repercussions video gaming has on cognitive skills. Despite the cliché of video games as passive and intellectually little demanding, gaming has the capacity to foster several cognitive skills. In training studies, shooter games (action games where the gamer plays from a first person perspective and often contain violence) have a positive impact compared to other video games. A meta-analysis conducted by Uttal et al. (2013) showed that people profit equally in terms of their spatial skills by shooter video games as from college and university courses with the same aim. Moreover, improvements are reached in a short period, can be transferred to other areas, and last over a longer period (Uttal et al., 2013). Randomly assigned students in the shooter condition exhibit higher spatial resolution in visual processing, more accurate and faster attention allocation, and an increase in mental

rotation abilities (Green & Bavelier, 2012). Evidence from a functional magnetic resonance imaging study hints that gamers allocate their attention more efficiently compared to non-gamers, as indicated by reduced activation in the fronto-pariental cortex (Bavelier et al., 2012). A correlational study by Steinkuehler and Duncan (2008) examined the relation between video gaming and problem solving. In this study, *World of Warcraft* players showed an advantage of players versus non-players. However, no causal statement could be achieved through this design. A longitudinal study reported that adolescents who stated playing strategic video games improved their problem-solving skills and eventually exhibited better school grades (Adachi &Willoughby, 2013). Finally, playing video games is correlated with creativity (Jackson et al., 2012).

Many studies have investigated the positive impact video games have on mood improvement and positive emotions. For instance, Russoniello et al. (2009) showed that playing puzzle video games can provide protection against anxiety, foster recreation, and improve mood. However, most studies are correlational, making a causal interpretation difficult; additionally, no statement about long-term effects on mood can yet be made. As video games also elicit negative emotions, such as anger, frustration, sadness, or anxiety, they might not only serve emotion regulation, as Frederickson (2001) hinted. Adaptive emotion regulation strategies, such as reappraising or problem solving, are often rewarded in video games. In contrast, Holtett and Harris (2020) found a correlational association between maladaptive emotion regulation or problems with impulse control and video gaming problem. In this case, players use video games to distract themselves from unwanted emotions, thus avoiding working through the experiences. As the study used a correlational design, it allowed no conclusions concerning the effects video games have on young people. A comparative study of regular and irregular gamers with 159 French adolescents investigated differences in emotion expression, emotion intensity, emotion regulation, and alexithymia (Gaetan et al., 2016). The results showed that regular gamers experience their emotions more acutely but are better at controlling their emotions. However, they are less likely to express their emotions and show a higher alexithymia level compared to irregular gamers. These findings suggest that video games can act as a means to acquire emotion regulation strategies. Hemenover and Bowman (2018) authored a more recent review about the relation between video gaming and emotion regulation. Findings that complement the already mentioned ones are depicted briefly. Oliver et al. (2015) conducted an international survey among gamers. They found that 75% of all participants remembered meaningful experiences, which included reflection and introspection, during a

game, leading to more reported insights and feelings of relatedness or connectedness (Oliver et al., 2015; Rogers et al., 2017). Video games are often used to reduce stress or boredom, for example, through escapism or diversion (Sherry et al., 2006; Yee, 2006). Players can adapt their choice of game in regard to their stress level, choosing moderately demanding games when stressed, thereby achieving the best mood repair (Bowman & Tamborini, 2015). Additionally, mood repair is associated with whether a gamer's need for autonomy or competence is met (Reinecke et al., 2012) and recovery experiences (Reinecke et al., 2011). Success in a game serves as a predictor for mood repair afterward (Rieger et al., 2014); video games are more effective in repairing mood than non-interactive media (Rieger et al., 2015).

Video games also have social benefits. Contrary to existing stereotypes of lonely, isolated gamers, over 70% of the gamers stated playing with a friend (Entertainment Software Association, 2012). Apparently, several important prosocial skills are learned by playing video games: helping others, cooperating with them, and supporting them (e.g., Ewoldsen et al., 2012; Harrington & O'Connell, 2016). Gentile et al. (2009) summarized evidence from three international studies. One was experimental, while the others were longitudinal and correlational. Each study supported evidence of a positive influence of playing video games on prosocial behavior (Gentile et al., 2009). This is true for even violent games if they reward prosocial behavior (Ferguson & Garza, 2011). Additionally, feelings of hostility (Eastin, 2007) and violent thoughts (Schmierbach, 2010; Velez et al., 2012) can be reduced, and prosocial behavior in the real world can be fostered (Ewoldsen et al., 2012), when violent games are played cooperatively. Note that these effects disappear if the games are played extensively and as maladaptive emotion regulation strategies (e.g., Carras et al., 2017). No reduction in prosocial behavior could be found even for players of the most violent games (Tear & Nielsen, 2013). Lobel et al. (2019) conducted a longitudinal study with children between 8 and 13 years of age. Those who stated playing a competitive game at the first assessment point were more likely to exhibit less conduct problems and better peer relations (Lobel et al., 2019). Moreover, two correlational studies found a positive association between civic engagement and playing video games with civic experiences (Ferguson & Garza, 2011; Lenhart et al., 2008).

Playing video games can also have a positive impact on motivational variables. However, only one study was conducted on this topic, which found that people are the more persistent in trying to solve difficult tasks (an anagram riddle), the more they play video games (Ventura et al., 2013).

Taken together, depending on the kind of video game, different cognitive skills are stimulated, which also impact other contexts. Video games can be a means to acquire positive emotion regulation strategies and act as a means for emotion regulation themselves. Additionally, they can initiate intensive positive emotions. Video games that reward prosocial behavior, in particular, can foster it in the real word. Even the most violent games do not lessen prosocial behavior when they are played cooperatively. Cooperative games foster social skills such as helping others, cooperating in real life, and supporting others; games with civic experiences can lead to more civic engagement.

### 2.3.6. Geographical Maps

For several of the above media, an important component of literacy is the ability to understand geographical maps. In video games, for instance, the player must often navigate a fictional world using a map. Children as young as 2.5 years can spontaneously use purely geographical maps to find objects, even when they differ from the layouts in size, mobility, orientation, dimensionality, perspective, and even when the target objects are not displayed directly (Winkler-Rhoades et al., 2013). Three- to four-year-olds can understand simple maps (Huttenlocher et al., 1999; Shusterman et al., 2008), and by the age of 6, many are able to navigate through six unfamiliar rooms using maps (Uttal & Wellman, 1989). However, some children still interpret maps as iconic (e.g., assuming that a street marked red on the map will be red in reality, too) (Liben & Downs, 1989). Adults are usually able to navigate using a map aligned to their own spatial orientation, but when misaligned by either 90° or 180°, accuracy and speed are increasingly impacted by increasing misalignment (May et al., 1995).

Summarizing the results for all media, much research has emphasized the development of media literacy in children, but comparatively little information exists about the transformations taking place in adolescence.

### 2.3.7. Own Model of Media Literacy and the WMK

In this section, a model of media literacy, on which the studies presented in this thesis are based, as well as the instrument that was developed to empirically test this model, is presented. This model serves as a basis for an own media literacy test that was evaluated and utilized in the three studies in the empirical section (chapter II.3.). Although there are several existing instruments for the assessment of media literacy, the decision to create our own instrument was made. This was, on one hand, based on the fact that the own model is tested empirically; on the other hand, none of the available instruments met the requirements for the present research

project. The aim was to assess the broad construct of media literacy beyond its subcomponents, including a broad range of media and practical aspects.

The existing tools can be broadly assigned to three categories: self-report tools, multiple-choice tests, and practical tasks. Of these, the most common are self-report tools, such as Lee et al.'s (2015) attempt to measure what they described as "the new media literacy" (NML), including mobile media, interactive media, and participatory media (such as online social media). Likert-type scales were used to assess students' NML by asking which tasks they could solve without help and how often they performed these tasks by themselves. In general, self-report-based tools require the participants to rate their own skills, with no objective verification. Self-reports are prone to distorted results, as the participants may overestimate their skills or overstate their knowledge because of embarrassment (e.g., Lee et al., 2015). The second category (multiple-choice tests) is more useful because it avoids the limitations of self-reports. One example is the Computer Literacy Inventory (Inventar zur Erfassung der Computerbildung; INCOBI-R) developed by Richter et al. (2010). On multiple subscales, the participants are required to choose the correct alternative from multiple options, thereby enabling a more objective assessment of actual knowledge. The advantage of the last category (the practical test) is that it neither relies on self-reporting nor on guesswork (as may occur in multiple-choice formats). Many tools require participants to solve practical tasks in a simulated computer environment to assess ICT skills (Goldhammer et al., 2013; Huggins et al., 2014; Katz & Macklin, 2007). However, all instruments were restricted to ICT and therefore did not meet our requirements.

Hence, the Würzburger Medienkompetenztest (WMK) was developed, comprising 183 items across five scales. In addition to the above introduced models by Groeben (2002, 2004), Potter's (1998, 2016) and Hobbs' (1997) elements of further conceptualizations and empirical findings were integrated. Five subscales of media literacy were extracted, which will be described in detail below: *media sign literacy, distinction between reality and fiction, knowledge of media law, knowledge of media effects*, and *production skills* (Fig. 2). The items of the WMK are either practical applications or multiple-choice questions and refer to both classical media and contemporary devices. Examples are tablets, smartphones, and social media as the everyday living environment in which young people are immersed, making these devices essential for participation in today's social world. A more detailed description of separate tasks can be found in chapter II.2.3.1, and excerpts can be found in the Appendix.
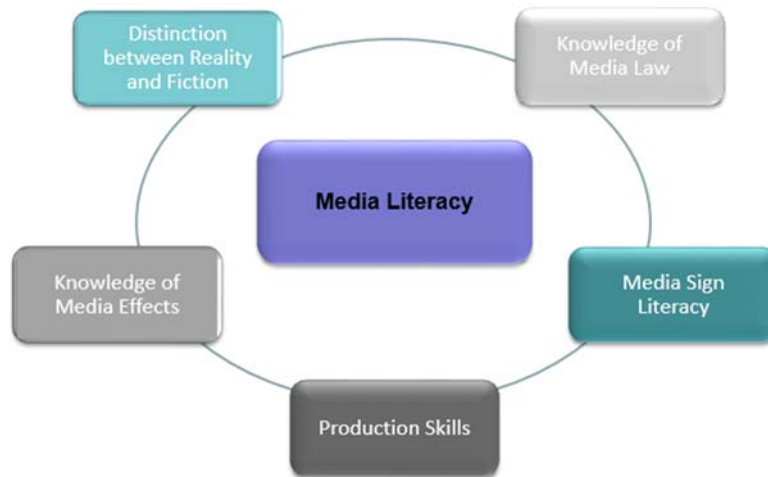
*Figure 2.* Five scales of media literacy (Gralke et al., 2015)

Our first scale was *media sign literacy,* because if it is missing, none of the other skills can be developed, as each implies at least a basic skill in this area. Hobbs (1997) explicitly named media sign literacy as a core component of media literacy. As stated in chapter I.2.3.1, media sign comprises—on a basic level—the skill to understand the sign system of a medium (Hobbs, 1997) and is the first part of media literacy young children acquire. Some authors have postulated a common source hypothesis (e.g., Namy & Waxman, 1998; Roth, 2001), which states that there is a general symbolic skill that acts in different domains. Thus, separate symbolic skills (reading, writing, comprehension of pictures, etc.) are expected to be correlated. There is evidence for this assumption: A recent study by Cheung et al. (2022), for instance, found that late-talking children also need longer to acquire picture comprehension. This is one reason why we considered Potter's (2013) *experiential exploring* as a part of media sign literacy. A search for new content leads to contact with diverse media, where a general symbolic skill will help a user similarly with different kinds of media. An alternative explanation could be that once representational insight is gained in one symbolic domain, it can be transferred to other domains (e.g., Troseth et al., 2007). Regardless of which explanation is accurate, both approaches emphasize sign literacy. While much is known about the development of this component in childhood (chapter I.2.3.1), its trajectory from 12 years onward remains unclear. For this reason, more difficult tasks pertaining to contemporary signs—principally those used online and on contemporary devices used by adolescents—were developed for the WMK. As reading and interpreting maps falls in this area of competence (Huttenlocher et al., 1999; Shusterman et al., 2008; Uttal & Wellman, 1989), map-related tasks were included as a subset of this skill. Similarly, the knowledge about various media devices [Groeben's (2002, 2004)

*media knowledge*], the comprehension of montage in films [Potter's (1998) *matching meaning*], as well as handling hypertexts [Groeben's (2002, 2004) *media-specific reception patterns*], were included.

*Distinction between reality and fiction*, the second scale, is based on Potter's (2010) observation that this skill is decisive for the comprehension of media. This implies the ability to differentiate between program formats and advertisements. As described above (chapter I.2.3.), this ability develops further during childhood (e.g., Rice et al., 1986; Wright et al., 1994). While very young children can already distinguish among program formats (e.g., Diergarten et al., 2014), it takes them about 8 years until they realize what these formats imply (Nieding et al., 2006). Even young adults have difficulties correctly identifying scripted reality formats (Feierabend et al., 2014), and adults still make a fiction-to-news confusion (Koolstra, 2007). In a recent article, Baum and Potter (2019) noted that even more difficult is the so-called *soft news* (Baum, 2002; Groeling & Baum, 2008). Their observations are briefly stated. They concluded that the aim of soft news is to merge information and entertainment, which also leads to the creation of more extreme versions of polarized news (Tufekci, 2018). In particular, foreign policy events seem to be taken out of the actual context of an event and utilized for individual goals (Baum & Potter, 2008). Baum and Potter (2019) were concerned about the trend in social media in which media are delegitimized. Moreover, misinformation campaigns and targeted advertising are growing on social media (Bloom, 2013; Tuten, 2008). The Stanford History Education Group found that 80% of students believe that advertisements are news (Wineburg, 2016). On social media platforms, stories are shared over and over again, becoming myths (Page, 2018), making it difficult for young people to evaluate whether new information is truth or fiction. Out of the reasons mentioned above, scholars such as Wilson et al. (2014) have emphasized teaching young people to identify misrepresentations. It is apparent that the distinction between reality and fiction becomes increasingly crucial. The findings above show that the distinction between reality and fiction is an important component of media literacy, especially for adolescents and adults. As we wanted to test this skill on a higher level, difficult tasks were designed for adolescents and adults. If they lack this ability, sometimes dramatic outcomes take place in real life. Even without overdramatizing media's impact, less drastic effects are occurring daily, impacting our lives to various degrees.

Often, laymen take the next component of media literacy, *knowledge of media effects,* as the main or sole definition of media literacy. It is also the idea behind the construct of *critical media literacy*. The core question is as follows: What do media producers want to do with/to a

consumer? The aspect of media literacy is highlighted by Hobbs (1997) as the capacity to use, analyze, evaluate, and communicate diverse media messages, which Potter (2013) characterized as *critical appreciation*. One needs the ability to critically reflect on the effects of media on oneself and on others, as well as on the techniques used to manipulate consumers. Adopting a similar approach, Chen et al. (2011) assumed that media literacy comprises—among other aspects—a functional aspect. They argued that one needs a critical level of media literacy that allows a consumer to analyze and evaluate content according to its social repercussions and to integrate a message into its context (Chen et al., 2011). Similarly, Kellner and Share (2007) stated that "The type of critical media literacy that we propose […] focuses on ideology critique and analyzing the politics of representation of crucial dimensions of gender, race, class, and sexuality; incorporating alternative media production; and expanding textual analysis to include issues of social context, control, and pleasure." (p.8). As media can be a powerful tool to influence people, it is important that teachers show students a critical evaluation of the media (Kellner, 2006). In their T.A.P. (Text, Audience, Production) model of media literacy, Duncan et al. (1998) stressed the interplay of the three name-giving components. They emphasized that to fully understand a media message, an individual has to consider the kind of text, what type and genre it is (*Text*), the intended audience of the text, and the fact that the personal background of a recipient changes the way a message is perceived (*Audience*). Finally, production stresses the way a text is produced and by whom it is produced (the institutional context). This model is mentioned here because the authors' approach to media literacy emphasizes what I regard as an important component of *knowledge of media effects*. In summary, Kellner and Share (2007) argued that "Media are […] not neutral disseminators of information because the nature of the construction and interpretation processes entails bias and social influence." For this doctoral thesis, the ability to critically reflect on the effects of media on oneself and on others, as well as on the techniques used to manipulate consumers, is of relevance. They form the scale of *knowledge of media effects*.

The second part of Potter's (2013) critical appreciation is the awareness of the legal framework of media use to ensure responsible, circumspect use of media, which I attempt to capture in the third scale, *knowledge of media law*. This is the only exploratory component of our media literacy model. As far as I am aware, not much attention has been paid to the knowledge of the legal frame of media use. Nevertheless, in accordance with Potter (2013), I believe that it is important for a recipient and a creator of messages to be aware of the laws that govern their actions. As a recipient, one should be able to evaluate whether a creator is crossing

a legal line. As a prosumer, it is even more so, as legal consequences could occur when laws are transgressed—regardless of knowingly or unknowingly.

The fifth and final scale, *production skills,* addresses the practical application of media and the production of own content. While the former scales emphasized media consumption, the last scale moves toward creation. The production of media messages is often assumed to be an important aspect of media literacy (e.g., Brooks, 2010; Groeben, 2002, 2004; Potter, 1998, 2010, 2013, 2016). Since Web 2.0, every user can create content. In their theoretical framework, Chen et al. (2011) assumed that media literacy includes *prosuming media literacy*, entailing functional and critical media literacy. They argued that functional prosuming should include knowledge to utilize technology expediently. Critical prosuming is a more complex skill, which implies the ability to not only create messages but also understand the kind of impact they will have on a recipient or on society (Chen et al., 2011). This is in line with Potter's (2013) skill of *social responsibility*, which emphasizes an important implication of active participation: the ability to anticipate the repercussions one's deeds have on society. The active creation of content is also important for minorities, as they are rarely represented in mainstream media (e.g., Harding, 2004). Note that the term "prosumer" refers to someone who both consumes and creates media content. Chen et al. (2011) designed consuming and prosuming as a continuum, emphasizing the fluent transition of these actions. Additionally, they regarded functional and critical media literacy as a continuum. This practical approach is especially relevant when investigating information and communication technology (ICT) literacy and its underlying skill component, basic computer skills, in which participants are asked to complete tasks involving graphical user interfaces (Educational Testing Service, 2008; Goldhammer et al., 2013; Huggins et al., 2014; Katz & Macklin, 2007). The items in the WMK for the assessment of production skills mainly aim at the functional level of Chen et al. (2011), because much of the idea behind critical prosuming is better represented in the scale knowledge of media effects.

In this section, our own model of media literacy, the WMK, is presented. In the following section, a summary of the models of media literacy and an outlook on the empirical part of this thesis will be presented in the following section.

## 2.4. Summary and Outlook

In the previous section, several definitions of media and media literacy were introduced. The focus lay on the three widely recognized models proposed by Hobbs (1997), Potter (1998, 2016), and Groeben (2002, 2004). There are several aspects of media literacy they agree upon,

such as the necessity of media sign literacy as a basic skill, processing media messages critically, and including a practical component. These models, in combination with additional research findings, were utilized as a basis to derive our own model. The five scales of media literacy—*media sign literacy, distinction between reality and fiction, knowledge of media law, knowledge of media effects,* and *production skills*—were presented. Based on that model, an assessment tool named the WMK (Würzburger Medienkompetenztest) was created. Generating an own tool was indispensable because existing tools were either restricted to one component of media literacy or did not contain a test with practical applications. Additionally, it provides an opportunity to underlie the model with empirical support. The development of the different dimensions of media literacy from childhood onward was summarized. The goal was to demonstrate that children start to engage with media from a very early age and that their handling of specific media and comprehension is continuously improving and making affiliating processes more complex. However, research often stops at adolescents; exceptions are rare (e.g., Ildirar & Schwan, 2015). The current section shows that a construct to measure a person's quality of media use exists. The next section will explain why media literacy is an important variable. Its effects on societal factors will be introduced, and their potential to support adolescent and adult learners in the knowledge acquisition process will be addressed. A direct reference to the variables investigated in the empirical section will follow below.

### 3. Effects of Media and Media Literacy on Cognitive and Political Factors

Many repercussions of media use on users have already been mentioned in the introduction. In the previous section, a definition of media and media literacy was presented. Additionally, several models of media literacy were presented. The following section will present in detail the effects media and media literacy can have on cognitive and educational factors, as well as on political engagement. In the empirical part of this thesis, the association between media literacy and academic skills, as well as academic success (study II, chapter II.3.2.) and learning from different kinds of texts (study III, chapter II.3.3.), will be examined more closely. To supply the reader with a theoretical background, the first part of the coming section concentrates on how different media shape the learning process differently and ends with a comparison of the learning effectiveness of the diverse kinds of media. As media are not solely used for learning but impact society, a further question in the empirical part investigated the link among media literacy, interest in politics, and political self-concept (study I, chapter II.3.1.). Thus, in

the second part of this section, the role media play in stimulating and forming political self-attributions and engagement will be discussed.

### 3.1. Effects of Media and Media Literacy on Cognitive Factors

Considering media's influence on the cognitive abilities of young consumers, negative aspects are often highlighted. There are concerns that media consumption can reduce concentration, impair verbal skills, and foster stereotyping (e.g., Ennemoser & Schneider, 2004, 2007). A statement about the repercussion of the use of one medium can only be made if the kind of use and the content are considered. Of course, like almost everything, the media have positive and negative effects. Recent research has shown that new media users exhibit several positive attributes—for example, active members of social networking sites show better attentional control, verbal ability, working memory, and academic attainment (Alloway & Alloway, 2012; Alloway et al., 2013). Adolescents who spend more time online exhibit better reading literacy (Jackson, von Eye, Witt, Zhao, & Fitzgerald, 2011), and video gamers score better on tasks involving visual-spatial perception and control of attention (Ferguson, 2007; Green & Bavelier, 2003, 2006, 2007; Ventura et al., 2012). In contrast, social media can lead to reduced learning or research outcomes if students rely only on information that is easily accessible, more time is wasted, and their language reaches a less complex level (Akram & Kumar, 2017). Additionally, there seems to be little association among heavy media use and slight concentration impairments (Johnson et al., 2007), risky ICT use, and falling victim to cyberbullying (Chen et al., 2017), and a meta-analysis showed a negative connection among (media) multi-tasking and cognitive control, academic outcome, and socio-emotional integration in young people (Van Der Schuur et al., 2015). These examples illustrate that media use can have both a positive and a negative impact on several cognitive processes. As learning builds the basis of educational attainment, which is an important factor in adolescents' life, the two studies of the empirical part investigate the association between media literacy and academic outcome (study II; chapter II.3.2.), and between media literacy and learning (study III; see chapter II.3.3.). Study III is a continuation of the findings from study II, conducted to find an explanation how media literacy can influence academic outcome. The next section will provide information on the media's influence on the cognitive processes that take place when somebody is extracting information from different kinds of texts. This information is important to understand how media literacy can ease the learning process and why different learning outcomes occur. In study III, the difference between gathering information from a text and drawing inferences is examined in regard to the influence media literacy has on both processes.

Thus, the process of drawing inferences from different kinds of media will be expounded on later in this chapter. At the end of the first section, a comparison of the learning outcomes between different media will follow. An additional question in study III is what kind of text learners benefit from most and whether the benefit differs between pure knowledge acquisition and inference construction. Finally, the connection between media literacy and learning will be presented, which is also the core research question in study III.

### 3.1.1. Processing Information from Media

In chapter I.1., the media use of adolescents and young adults was comprehensively discussed. The focus, however, lay on media use during leisure time, not in an educational context. In both cases, processing information from media or learning is highly relevant. In the JIM study of 2017 (Feierabend et al., 2017), German adolescents indicated that, on average, they utilized digital media for homework for 44 min on a working day. The type of school had no influence, but girls spent more time than boys (49 vs. 39 min), and the older the students were, the more time they spent on the internet for homework (65 min for the 18- to 19-year-olds). The internet was also used during lessons; 7% answered it was done daily, another 20% used it several times a week, and an additional 15% once a week. Overall, 42% reported that the internet was deployed at least once a week, showing that digital media have already entered school on (quite) a large scale. In almost one-third of the cases, a whiteboard was employed daily (31%), a PC in 22%, a smartphone in 13%, a laptop in 9%, and a tablet in 4% of the cases. However, frequency of use does not indicate competent use. When asked to rate their own abilities concerning the use of common software, 70% perceived themselves as "very good" or "good" with Microsoft Word, 62% as using PowerPoint, and only 20% as using Excel. More than half of the participants reported having acquired their knowledge at school (in contrast to that at home/from friends or self-learning). As (new) media are ubiquitous in schools, the question has to be asked whether they actually positively influence the learning process and knowledge acquisition. Whether media can stimulate learning has been investigated in several studies. Computer-assisted learning materials have been shown to be effective (Fletcher-Flinn & Gravatt, 1995; Tamim et al., 2011). One example is a training study about the program Head Start. Preschoolers who used the educational software for half a year showed better results in the school readiness test than children from a traditional curriculum of the program (Li et al., 2006). Positive effects were found for educational television. One example is the show *Sesame Street*, from which children in different countries benefit in terms of social development, learning about the world, numeracy, and literacy (e.g., Linebarger, 2015; Mares & Pan, 2013;

Mares et al., 2015; Penuel et al., 2012). Children can also acquire long-term domain-specific knowledge about a topic (e.g., Michel et al., 2007). Positive outcomes of computer-based training have also been demonstrated for mathematical skills (Räsänen et al., 2009) and precursors of reading (Mioduser et al., 2000). Apps similarly foster, for instance, vocabulary learning (Chiong & Shuler, 2010). In the studies mentioned above, educational media content was investigated. Of course, the mere use of media does not lead to an increase in learning. As mentioned above, the internet tempts students to gather information superficially or work ineffectively (Akram & Kumar, 2017). Multitasking (see chapter I.3.1., Van Der Schuur et al., 2015) and excessive media diversity (Lange & Costley, 2019) have a negative impact. Additionally, when used to their own likings, students prefer to use social media for social integration, not for learning purposes (Madge et al., 2009). Even when learning takes place, this should not be confused with knowing. For instance, Maurer and Reinemann (2006) found that while viewers of a television debate gathered information about the economy, they did not realize that the presented information was selective, thus gaining no actual knowledge.

As demonstrated in the previous paragraph, media can assist learning. For studies II and III of this thesis, it is of relevance to understand how the different media support a learner and to compare the different kinds of media respecting their learning outcome. Why is a different outcome assumed? In the 1980s, Clark (1983) reviewed several meta-analyses and studies concerning media's impact on learning outcomes. He concluded that no medium is superior to another, but that other factors, such as the instructional method, can act as an explanation for different results. In his reply, Kozma (1991) emphasized that learning is a constructive, active process in which the symbol systems of the respective medium play an important role. As media differ in their technology, processing capabilities, and symbol systems, they interact with the learner as well as task characteristics and thus influence cognitive processes and the structure of mental representations. In this respect, each medium has a distinct impact on the learning process and outcome (Kozma, 1991). To compare the effects and efficiency for the learning outcome, studies that compare two types of media with the same content are necessary, as in study III of this thesis (chapter II.3.3.). When knowledge acquisition from media is investigated, two kinds of content are usually tested: recognition and recall questions, only asking what is directly stated in the learning situation, and inference questions, which aim at comprehension beyond explicitly presented content. In study III (chapter II.3.3.), both kinds of learning outcomes are considered separately and compared. The correctness of answers depends on the answering format, such as closed and open questions, as well as on the age of the participant.

Recognition tasks (e.g., in a multiple-choice format) can already be solved by very young children (meaning that the performance only slightly improves with age), while they have problems with free recall reports (Roebers & Schneider, 2000). Open questions can be considered somewhere in between regarding their difficulty; from elementary school to adolescence, the achievement is continuously improving (Roebers & Howie, 2003). In study III, a multiple-choice format is chosen to achieve better comparability between the participants. This choice is critically reflected in the discussion of study III.

In the following section, findings concerning the impact of media on memory and inference construction will be presented. As a first step, learning requirements and characteristics of selected media (written, audiovisual, and auditory text) are introduced, and the question of whether there are media that are per se "difficult" or "easy" is answered.

### 3.1.1.1. Cognitive Processes in Different Media

*How* do media influence the learning process, and does one exceed the others in transporting information? According to Salomon (1990), learning with a medium describes the effects it has on an individual when the individual and the medium distribute cognition between each other. This means that mental tasks usually performed by an individual themselves are outsourced to the medium. For example, memorizing an item is not necessary when it is written down. It similarly influences the representations and cognitions taking place in that individual; especially interesting are those that endure after the current contact (Salomon, 1990). In this way, an interaction between the medium and the individual occurs. This is not just of relevance for study III (chapter II.3.3.), where learning is investigated directly, but also for study II (chapter II.3.2.), where the association between media literacy and reading, along with mathematical skills, is examined. A more efficient use of media can ease the adoption of academic skills. This should also be reflected in school grades, as study II investigates.

In the following section, the process of understanding texts with different media and their influence on representations will be outlined. First, to discuss the process of text understanding, a definition of the term *text* is necessary. The Oxford Dictionary defines a text as a) a book or other written or printed work, regarded in terms of its content rather than its physical form, or b) the main body of a book or other piece of writing, as distinct from other materials, such as notes, appendices, and illustrations. This definition, like many other definitions, is limited to written texts. In my thesis, in accordance with Seger et al. (2019), when I write about a text, a comprehensive definition is used, including written, auditory, audio-visual, and hypertexts.

Auditory texts consist of aurally presented verbal information, while audiovisual texts combine verbal information with static or dynamic pictures (a film). Written texts consist of orthographic symbols on a paper or a screen. These kinds of texts employ different symbols (pictorial vs. verbal) and aim at different perceptual systems (auditory vs. visual). Thus, a distinction regarding the kind of processing and, eventually, a different process of text understanding and learning outcomes is expected. In the last section of this chapter, the process of how inferences can be drawn from different media will be depicted; finally, a comparison between the learning effectiveness of different media will be drawn. The cognitive processes underlying text understanding from these media are presented in the following section.

### 3.1.1.1.1. Process of Text Understanding in Written Texts

*Written texts* consist of orthographical symbols on a paper or screen. These kinds of texts employ verbal symbols and aim at visual perceptual systems. The most common and traditional learning medium in educational institutions is the book. It consists of two kinds of symbol systems: written texts and pictures. In this section, the effects of purely written texts will be expounded. The interaction between both sign systems and further implications will be presented in the section concerning *learning from multimedia learning* (see below).

First, how does reading take place? The dual-route model of reading aloud (Coltheart, 1978; Coltheart et al., 2001) states that there is a lexical and non-lexical procedure. The first process relies on the mental lexicon of familiar words to transfer letters into spoken words. The metal lexicon contains information about the spelling of words (*orthographic lexicon*), their pronunciation (*phonological lexicon*), and their meaning (*semantic system*). Studies with people with brain injuries have suggested that these three components are stored independently (e.g., Blazely et al., 2005). Unknown words are processed through the nonlexical route. Regular words, where the grapheme-phoneme correspondence is straightforward, can be correctly read, where irregular words are pronounced incorrectly (Coltheart, 2006). The reading process is influenced by prior knowledge and reading proficiency. Ainley et al. (2002) found that prior knowledge eases the integration of further information on a certain topic. Moreover, prior knowledge is a strong predictor for learning new words from a written text (Webb & Chang, 2015). Less skilled readers need a longer time to decode words and make more mistakes (e.g., Stanovich, 2000). They also invest more cognitive resources in decoding symbols; these resources lack in the comprehension process, consequently resulting in worse outcomes (LaBerge & Samuels, 1974). Reading proficiency is highlighted in this context, as its

association with media literacy and academic attainment is examined in study II (chapter II.3.2.).

Learning from written texts takes place at different text levels. Text comprehension theories assume that the cognitive processing of a text results in the following three mental representations: the *text surface*, the *text base* and the *situation model* (Kintsch, 1998; Van Dijk & Kintsch, 1983; Zwaan & Radvansky, 1998; Zwaan & Singer, 2003). The mental representation of the text surface describes the exact wording of a text, while the text base contains the semantic content. Both levels are text-based because they do not go beyond what is explicitly stated in the text. The situation model refers to a mental representation of a situation described in a text. In the situation model, prior knowledge is integrated into textual information. Inferences are drawn to construct a coherent representation of the situation. Unlike the first two levels, the situation model goes beyond what is explicitly stated in the text. Zwaan and Radvansky (1998) stated that when a recipient has constructed a comprehensive situation model of the state of affairs described in a text, they have understood the text. In study III (chapter II.3.3.), text-based and inference questions are tested to assess the different representations of the text and to evaluate how different types of media influence these representations.

In summary, a written text has the advantage that its stability allows a learner to go back in the text and reduce the information pace, enabling them to comprehend difficult topics. Reading occurs through two routes: lexical and non-lexical. Prior knowledge and reading proficiency also influence the reading process. Understanding a text is a complex process; the text surface has to be represented, and the text base and the situation model have to be constructed.

### 3.1.1.1.2. Processes of Text Understanding in Audiovisual Texts

Similar to books, televisions (an audiovisual text) employ symbols, diagrams, and pictures. They are, however, transient instead of stable and offer the possibility to depict motion. Additionally, verbal information is not limited to written symbols but can be auditory. In most cases, verbal and pictorial information is presented simultaneously, which can cause the viewer to process information differently than in written texts and can thus create different representations (Kozma, 1991).

For a long time, watching TV was thought to be a passive, stimulus-driven action. The effectiveness of learning from educational television media is now generally recognized. For instance, adults have positive knowledge gain when they regularly follow science learning

programs on television (Miller et al., 2006). Vanderplank (2009) showed that adults can efficiently learn languages from DVDs and films. Moreover, learning new words can occur incidentally when watching audiovisual programs (Rodgers & Webb, 2020). Mayer and Fiore (2014) assumed that deeper learning should take place when words and pictures are combined compared to having just words. However, there is evidence that frequent TV viewing in adolescence is a risk factor for later attention problems and learning impairments (Johnson et al., 2007).

How does learning through television take place? The most important factors that influence visual attention when watching TV are *formal features* (Huston & Wright, 1983). They comprise auditory and vocal stimuli, animations, and editing techniques. In the early years of research, it was often assumed that young children's attention was caught and guided by certain features, such as auditory changes or visual movement (Anderson et al., 1979). Even back then, this purposed behavior did not necessarily imply a bottom-up and data-driven process, as evidence suggested that children have learned the association between the typical use of certain features and the likelihood that the content presented is comprehensible or meaningful. Investigations showed that visual attention to "normal" segments of Sesame Street was significantly higher than that to experimentally manipulated segments with reduced meaning, such as backward speech (Anderson et al., 1981). Rodgers (2016) investigated learning from audiovisual texts. He stated that if a learner becomes familiar with a program, they can build a specific schema of that program. As such, new information can be integrated more easily (Vandergrift, 2007). Additionally, Rodgers stated that there is evidence that prior knowledge is a further important factor that determines learning gain positively (e.g., Peters & Webb, 2018). Moreover, audiovisual texts provide context information, such as the body language of the actors or the location on which a scene takes place, making it easier for a learner to infer, for example, unknown words (Field, 2000; Ridgway, 2000). The genre of TV is also of importance; documentaries, for instance, lead to a higher learning outcome than pure entertainment genres (Rodgers, 2018).

Overall, the findings above suggest that watching television is a potent addition to the learning process. Watching television is an active process, and children are already aware when important information is presented. Viewers build schemas that help them extract information more effectively; moreover, they rely on prior knowledge and context information.

### *3.1.1.1.3. Processes of Text Understanding in Auditory Texts*

Similar to audiovisual texts, auditory texts use lingual information. They are similarly transient instead of stable; thus, the learner is bound to the pace of the presentation and does not have the possibility to go back in the text. Listening comprehension is defined as "the ability to extract information from auditorially presented language material" (Krashen, 1995). Compared to other skills, such as reading, writing, and speaking, listening is the most frequently used language skill in the classroom and in daily life (Nunan, 1997). Moreover, listening comprehension skills are crucial for academic attainment (Vandergrift, 2004).

It is still debatable whether listening comprehension follows a bottom-up or top-down process (e.g., Morley, 2001). A bottom-up process suggests that a listener pays close attention to every detail of an auditory presentation. Understanding is generated by putting every little detail – sounds to words, words to grammar, grammar to lexical meaning – together. Language forms the basis for extracted meaning. The top-down process assumes that a listener constructs information by integrating it into prior information. Prior information implies expectations about the world and language and prior knowledge about a certain subject. A person forms predictions about the incoming message and how it can be integrated in their knowledge of the world. To build a mental representation, both top-down and bottom-up processes have to occur (e.g., Lynch, 2006; Park, 2004). For the construction of inferences, a learner has to use non-linguistic, such as the context, or linguistic sources of information (Buck, 2001). Prior knowledge (e.g., Chiang & Dunkel, 1992) and the use of metacognitive strategies (Selamat & Sidhu, 2013), both essential parts of top-down processes, are strong predictors of learning success. Audio podcasts are supposed to hold high potential, especially for teaching at the university level (Cebeci & Tekdal, 2006), and are rated positively as a revision tool by students (Evans, 2008).

In summary, top-down and bottom-up processes work together in auditory text comprehension. Prior information and the use of metacognitive strategies influence how effectively a learner uses an auditory text.

### *3.1.1.1.4. Processes of Text Understanding in Multimedia*

Learning from multimedia is not investigated in this thesis, but its mechanisms are presented in this section, as they serve as explanations for the effects of study III. Additionally, text understanding from multimedia is a part of media literacy, and Mayer's model (2005; see below) delivers a good rationale to explain how media literacy can ease the learning process

(see chapters II.3.3.4., III.1.1.4., and III.1.2.4.). When learning from multimedia is discussed, several interactions between the presentation formats must be taken into account. What is meant by the term "multimedia"? It refers to presentations in which the medial demonstration does not rely on one channel of information but integrates at least two formats, such as a textbook, which includes written texts and pictures (Mayer, 2002). In a meta-analysis, Takacs et al. (2015) showed that multimedia features can replace teaching adults in developing the story comprehension of children. Children who are more media-literate are likely to profit even more from these modern texts in terms of vocabulary and text comprehension. This will be discussed further in the section concerning media literacy and learning (chapter I.3.1.3.).

Mayer (2005) developed a *cognitive theory of multimedia learning* (Fig. 4) based on the *Cognitive Load Theory* (Sweller, 1988). Cognitive load relates to the total amount of mental effort that is used in working memory. In Cognitive Load Theory, three types of cognitive load are proposed. The first is intrinsic cognitive load, which refers to the mental effort involved in a certain task. Each piece of information has a special intrinsic demand for the learner, caused by its quality. An easy text requires little effort, while complex information is regarded as challenging. Extraneous cognitive load arises from the modality of information presentation. It is produced by the instructor or the kind of presentation and is extraneous to the learning task. Effective teaching methods decrease, while ineffective teaching methods increase extraneous load. Finally, germane cognitive load involves the effort needed to create a permanent set of knowledge, called schema. Schemas help people acquire new information or skills, as they act as conceptualizations about what to anticipate in a certain situation or from a certain object. As the capacity of the working memory is limited, people can process more material when the cognitive load of subtasks is reduced. Mayer's (2005) cognitive theory of multimedia learning holds three premises. First, it proposes that pictorial and verbal material is processed in separate systems (dual-channel assumption; for example, Paivio, 1991). Another premise is the limited capacity assumption. This suggests that each channel can only process a limited number of a certain amount of material at one time (Baddeley & Hitch, 1974). Additionally, cognitive processing, which involves the construction of a connection between pictorial and verbal representations, has to occur (active processing assumption). Mayer (2005) assumed that if the presentation of information aims at different channels, more material can be learned. For instance, he proposed that it is more effective to combine images with auditory comments than with written descriptions. As such, extraneous cognitive load is reduced, as learners do not have to apply mental effort for scanning between the image and the printed captions.
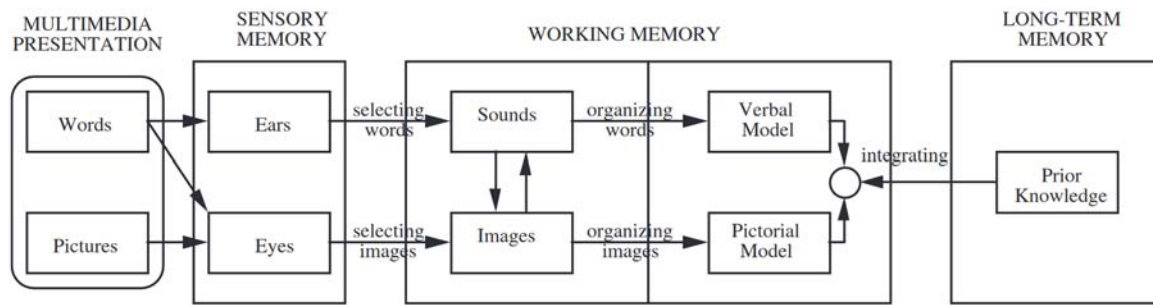
*Figure 3. Cognitive theory of multimedia learning* by Mayer (2002) ©Mayer & Johnson, 2008.

Meaningful learning can occur only when a number of subsequent processes take place. Initially, the learner has to pay attention to the relevant material (words or pictures) so that it can be registered in the sensory memory. This procedure is indicated by the arrows titled "selecting words" and "selecting images" in Fig. 3. In the working memory, verbal and pictorial representations have to be interconnected and integrated with prior knowledge retrieved from the long-term memory. The newly gained information is eventually stored in the long-term memory, which has unlimited capacity.

As a critic of Mayer's model, I have to state a study conducted by Lange and Costley (2019), which showed that the more media were used for learning, the weaker the association between self-regulated effort and germane load became. This is evidence that too much information might lead to confusion. For this reason, several multimedia effects were identified to avoid impairing effects on learning. A brief explanation will be provided in the next section.

*Excurse: Multimedia Effects*

This excurse is included in my theses, as multimedia effects become relevant for an explanation of the empirical findings from chapter II. Many multimedia effects on students' learning outcomes are well-researched and will be summarized in the following section. They confirm the cognitive theory of multimedia learning and are interpreted according to its rationale. In his review (Mayer, 2002) and a meta-analysis (Mayer & Fiore, 2014), Mayer gave a short overview of several known multimedia principles. The first is called *multimedia principle*, which states that students learn better from multimedia (written text with pictures/audiovisual dynamic text) than from one kind of text (written text without pictures/auditory text without a film) alone (e.g., Mayer & Anderson, 1991; Moreno & Mayer, 1999; Ostrow & Heffernan, 2014). It is assumed that students in the multimedia condition are able to form a verbal as well as a pictorial mental model, between which they can additionally

build connections. If pictures lack, the likelihood that a pictorial mental model will be constructed is reduced, similarly the formation of connections. An effect size[2] of 1.39 over 11 studies was found for this principle (Mayer, 2002). The *spatial contiguity principle* indicates that learners show a better outcome when corresponding information in written texts and pictures is presented in close proximity rather than far from each other on a page or a screen (e.g., Holsanova et al., 2009; Johnson & Mayer, 2012). When the corresponding information is close, fewer cognitive resources have to be invested in the search and are thus available for processing the content. For this principle, an effect size of 1.10 from an analysis of 22 experiments was found (Mayer & Fiore, 2014). Very similar is the *temporal contiguity principle*, which indicates that learning is more efficient if corresponding information from two presentation formats (auditory text and audiovisual dynamic text) is presented simultaneously not successively (e.g., Mendelson & Shultz, 1976; Schüler et al., 2012). If separate presentations take place, it is more difficult for a student to hold mental representations of both verbal and visual content in the working memory, making it less likely for a mental connection between these two presentations to be formed. The meta-analysis of nine studies resulted in an effect size of 1.22 (Mayer & Fiore, 2014). The *coherence principle* states that deeper learning from a multimedia message takes place when extraneous material is excluded rather than included (e.g., Harp & Mayer, 1998; Mayer, Bove, Bryman, Mars, & Tapangco, 1996; Mayer, Heiser, & Lonn, 2001). The theoretical rationale behind this principle is that additional irrelevant material competes with relevant information for cognitive resources in the working memory. It can divert attention from the learning material, interfere with the organization of this material, or prime a person to organize the information around inadequate topics. An effect size of .86 for this principle resulted from an analysis of 23 experiments (Mayer & Fiore, 2014). The *modality principle* describes the circumstance in which students learn more efficiently from audiovisual dynamic text combined with auditory information than from audiovisual dynamic text with a descriptive on-screen text (e.g., Ginns, 2005; Harskamp et al., 2007). The reason might be that a simultaneous presentation of two visual materials, such as pictures and words in films or on-screen texts, overstrains the visual channel. From 12 studies, a median effect size of 1.13 could be extracted (Mayer, 2002). Another finding is called the *redundancy principle*, which suggests that redundant information inhibits rather than eases learning (e.g., Kalyuga & Sweller, 2014). According to the Cognitive Load Theory, more working load is generated and

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[2] Effect size describes the strength of a statistical effect. In reference to Cohen (1988), the effect size d can be classified as a small effect (d = 0.2 − 0.5), medium effect (d = 0.5 − 0.8), and strong effect (d > 0.8).

thus interferes with the learning process. In line with the cognitive theory of multimedia learning, when redundant information is presented in the same modality (e.g., pictures and written words in films or as an on-screen text both aim at the visual channel), an overload of the respective channel takes place. Mayer (2002) found that students show a better learning outcome when the material is presented visually-dynamic and auditory simultaneously and not only visually-dynamic, auditory, or as an on-screen written text. Later research underlined that the way redundant information is presented is important. There are certain conditions under which it can enhance learning. First, it follows the *spatial contiguity principle*, meaning that redundant information is presented in a close spatial proximity; second, if the additional informational written text that describes a picture is short rather than long; and finally, when text is added to static illustrations (e.g., a diagram including annotation) rather than dynamic pictures (e.g., a film with subtitles) (Mayer & Johnson, 2008). An effect size of .86 resulted from 16 experiments (Mayer & Fiore, 2014). The *pre-training principle* states that people learn better if a training on components (e.g., of the names and behaviors of main concepts) takes place before the message is presented rather than afterwards (e.g., Erhan et al., 2010; Mayer, 2010). It is assumed that by pre-training, students can construct mental models about the operating modes of each component, which results in a reduction in cognitive load when a mental model of the system has to be derived from the multimedia message. An illustrative example is that a biological system such as a cell is easier to understand when the names of the different components that form the cell are known before. The analysis of the three studies yielded a median effect size of 1.39 (Mayer, 2002). A further finding is called *signaling principle*, which indicates that students show a better learning outcome when the training purpose is signaled explicitly (e.g., Mautone & Mayer, 2001; Ozcelik et al., 2010). This might because by receiving signaling, students are better able to allocate their attention to the learning material, which reduces cognitive load and thus facilitates learning. From the two experiments, an effect size of .60 could be deduced (Mayer, 2002).

Taken together, learning from multimedia is a multilayered process, as interactions of different kinds of media and the aforementioned effects have to be taken into account. The combination of different media holds a high potential for enhancing the learning process when the material is prepared in an adequate way that considers research findings and Mayer's (2002) cognitive theory of multimedia learning. In that way, cognitive load can be reduced and resources for the learning process are liberated (see also Mayer & Moreno, 2003).

### 3.1.1.2. Drawing Inferences from Different Media

The construction of inferences from three types of texts is examined in the empirical part of this thesis (see study III, chapter II.3.3.), and a summary of the relevant findings is presented here. So far, a final conclusion regarding whether the medium influences the construction of inferences cannot yet be drawn. The results are inconclusive; however, several studies allow first interpretations. Hildyard and Olson (1978), for instance, found better inference results for auditory compared to written texts in a sample of 10- to 12-year-olds. Other investigations showed no differences for adult participants (Kürschner et al., 2006). The advantage children gain from auditory texts could reside in the fact that they have gained much experience with this kind of text (e.g., Ritterfeld et al., 2006).

When written and audiovisual texts are compared, 10- to 12-year-olds build more inferences after the presentation of an audiovisual text. This is also true two to three weeks afterward (Beentjes & van der Voort, 1993). A possible explanation could be the facilitated construction of a situation model due to the film. Other studies, on the other hand, found no difference in the number of inferences for the two kinds of texts in a sample of 8-year-olds (Neumann, 1989). In addition to the age difference of the samples, a reason for these different findings could be the difference in the stimulus material. This might exhibit disparate grades of redundancy concerning visual and auditory information, making the studies difficult to compare. A closer description of the used stimuli is missing; thus, no final conclusion can be drawn. Wannagat et al. (2018) compared the construction of the situation model in auditory and audiovisual texts in children. They found that the memory for inferences was better for audiovisual presentations.

There are several known moderating variables. Reading literacy is one known influencing factor when drawing inferences from written texts is investigated. In general, participants with a higher reading proficiency learn more from written texts (e.g., Chiang & Dunkel, 1992). In contrast, Holmes (1987) found that children with low reading skills are equally well able to draw inferences from a written text as those with high reading skills if the text contains illustrations. There is no evidence of whether reading skills influence the construction of inferences from audiovisual texts. In study II, reading skills are set in the context of learning success, while in study III, the construction of inferences from texts is focused on (see chapters II.3.2. and II.3.3.). Diergarten and Nieding (2015) compared the construction of emotional inferences in eight- and ten-year-olds and adults. The participants either received a written short story or an auditory presentation of the same story. They found that age, type of text

presentation, goal emphasis, and updating capacity influence whether emotional inferences from texts are built and how precise these inferences are. In particular, a developmental trend existed regarding the accuracy of emotional inferences. The adults were slightly better after auditory presentation (Diergarten & Nieding, 2015).

Different media seem to influence the source of information that is used as a source for answering the inference questions differently. According to Meringoff (1980), the construction of inferences from both auditory and audiovisual texts is equally good. However, depending on the kind of medium with which they were confronted, the children named different sources as a basis for their information. Children who watched the film focused primarily on visual information and actions of the protagonists, whereas those of the auditory group paid attention to the verbal content and used a more figurative and expressive language and more previous knowledge to answer the questions. Similarly, Beagles-Roos and Gat (1983) found that more details were recalled by seven- to eleven-year-olds after the film condition, while children in the auditory condition used a more expressive language. Taken together, the audiovisual text focuses the attention of the viewers on movement and actions, stressing the dynamic character of films. Children who listened to the auditory text, however, relied more on existing previous knowledge to generate inferences.

These results suggest that depending on the kind of medium, different sources of information are used for answering inference questions. Thus, the best learning results should be obtained by using all sources of information, which means creating an appropriate mixture of medial stimuli.

### 3.1.1.3. Comparison of the Learning Outcomes from Different Media

A comparison of three different kinds of media (written, audiovisual, and auditory text) is conducted in study III (chapter II.3.3.), and the existing results concerning the discrepancies in the learning results from these media are presented in this section. As demonstrated in the section above, different media imply heterogeneous ways of cognitive processing and have a specific impact on the learning outcome. When different kinds of learning material are compared in regard to their learning outcome, several factors, such as the age of the learner and the content of the text, play a role. There is evidence that general comprehension skills exist in adults, which extend beyond nonverbal materials, such as picture stories (Gernsbacher, 1990). For instance, findings suggest that the skill in comprehending written and auditory stories correlates highly with skill in comprehending nonverbal picture stories (Gernsbacher et al.,

1990). However, the diverse kinds of texts imply different symbols (pictorial vs. verbal) and aim at different perceptual systems (auditory vs. visual). Thus, a distinction between the kind of processing and, eventually, a different learning outcome is expected. Much research has been concerned with the question of whether there is one medium that is per se "easier" or "tougher." Often, television is perceived as easy, while print is considered difficult. Results concerning differences between media will be presented in the following section. First, written and audiovisual texts will be compared, followed by auditory and audiovisual texts, and finally, written and auditory texts.

### 3.1.1.2.1. Written and Audiovisual Texts

Through his amount of invested mental effort (AIME) model, Salomon (1984) tried to answer the question of whether one of the two formats, a traditional written text or a film, can be more easily processed. AIME is defined as the amount of non-automatic cognitive elaboration taking place while processing material. Salomon (1984) proclaimed that more effort should result in better learning outcomes. In his own studies, Salomon used self-reports to assess AIME and confirmed his hypothesis that less effort is invested in learning and less inferences are built from films than in the written text condition (Salomon, 1984). His participants were 12-year-old students who were either presented with a film clip without an auditory track (a short story) or a written text with similar content. Both groups had to answer questions aimed at the text base and inferential questions. Those who received the written text reported more AIME. No group difference was found concerning the correct answering of questions regarding explicit information (emotions), but the print group performed better with inferential questions. The discrepancy between the two kinds of knowledge areas (explicit information vs. inferences) confirmed Salomon's expectations, as he proclaimed that AIME should only influence the construction of inferences, not recalling explicitly stated emotions. He was the first to show that different modes of presentation can influence recognition and inferences differently, and that the two do not directly depend on each other. Salomon's method has been criticized at several points over the years. Besides the use of a film without an auditory track, the reliance on self-reports was regarded as the main restriction of his studies. Beentjes and van der Voort (1993) added an objective measure to AIME. They presented a film version of a story and another story as a written text to fourth-and sixth-grade students. In addition to Salomon's self-report measure, they assessed AIME with a secondary task. While following the stories, the students had to react as quickly as possible to an auditory signal by pressing a button. A slower reaction should indicate more AIME as pupils should be more concentrated

on the learning material. Story retention and story-related inferences were both tested directly after each story, as well as two to three weeks later. When assessed with Salomon's method, children apparently invested more effort in reading than in viewing. The reaction-time measure, however, found that the reaction time was slower for those participants who were watching television, indicating that more AIME was needed for processing information from television than from a written text. Additionally, more inferential learning was found in the television condition than in the written text condition. At the first point of measurement, no differences in recall occurred, while the delayed test revealed better retention for the film condition. The results of this study suggest that while audiovisual texts are subjectively perceived as easier by children, they are processed more deeply. Similar studies with adults have indicated that these findings are not restricted to this age group (Baggett, 1979; Baggett & Ehrenfeucht, 1983). Like children, adults only show better recall for cued recall in the delayed retention condition. This indicates that cognitive reorganization processes occur, integrating the new information into prior knowledge and thereby building new, advanced knowledge structures, which could differ between media. Beentjes and van der Voort (1993) suggested that while the same amount of information is extracted and encoded from written and audiovisual texts, the memory track of visual information disintegrates slower than other tracks.

The abovementioned studies focused on stories, whereas more recent studies have used news broadcasts, as they are believed to be better comparable due to their structured format. Walma van der Molen and van der Voort (1998), for instance, found that children perform better in cued recall tests following news from television rather than from print, even when their reading proficiency is considered. Research with children up to 12 years of age generally suggests supremacy of audiovisual texts (Beentjes & van der Voort, 1991, 1993; Furnham et al., 2002; Gunter et al., 2000; Walma van der Molen & van der Voort, 1998, 2000). A reason for this superiority of films for children could be that in audiovisual texts, the situation model is supported by the medium; thus, more cognitive capacity can be invested in understanding the text content. When adult learning is investigated, most findings suggest an advantage of a written presentation compared to an audiovisual for content recall (Byrne & Curtis, 2000; Corston & Colman, 1997; DeFleur et al., 1992; Furnham & Gunter, 1985, 1987; Furnham & Williams, 1987; Furnham et al., 1989; Walma van der Molen & van der Voort, 2000; Wicks & Drew, 1991). In some studies, no difference was found concerning the recall of facets (Christie & Collyer, 2008), the recall of verbal and visual information (Furnham et al., 2002), and local bridging inferences (Tibus et al., 2013). The superior recall of written texts is often explained

by the fact that more control over information processing can be exercised in the reading process than in the viewing process of audiovisual texts (Kozma, 1991). Similarly, readers are given the possibility to process information at their own pace, reread passages, and look up details, and thus, the storage of information is facilitated (Furnham & Gunter, 1985). Merkt et al. (2011) conducted a study with film clips that included interactive features, such as stopping the video or browsing. These activities correspond to the control mechanism readers have over printed texts. The learning results of the participants with printed and interactive audiovisual texts were comparable (Merkt et al., 2011). There is evidence that, under some conditions, adults profit more from an audiovisual presentation. This seems to be the case when the additional visual information is semantically identical to the auditory information (Walma van der Molen & van der Voort, 2000). Like Mayer (2005) expected in his cognitive theory of multimedia learning (see chapter I.3.2.1.1.4.), a higher redundancy in two perception channels enables more efficient processing and better encoding of information. Similarly, visual and auditory information can be integrated more easily. As information is not presented within the same modality, the redundancy principle does not occur, but a temporal contiguity is given. If information from the two modalities differs excessively, as is often the case with adult news, information from the two channels of the working memory is harder to combine, leading to a cognitive overload and thus degrading performance (Mousavi et al., 1995). In concordance with this assumption, a prior audiovisual presentation of the solution of a geometrical task leads to a latter better performance in adults than a prior verbal or visual presentation (Mousavi et al., 1995).

In summary, children up to adolescence profit from audiovisual presentations, while adults profit more from written texts. Exceptions are audiovisual presentations that imply a high redundancy of visual and auditory information without causing competition of resources in the working memory and presentation modes that allow an active manipulation of the material presented (e.g., a film clip that can be reversed).

### 3.1.1.2.2. Auditory and Audiovisual Texts

In contrast to written texts, auditory and audiovisual texts can be investigated from an early age, as they do not require the ability to read or write. Auditory texts are very popular among preschoolers. In a study by Grüninger (2013), 34.8 % of 3- to 6-year-olds reported consuming them daily. Because of their early familiarity with the material, it is often surmised that young children learn better from auditory texts. Some studies have confirmed this assumption, such as Gibbons et al. (1986), who found auditory media to be advantageous over audiovisual media in both recall and inference drawing for 4-year-olds but not for 7-year-olds. In general,

however, for children from three to twelve years of age, an audiovisual presentation seems to be more beneficial than an auditory presentation. This is also true considering text base memory (Beagles-Roos & Gat, 1983; Gibbons et al., 1986; Guttmann et al., 1977; Gunter et al., 2000; Greenhoot & Semb, 2008; Hayes et al., 1986; Pezdek et al., 1984; Ricci & Beal, 2002; Walma van der Molen & van der Voort, 2000) and situation models, such as inferences (Diergarten & Nieding, 2015; Gibbons et al., 1986; Wannagat et al., 2016). Some studies have to be examined in depth to draw appropriate conclusions. Beagles-Roos and Gat (1983) compared the learning outcomes of an audiovisual text against an auditory text in children in elementary school. They found that the group that learned from audiovisual texts performed better than those who had an auditory text in terms of detail recognition, sorting pictures, and drawing inferences from actions. The group that learned from auditory texts performed better at recognizing expressive language and drawing inferences. The study was conducted with-in design with a one-week delay, so both groups were confronted with both types of text; the order was randomized. An order effect occurred with an advantage for those participants who were exposed to the auditory text first. Wannagat et al. (2016) showed that while children exhibited a better recall of the text surface and situation model at audiovisual presentation, the memory for the text base was better for auditory presentation. Despite some exceptions, the general superiority of audiovisual texts to auditory texts can be assumed in childhood, at least concerning the construction of situation models. In general, as Mayer (2005) underlined in his model (see chapter I.3.2.1.1.4.), the inclusion of information for the visual channel seems to enhance understanding in children as mental representations are enriched and more encoding options are given. According to Hayes et al. (1986), visual information is better for underlining events and actions, leading to a better understanding and fewer misconceptions in children. This was confirmed by Meringoff (1980), who compared the understanding of a text read from a picture book to a film clip about the same content in 7.6- to 9.6-year-olds. While recall was equally good, differences occurred in how and what aspects of the content were remembered. The participants in the film condition remembered more story actions, estimated the time and distance it took to carry out an action as shorter, and relied more on visual material for the construction of inferences. The picture book group recalled more vocabulary and used more textual content to draw inferences. Regarding adults, Hayes et al. (1986) and Wannagat et al. (2017) found no advantage for an audiovisual text or an auditory text. In general, adults do not seem to need additional information that the visual material supplies. They can extract all necessary information from the auditory text and draw inferences for the construction of a situation model without the need

for further input. In many cases, the supplementary information even interferes with encoding (e.g., Mayer, 2005). Nevertheless, animated pictures can help adults when coherence breaks occur in the auditory presentation (Tibus et al., 2013). In that case, the auditory information might not be sufficient, and further sources of material are necessary. They do not interfere with processing but enhance comprehension.

Taken together, children up to adolescence profit from audiovisual presentations, while adults receive same results for both audiovisual and auditory texts. For the latter group, however, research is still rare.

### 3.1.1.2.3. Written and Auditory Texts

When comparing written and auditory texts, the first holds the same advantages over the latter than over audiovisual texts: An own reception pace can be chosen, details can be looked up, and unclear information can be reread. Auditory texts, in contrast, hold the advantage that prosodic features, the use of breaks or variations in the volume level, can serve as cues (Samuels, 1987). Although both media transport verbal information, they aim at different modalities. An auditory text is transmitted through sound waves, while the symbols of the written text are perceived by visual systems. Whether these two media cause differences in cognitive processing and understanding remains controversial. Supporters of the unitary approach argue that the same cognitive processes underlie reading and listening comprehension (Bäuerlein, 2014; Kürschner et al., 2006). In both cases, the same mental lexicon is drawn, leading to comparable mental representations and similar learning results. The same general ability is required to comprehend language (verbal intelligence) (Gough et al., 1996; Gough & Tunmer, 1986). In contrast, researchers such as Marx and Jungmann (2000) hold a dualistic view. They suggest that modality-specific differences cause differences in cognitive processing, leading to different kinds of representations. Differences occur at a higher and a lower level of cognitive processing. Additionally, different processing strategies and modality-specific memory processes take place (Kürschner et al., 2006). Evidence for the unitary approach would be obtained if the two media lead to the same learning results. So far, however, neither approach has been empirically confirmed. Reading generally leads to more detailed knowledge, while listening leads to a better recall of action sequences. Thus, an integrative model was proposed by Kürschner et al. (2006). They suggested that at a lower level of information processing (perception and processing in working memory) and during processing modality-specific text features (prosody and graphic presentation), constructions of differently elaborated mental representations occur. At a higher level of information processing, similar modes of processing

are expected. Consequently, auditory and written texts can lead to different learning results due to differences in mental representations. Although it remains unclear exactly how the memory processes on lower and higher levels during processing work, they might differ according to the recipient and the material. Data indicate that with the age of the learner, a change takes place. Sticht and James (1984) indicated that, up to adolescence (about seventh grade), children learn better from auditory media, which is followed by a period where neither is superior, and eventually, written texts exceed auditory texts. The advantage of auditory presentation compared to written text for children has been confirmed in several studies (Diakidoy et al., 2005; Hildyard & Olson, 1978; Wannagat et al., 2017). Others, however, have found no difference in terms of text detail recall for children between the two media (Gunter et al., 2000; Walma van der Molen & van der Voort, 2000), and one study even found an advantage for the written text (Pezdek et al., 1984). Regarding adults, some findings have suggested that a written presentation exceeds an auditory one in terms of detail recognition (DeFleur et al., 1992; Furnham & Williams, 1987; Furnham et al., 1989), while others have concluded that neither is superior for recall (Corston & Colman, 1997; Kürschner et al., 2006; Wannagat et al., 2017; Wicks & Drew, 1991). Kürschner et al. (2005) discovered that individual differences in preferences for learning modalities exist in adults. When these preferences are considered, reading leads to more detailed knowledge, while no advantage for visual-spatial information occurs for auditory presentation (Kürschner et al., 2006).

Summarizing the results for children, contradictory findings exist. A greater number of studies hint at auditory presentation being predominant compared to a written text in childhood. During adolescence, a change occurs. For adults, the results are similarly contradictory; the individual preference could be of importance.

### 3.1.2. Summary of Cognitive Processes in Different Kinds of Media

The previous section was concerned with the cognitive processes that take place in the learning process in written, audiovisual, and auditory texts, as well as from multimedia. The way inferences are drawn from these kinds of texts was also presented. This information is included in this thesis, as the empirical study builds on them. Study II (see chapter II.3.2) is concerned with media literacy's association with school grades and the academic abilities of reading and mathematics. How a student learns influences their grades. Reading abilities are directly linked to learning from texts (see below). Study III (see chapter II.3.3) explains the effects of media literacy on the learning outcome from study II. In addition to investigating the effect media literacy has on learning from texts, the learning outcomes obtained from the

different kinds of texts are compared. The influence of prior knowledge, as well as differences in knowledge acquisition and drawing inferences from texts, is considered.

The last section shows that the type of medium changes the way information is processed. A written text is stable, enabling the reader to go back into the text and re-read difficult sections. Three different mental representations—the *text surface*, which is the exact wording of the text; the *text base*, meaning the content of a text; and the *situation model,* a representation of the context of a text—have to be created to thoroughly comprehend a text (e.g., Zwaan & Singer, 2003). A reader has only fully understood a text when they have built an enfolding situation model (Zwaan & Radvansky, 1998). Prior knowledge (Ainley et al., 2002) and reading proficiency (Stanovich, 2000) have positive effects on the learning process from written texts.

Audiovisual texts combine auditory, lingual, and visual information. They are transient and can depict motion. Contrary to earlier assumptions, learning new information from films is an active process (Anderson et al., 1981). Prior knowledge has a positive effect on learning from audiovisual texts (Peters & Webb, 2018). Familiarity with a program allows a viewer to build a certain schema, making the processing of new input easier (Vandergrift, 2007). Audiovisual texts provide considerable contextual information, such that a viewer can infer much (Field, 2000; Ridgway, 2000).

Auditory texts provide transient auditory lingual information. To learn effectively from an auditory text, a combination of bottom-up and top-down processes seems to be important to reach understanding (Lynch, 2006). When sufficient information has been processed bottom-up or top-down, understanding occurs (Buck, 2001). Part of the top-down information is prior information. It consists of expectations about the world and language, as well as prior knowledge, which moderates the way new information is integrated into existing knowledge (Buck, 2001; Lynch, 2006). Moreover, metacognitive strategies, which belong to top-down processes, enhance learning from auditory texts (Selamat & Sidhu, 2013). Finally, it is also important how proficient someone is in the language of a text (Berne, 2004).

Learning from multimedia is a complex process as the interaction of the aforementioned processes comes into play. Several multimedia effects have been well-investigated (chapter I.3.1.1.1.4.). Combining different media can enhance the learning process when the material is prepared in an adequate way that considers research findings and Mayer's (2002) cognitive theory of multimedia learning. As such, cognitive load can be reduced and resources for the learning process are liberated (see also Mayer & Moreno, 2003).

Inferences are drawn from every kind of medium. The source of information used to answer inference questions, however, differs between the types of media (e.g., Beagles-Roos & Gat, 1983; Meringoff, 1980). Learning results will be the best if an appropriate mixture of different types of media is used.

When comparing the learning outcomes from different media, several variables, such as the age of a participant and the content of a message, have to be considered when statements about learning effectiveness are made. In general, children profit more from audiovisual texts compared to written text (e.g., Walma van der Molen & van der Voort, 2000) and auditory texts (e.g., Diergarten & Nieding, 2015). However, regarding auditory presentations and written texts, the findings are inconclusive. Some have claimed a superiority of auditory texts (Diakidoy et al., 2005), while others have found no differences in text recall (Gunter et al., 2000). In adolescence, cognitive changes occur. For adults, written texts present the most effective medium (compared to audiovisual texts; see e.g. Byrne & Curtis, 2000), while audiovisual and auditory texts yield same results (Hayes et al., 1986). In many studies, written texts have exceeded auditory texts (e.g., DeFleur et al., 1992), while other studies have found no difference (e.g., Wannagat et al., 2017). Furthermore, exceptions, such as audiovisual presentations that include interactive features (Merkt et al., 2011) or that hold a high redundancy of auditory and visual information, exist (Walma van der Molen & van der Voort, 2000). In both cases, written and audiovisual texts result in the same learning outcome.

In the next section, the influence of media literacy on the learning process will be discussed.

### 3.1.3. Media Literacy and Learning

In this section, the literature on the influence of a person's media literacy on knowledge acquisition is introduced. This piece of information provides theoretical background for study II (chapter II.3.2.), in which the association between media literacy and academic attainment and abilities is investigated. Academic attainment refers to the grades students achieve at school, while academic abilities encompass reading and mathematical skills. Evidence of a direct positive connection between media literacy and educational success comes from research with preschoolers by Nieding et al. (2017). A longitudinal study of children, which began at age 4, found that an initial high level of media literacy had a positive effect on the precursors for mathematical, reading, and writing skills in preschool (Nieding et al., 2017). Media literacy is also an important factor to explain inter-individual differences in 4- to 6-year-olds in terms of comprehension and learning from different kinds of media (Diergarten et al., 2017). This

effect could prevail in older cohorts as well. In a longitudinal study, Paino and Renzulli (2013) found that students who were rated higher in computer proficiency by their teachers showed better academic abilities in mathematics and reading at later measurement points. However, student proficiency with personal computers (PCs) was not assessed directly, and school grades and achievement were not assessed separately. Considering these findings, it is surmised that the employment of digital media can improve lessons and that the mediation of computer and information literacy makes an important contribution to school and curriculum development (see also Eickelmann & Schulz-Zander, 2010; Schulz-Zander, 2005). Diergarten et al. (2017) found that media literacy is an important factor in explaining inter-individual differences in children between 4 and 6 years of age in terms of comprehension and learning from different kinds of media. Reading ability forms the foundation for successfully handling modern media. When searching for information in hypertext, for instance, being able to navigate successfully through the pages is of no use if the content of the text is not understood. A quicker and easier processing of the sign systems used in media eases the acquisition of new information to the great advantage of the learner. Additionally, media literacy positively influences the ability to build emotional inferences (Diergarten & Nieding, 2015). There is evidence that media literacy becomes even more important for reading non-classical media as the reading comprehension process is different in classical text reading (Coiro & Dobler, 2007; Schilling, 2012). Similar applications, such as drawing inferences, and even more complex applications, such as navigating through the hypertext when reading texts online, are required, suggesting that a more elaborate process of self-directed text construction must take place (Coiro & Dobler, 2007; Schilling, 2012). Further evidence for a positive association between media literacy and academic performance comes from training studies. Hobbs and Frost (2003) introduced a one-year media literacy curriculum for eleventh graders. Compared to the control group, their writing quantity and quality, their ability to identify the purpose, target audience, and construction techniques in media messages, as well as their identification of omitted information, showed significant improvement. As Paino and Renzulli (2013) showed in terms of PC literacy (a component of media literacy), media literacy can also promote mathematical skills. The previous findings obtained for preschoolers also confirm this assumption (Nieding et al., 2017). Moreover, new media can be applied successfully as instruction aids or in the place of instructors in mathematical classes for children of different age groups (Longnecker, 2014). For instance, when acquiring early mathematical skills, primary school children can profit more from tablet intervention than from regular teacher instruction (Pitchford, 2015). If

findings on young children prevail (e.g., Diergarten et al., 2017), students with a higher level of media literacy should profit more from these interventions.

Taken together, the findings suggest that media literacy can foster academic skills, such as reading and mathematics, in both children and adults. The connection of both skills with media literacy is investigated in study II (chapter II.3.2.). It seems likely that media literacy becomes even more relevant in modern media, such as hypertexts, as self-directed learning is required.

This section outlines the impact of media and media literacy on school attainment and learning. In the next section, a summary of the impact of media use and media literacy on cognitive and political variables will be presented. This will be followed by a complete summary of the theoretical part before the empirical part is introduced.

## 3.2. Effects of Media Use and Media Literacy on Political Factors

The first study of this thesis (chapter II.3.1.) is concerned with media literacy's impact on the political self-concept and interest in the politics of adolescents and young adults. In this section, the literature related to the association between media use or media literacy and political variables is presented. First, I focus on the influence media use and media literacy have on political participation. Political participation is introduced here, as I believe that interest and a positive self-concept are precursors of participation (see below). Another aspect that is highlighted is the connection among media use, media literacy, and political efficacy, as it is closely related to the political self-concept, whose relation with media literacy is investigated in study I.

### 3.2.1. Media Use, Media Literacy, and Political Participation

Before the association among media use, media literacy, and political participation is summarized, a definition of political participation and a look at contemporary (digital) political participation is necessary. An overview is given in the following section.

#### 3.2.1.1. Digital Political Participation

According to Brady (1999), political participation can be defined as any activity of citizens to influence a political decision. Defining political participation has become more difficult, as classical ways of participation are replaced and replenished by online activities such as sharing political content or initiating or signing online petitions (Mihailidis & Thevenin, 2013). What sets online activities apart from classic media is their *participatory culture*. Jenkins et al. (2019) described participatory culture as interactive, peer-based, nonhierarchical, social, and

independent of elite-driven institutions. This concise statement reveals a lot about the difference between modern participation and traditional ways of political participation, as well as about the self-conception of this movement. Digital political agents do not want to rely on established media to create their truth, nor do they want to be mere recipients, or be in a seemingly teacher–student relationship. People who create and consume political or social content online are also called *digital citizens* (Jenkins, 2006; Jenkins et al., 2013). The term *digital citizenship* emphasizes the ability to use digital media to participate in society, for instance, through civic engagement, economic attainment, or political participation (Mossberger et al., 2003). Digital civic engagement tends to happen at more irregular intervals than traditional participation and is more fluid (Banaji & Buckingham, 2013). Nowadays, it has become less important to be a "dutiful citizen," who feels obligated to vote or attend town hall meetings; rather, digital citizens prefer to join online communities on social media platforms (Bennett, 2008). By forming the so-called *networked publics* (Castells, 2012), social media platforms are a means to build up pressure on institutions or enterprises, raise funds, organize social or political events, and, eventually, even help movements such as Arab Spring and #MeToo (e.g., Bennett & Segerberg, 2012). Further recent examples are Black Lives Matter and Never Again. Late surveys have revealed that many young people get their political information from social media (Mitchell et al., 2015; Robb, 2017). Very often, they obtain this information by coincidence or algorithms (Dewey, 2015; Mitchell et al., 2013). Most importantly, online and offline political participation does not co-exist unconnectedly. Online participation often fosters offline political activities (McLeod et al., 2009; Mossberger et al., 2008; Shah et al., 2009).

This paragraph presents a short impression of what sets modern, digital political participation apart from traditional participation. In the following section, classical and newer ways of participation will be regarded concerning their relationship with media use and media literacy.

### 3.2.1.2. Association among Media Use, Media Literacy, and Political Participation

In this section, at first, the connection between media use, especially internet use, and political participation is analyzed. Next, the role of media literacy is discussed.

For a long time, there have been many concerns that young people neglect civic political participation (Putnam, 2001; Sajuria et al., 2014; Zukin, 2006). Some regard the internet as a kind of remedy, as people who are typically uninterested and inactive in politics can be reached (Best & Krueger, 2005; Boogers & Voerman, 2003; Gibson et al., 2005). Strandberg (2006)

summarized four arguments for this assumption: First, the internet fosters interest in political issues and provides citizens with new tools of participation (Norris, 2001; Ward & Vedel, 2006), it lowers the cost of participation and provides more equality of opportunity of participation (Best & Krueger, 2005; Bimber, 2001; Strandberg, 2006), it is quick and up to date (Tolbert & McNeal, 2003), provides necessary information for participation (Delli Carpini & Keeter, 1996; Hale et al., 1999), and it enhances ways of direct democracy (Di Gennaro & Dutton, 2006; West, 2004). As a result of new media tools, the ways of political participation are changing. Young people show less classical political participation—such as joining a political party or attending demonstrations—but report more civil participation and community involvement (Eden & Roker, 2002; Zukin, 2006). Kahne et al. (2013) saw great promise in this trend, as engagement in other participatory cultures may serve as a gateway to participation in political life. This is the core idea of Norris' *mobilization thesis* (Norris, 2001), which states that the internet attracts people who are under-represented in traditional forms of political participation, such as young people or ethical minorities. Digital participation has many advantages; however, a *participation gap* (Jenkins, 2006, p. 257) is discussed. An associated term, which is often used as a synonym and was established in the 1990s, is the *digital divide*. Both terms describe an inequality in access to new media technologies and in using their possibilities to participate in society. Factors that influence the accessibility to media include SES, sex, age, and ethnicity (e.g., Smith et al., 2001). A broad range of young people name digital media the most important means for researching information about politics (Pasek et al., 2006; Robb, 2017; Shah et al., 2001). Political knowledge increases the likelihood of participation; thus, media play a crucial role in prompting political participation (Delli Carpini & Keeter, 1996). The connection between internet use and political participation has been inspected in adults, but due to contradictory results, no final conclusion can be drawn (Bimber, 2001; Gibson et al., 2005; Krueger, 2002; Tolbert & McNeal, 2003). A more recent study by Quintelier and Vissers (2008) investigated the link between the time spent on the internet and political participation in 16-year-olds in Belgium. They found no connection between the amount of time spent on the internet and political participation, but a connection with the type of action (e.g., blogging or joining discussions) (Quintelier & Vissers, 2008). Similar effects were shown for adults; relevant behaviors that were positively linked to political participation for them were, for example, forwarding e-mails with political content, voting online (De Vreese, 2007; Solop, 2000), and visiting news websites; this effect is more pronounced in young adults, as they are more apt to seek political information in the World Wide Web than the older

ones (Jung et al., 2001; Lupia & Philpot, 2002). On the other hand, the internet can also supplement offline political participation, but it does not lower involvement in political issues (Quan-Haase & Wellman, 2004). There are some real-life examples where social media played an important role in politics. In a survey of Tunisian internet users by Marzouki et al. (2012), 80% of the participants rated Facebook's contribution to the Tunisian revolution as decisive. The participants ascribed three main functions to the social network that contributed to its impact: media platform function, political function, and informational function. Facebook is seen as a catalyst that accelerates processes that would have taken place without the existence of the network, but at a far slower pace (e.g., Marzouki et al., 2012). Kahn and Keller (2004) even believe that in order to participate in a contemporary democracy, one has to engage in the digital world.

Why should media literacy be necessary? The participatory culture has created fresh problems or enhanced existing political problems. Digital media foster echo chambers (Pariser, 2011; Sunstein, 2007) and insults (Coe et al., 2014); people mainly seek news stories that confirm their own opinion (Messing & Westwood, 2014) and the dissemination of misinformation (Silverman, 2016). Moreover, media platforms mostly belong to enterprises that attempt to modulate public opinion in their own interest (Fuchs, 2011). Although these developments are often viewed critically, interacting with people who hold the same views can be beneficial: it enhances the likelihood of political participation, civic engagement, and a more profound understanding of one's own views (Jamieson & Cappella, 2008; Mutz, 2006). More recent events have shown the danger that the influence of social media can have. In the 2016 presidential election in the USA, news on social media bypassed editorial media, spreading their own truth and sowing mistrust against "official" news (Enli, 2017; Oh & Kumar, 2017). Finally, on January 6, 2021, Trump's continuous querying of official media finally led to the attack of over 2000 of his followers on the US Capitol, which caused the death of five people. His followers believed Trump's statements about electoral manipulation (Mascaro et al., 2021). The economy was similarly influenced by him, as ex-president Trump's comments on Twitter about media and non-media firms influenced their stock prices (Ajjoub et al., 2020). Many researchers have postulated that teaching users media literacy prepares and immunizes them against these damaging influences and is a means against the participation gap (Gilbert, 2009; Hobbs, 2010; Jenkins et al., 2009; Mihailidis & Thevenin, 2013; Ranieri & Fabbro, 2016; Rheingold, 2008). Craft et al. (2017) showed that news media literacy (a part media literacy limited to news) reduces the risk of believing in conspiracy theories, even if they align with

one's own political beliefs. Moreover, a person who possesses digital skills is more likely to join online political activities (e.g., Cohen et al., 2012; Hargittai & Shaw, 2013). If a person is looking for information off- or online, the quality of this information matters. To make this evaluation, the person has to be media-literate. This is especially relevant in states that do not foster journalistic freedom; their media literacy can act as "emancipatory knowledge" (Toepfl, 2014). Critical media literacy is also regarded as a means to establish proficient and engaged citizens (Kellner & Share, 2007). Mihailidis and Thevenin (2013) argued that media literacy is a core competence for a citizen in today's contemporary digital society. The main features are a person's analytic and critical abilities when dealing with media (Mihailidis & Thevenin, 2013). In Fig. 4, they illustrate the association of media literacy, critical thinking, and political and social participation. Mihailidis and Thevenin (2013) showed that the competencies that build media literacy competencies, such as a participatory competency or a collaborative, expressive, and critical competence, foster being a creator and communicator, an agent of social change, and a critical thinker. Being an agent of social change and a critical thinker, in turn, supports a person in becoming a creator and communicator; it also stimulates being an engaged citizen, which in turn fosters media literacy competencies. Similarly, engaged citizenship and media literacy promote each other reciprocally.
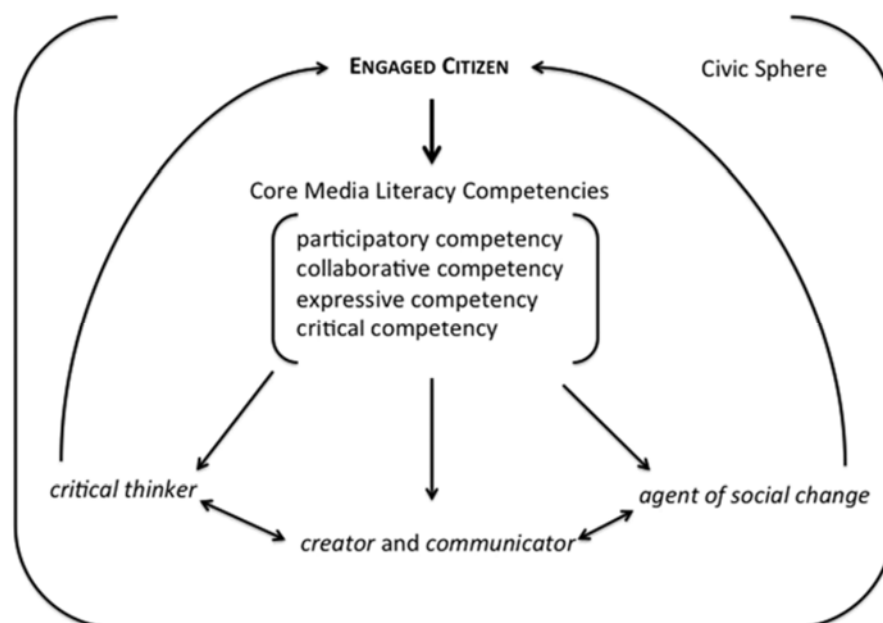


*Figure 4.* Association of media literacy, critical thinking, and political and social participation. © Mihailidis, P., & Thevenin, B. (2013).

Arguing on the same lines, Peréz Tornero and Varis (2010) of UNECSO stated that "[an important value of media literacy is that it] uphold[s] the ideal of an active, communicative democracy that should foster political democracy" (p. 46). Furthermore, they claimed that media literacy is related to critical thinking and civic participation, as well as active citizenship (p. 57). Vraga et al. (2012) found that news media literacy promotes critical thinking. Several studies have confirmed a direct connection between media literacy and political participation or civic engagement (Ashley et al., 2017; Kahne et al., 2012; Martens & Hobbs, 2015). What could be the reasons that media literacy and political participation are associated? Following Delli Carpini and Keeter's (1996) argumentation, awaking interest in a topic should foster participation. Thus, the question arises whether media or media literacy have the capacity to stimulate young people's interest in politics. This question is part of this thesis and is integrated with the description of the empirical part of this work. Of course, more mediating variables exist between media literacy and political participation. A possible one is political efficacy, which will be described in the section below.

Taken together, studies have hinted that using modern media, such as the internet, fosters political participation but not necessarily traditional ways of participation. Rather, actions that are similarly performed online are stimulated. However, some studies have suggested an association between online and offline political participation. Media literacy is seen as a means to lessen digital media's harmful effects and to enable a well-informed, competent political citizenship.

In the following section, the connection among media use, media literacy, and political efficacy will be presented. This construct is included in my thesis as it could act as a mediating variable between interest in politics and political participation; moreover, it is closely related to political self-concept (for both, see below).

### 3.2.2. Media Use, Media Literacy, and Political Efficacy

While the previous section dealt with political participation in relation to media use and media literacy, this section focuses on political efficacy. Political efficacy can be defined as "the feeling that an individual political action does have, or can have, an impact upon the political process" (Campbell et al., 1954, p. 187) and "the belief that one has the skills to influence the political system" (Zimmerman, 1989, p. 554). Often, three types of political efficacy are distinguished. The first, internal political efficacy (IPE), is the conviction that one is able to understand and participate effectively in the political process (Bandura, 1982; Kenski

& Stroud, 2006; Niemi et al., 1991). The second type, external political efficacy, describes the extent to which a political system is susceptible to a person's impact and is linked to active civic engagement (Zhou & Pinkleton, 2012). The third, epistemic political efficacy, describes a person's capacity to critically analyze a political medial message and extract true facts about political issues (Pingree, 2011; Pingree et al., 2013).

Why should media use or media literacy foster political efficacy? When a person is able to use media effectively and is confident in analyzing media messages, they can build up knowledge. Media use is indeed correlated with political knowledge (Eveland et al., 2005); it seems to be a reciprocal interaction (Moeller & de Vreese, 2015). The latter, political knowledge, is a necessary condition for political participation (Dudley & Gitelson, 2002). Media literacy programs have the ability to increase the confidence one has in their political competence (Kahne & Westheimer, 2006; Pasek et al., 2008). Furthermore, they foster both political knowledge and political efficacy (Geers et al., 2020). Ashley et al. (2017) found a positive correlation between news media literacy and political knowledge, as well as IPE. Not only does the real level of media literacy matter, but also self-perceived media literacy skills. If an agent is more confident about their media literacy, they should also be more likely to participate in politics (Burroughs et al., 2009; Kahne et al., 2012; Maksl et al., 2015). According to Tully and Vraga (2018), this connection can be explained by the theory of planned behavior (Ajzen, 1985) because self-perceived media literacy can act as perceived behavioral control in interaction with medial messages. These authors confirmed the assumed association between self-perceived news media literacy and IPE, as well as epistemic political efficacy (Tully & Vraga, 2018).

Most studies on political efficacy and media use or media literacy have investigated IPE. These studies are outlined in this paragraph. Apparently, IPE is more often investigated, as it is regarded as more likely to be a product of communication than the other kinds of political efficacy (Jung et al., 2011). IPE is also important, as even small increases can lead to increased political participation (Moeller et al., 2014). Most studies have found positive correlations between IPE and online news use (Chan, 2014; Hoffman & Thompson, 2009; Jordan et al., 2014), as well as online communication about political topics (Moeller et al., 2014). Several studies have confirmed a positive association between IPE and digital news consumption, as well as an increase in political participation (Baumgartner & Morris, 2006; Hoffman et al., 2013; Kenski & Stroud, 2006).

Overall, research has suggested a positive link among political efficacy, media use, and media literacy. In the next section, a summary of the effects of media use and media literacy on political factors is presented.

### 3.2.3. Summary of Effects of Media Use and Media Literacy on Political Factors

The first study of this thesis (see chapter II.3.1.) is concerned with media literacy and its relation to the political variables of *interest in politics* and *political self-concept*. In the previous section, the effects of media use, mainly the use of the internet, on political participation and political efficacy were described. They are of relevance in the context of study I, as the "goal" of arising interest in politics is political participation, and a positive association between these two has already been confirmed (see below). One component of political efficacy and the political self-concept are closely related, and I assume that they mediate the influence of interest in politics and political participation (see chapter II.3.1).

Internet use can stimulate participation in politics; however, it is more effective in enhancing online participation than offline activities. The latter are sometimes supplemented by online activities. Some studies could also find enhanced offline participation through online participation. Media literacy also has the capacity to foster political participation and is a tool to reduce the harmful effects of digital media. Political efficacy is connected with political participation and is often regarded as a precondition for participation. Studies have confirmed a positive impact of media literacy training on political efficacy and political knowledge. Thus, media literacy seems to have the capacity to stimulate a person's confidence in their political online actions.

To provide the reader an overview of the variables that were so far presented in their relation to media use and media literacy, the next section will provide a summary.

### 4. Summary of Media Use's and Media Literacy's Impact on Cognitive and Political Factors

In the first part of this section, findings on media's and media literacy's influences on learning, cognitive skills, school attainment, knowledge acquisition, and the construction of inferences from different media are aggregated. This information will be relevant for studies II and III (chapters II.3.1. and II.3.2.) in the empirical chapter. Both studies deal with the association between media literacy and cognitive skills. Study II focusses on three research questions. One question is concerned with the development of media literacy between the ages of 13 and 19. The other two research questions examine the link between media literacy and

academic skills (reading and mathematical abilities), along with academic outcomes (school grades). Therefore, it is necessary to expound how media and media literacy influence cognitive variables. Study III is closer to the topic as it investigates how media literacy affects learning from three different kinds of media (a written text, an audiovisual text, and an auditory text). It is conducted to reach a deeper understanding of how cognitive processes are influenced by media literacy, to explain the effects in study II. The learning outcomes of these three media are also compared separately for mere knowledge acquisition and drawing inferences. Because of this, the literature on drawing inferences from different media is included in the theoretical part of my thesis. Relevant variables mentioned in study III are also the effect of prior knowledge and reading proficiency on learning from all kinds of text. Therefore, information concerning these factors is similarly included.

Media have different properties that influence the way information is processed. A written text is stable, which allows the reader to re-read sections. To fully understand a text, three different mental representations have to be created (e.g., Zwaan & Singer, 2003). The first is the *text surface* (the exact wording), the second is the *text base* (the content), and the third is the *situation model*. A reader has only thoroughly understood a text when they have built an enfolding situation model, which is a representation of the context of a text (Zwaan & Radvansky, 1998). Some factors that influence the reading process positively include prior knowledge (Ainley et al., 2002) and reading proficiency (Stanovich, 2000).

Films or television are referred to as audiovisual texts that deliver both visual and auditory information. Unlike written texts, they are transient and able to show motion. Learning from audiovisual texts is an active process (Anderson et al., 1981), which provides a learner with much context information that eases inferring (Field, 2000; Ridgway, 2000). Prior knowledge (Peters & Webb, 2018) and familiarity with a program (Vandergrift, 2007) support learning from audiovisual texts.

Finally, auditory texts comprise transient auditory lingual information. To learn from an auditory text, bottom-up and top-down approached have to be combined (Lynch, 2006), with sufficient information leading to understanding (Buck, 2001). Metacognitive strategies (Selamat & Sidhu, 2013) and prior knowledge enhance (Buck, 2001; Lynch, 2006) learning from an auditory text, both of which are top-down processes. Additionally, good language proficiency eases learning from auditory texts (Berne, 2004).

Concerning multimedia, the interaction between different media must be considered in the learning process. A model that describes this knowledge acquisition process is Mayer's (2005) cognitive theory of multimedia learning. This theory suggests a way to reduce cognitive load and liberate resources for information processing, thus improving the process (Mayer & Moreno, 2003).

Each medium enables a learner to draw inferences; only the information sources are different (e.g., Beagles-Roos & Gat, 1983; Meringoff, 1980). The best results can be obtained through an appropriate combination of media.

The research presented above focused on the effects that singular media have on the learning process. In what follows, a short summary of the comparison of the learning outcomes of written, audiovisual, and auditory texts is presented. General statements about the superiority of one medium cannot be given, as factors such as participant age and the content of the text moderate the results. Overall, children usually profit most from audiovisual texts. Some studies have found better learning results with auditory texts than with written texts (e.g., Diakidoy et al., 2005), while others have found no differences (e.g., Gunter et al., 2000). This is attributable to the fact that, in audiovisual texts, the situation model is supported by the medium, enabling the recipient to invest cognitive capacity in understanding the text content. Auditory texts are commonly used by small children, and this familiarity might ease processing. This picture changes in adolescents when reading becomes an automatic process. Adults learn better from written texts than from audiovisual texts (e.g., Byrne & Curtis, 2000). A comparison between written and auditory texts is still inconclusive; some studies have shown a superiority of written texts (e.g., DeFleur et al., 1992), while others have found no difference (e.g., Wannagat et al., 2017). Audiovisual and auditory presentations have achieved same results (e.g., Hayes et al., 1986). The effectiveness of audiovisual texts can be enhanced when interactive features are included (Merkt et al., 2011) or when auditory and visual information is highly redundant (Walma van der Molen & van der Voort, 2000). However, only a few studies have compared audiovisual and auditory formats in adults; thus, no final conclusions can be drawn. Thus far, their outcome seems to be comparable.

So far, the effects of the different kinds of media have been considered. Of course, the recipient is not just a passive object. The way they use a medium is pivotal. A competent use of media is referred to as media literacy. If sign systems are processed with less effort, the acquisition of new information should be more efficient (Diergarten et al., 2017). Children who

are media-literate have better academic skills, such as reading proficiency, in elementary schools (Nieding et al., 2017) and a better text comprehension and learning outcome (Diergarten et al., 2017) than low media-literate children. Additionally, they are better at drawing emotional inferences from texts (Diergarten & Nieding, 2015). Adolescent students with higher computer proficiency exhibit better mathematics and reading abilities (Paino & Renzulli, 2013). The same positive effects of media literacy on academic performance have been found in training studies (Hobbs & Frost, 003). Whether these effects prevail in adulthood is one of the main questions that are attempted to be answered in the empirical part of this thesis. There is evidence that media literacy is even more important in modern media, such as hypertexts (Coiro & Dobler, 2007; Schilling, 2012).

Study I of the empirical part (chapter II.3.1.) investigates the influence of media literacy on political self-concept and interest in politics in adolescents and young adults. In what follows, research on media use's and media literacy's impact on political participation and political efficacy will be summarized. These constructs are introduced as the outcome of interest in politics is surmised to be political participation. It should be the interest's practical repercussion (see below). Another confirmed link in the chain between interest and participation is positive self-concept of one's own competence or knowledge in politics. This is what I mean by political self-concept; it is sometimes called internal political efficacy, which is a component of political efficacy.

The internet is often named as the main source of political information by young people (see Pasek et al., 2006). Delli Carpini and Keeter (1996) regarded political knowledge as the decisive factor in stimulating political participation. Political participation is nowadays closely linked to online participation (Jenkins et al., 2019). Online political engagement can foster offline political engagement (e.g., McLeod et al., 2009). To take part in society, it is important to be able to use digital devices (Mossberger et al., 2003). This development emphasizes media literacy in regard to political participation. The internet has long been regarded as a means to activate traditionally inactive citizens (Kahne et al., 2013). It can help to close the participation gap (Jenkins, 2006) that exists among ethnicities, sexes, and SES. A connection between certain online activities, such as forwarding e-mails with political content and political participation, was found very early for adolescents (Quintelier & Vissers, 2008) and adults (e.g., De Vreese, 2007). Media literacy has been shown to protect users against the harmful influences of the internet (Craft et al., 2017). Additionally, a direct positive association between media literacy and online political activities (see Hargittai & Shaw, 2013) and offline activities (e.g., Ashley

et al., 2017) was found. Thus, many scholars have pledged media literacy education in schools (e.g., Ranieri & Fabbro, 2016). Delli Carpini and Keeter (1996) assumed that awaking interest in a topic should foster participation; thus, media literacy might help in fostering interest in politics and, in turn, increase political participation. Additionally, when information is received, its quality must be evaluated. To make this evaluation, a person needs to be media-literate. In the empirical part of this thesis, the question of whether media literacy is a factor that fosters interest in politics—as the first link in the chain toward political participation—is investigated.

Political efficacy is often assumed to be connected with media literacy. It comprises IPE, the belief that one has the skills to understand and politically participate (e.g., Kenski & Stroud, 2006); external political efficacy, the susceptibility of the political system to an individual act (Zhou & Pinkleton, 2012); and epistemic political efficacy, the proficiency of a user to critically analyze a message and extract relevant facts (e.g., Pingree et al., 2013). A feeling of efficacy is important to build knowledge and turn it into action (Dudley & Gitelson, 2002). An increase in IPE also increases political participation (e.g., Hoffman et al., 2013), online news use (e.g., Chan, 2014), and online communication about political topics (e.g., Hoffman et al., 2013). Media use and political knowledge are correlated (Moeller & de Vreese, 2015). Media literacy training can increase political knowledge and political efficacy (e.g., Geers et al., 2020). Later in this thesis, this feeling of political competence will be investigated more closely in relation to its link to media literacy. In the next section, a summary of the complete theoretical part will be given, followed by the empirical part.

## 5. Summary of the Theoretical Part and Outlook on the Empirical Part

As the studies in the practical part of this thesis are concerned with the association between media literacy and several academic and political variables, the first chapter provided an overview of the theoretical basis of these variables. In the beginning, the pervasiveness of media in our lives and thus their importance was underlined by a summary on media use in two westernized countries: the USA and Germany. Germany was chosen because the samples of the studies in the empirical section are German. After that, to understand what I mean when writing about media literacy and what components it contains, the construct media literacy was presented in more detail, and our own model of media literacy was introduced. As study II investigates the development of media literacy from adolescence to young adulthood, an overlook on existing literature was provided. Studies II and III also investigated media literacy's influence on cognitive variables; thus, several sections about learning from media and what is

so far known about media literacy's impact were expounded. While study II is concerned with academic outcomes and abilities, study III serves to better understand why this influence could exist. In study III, a comparison of the learning outcome from three kinds of media—a written, an audiovisual, and an auditory text—is performed. For that reason, information processing and the possibility of drawing inferences in each medium and multimedia is considered, followed by research on the comparison of these media. Finally, as study I deals with the association among media literacy, interest in politics, and political self-concept, known, related constructs are presented. Political participation and its link to media literacy is introduced, as some results hint that participation is caused by interest and a positive self-concept. Political efficacy is discussed because it is closely related to the political self-concept. A more detailed summary is given in the following section.

The first section elaborates on adolescents' and young adults' media use and possession. A comparison between German and US-American users is drawn. Adolescents from both countries have a broad variety of media devices. A great proportion of their leisure time is spent using these devices. Girls usually report more reading time, while boys spend more time with computer games. Teenagers from lower SES possess fewer devices and spend more time with screen media than those from higher SES. US-American adults own several devices (Lenhart et al., 2010). They similarly show a sex difference: males are more likely to access the internet through a laptop, females through mobile phone, and more women have accounts on social networking sites. German adults (Adler et al., 2017) also own many devices. Age is the most important influencing factor. Young adults (<30 years of age) spend more time online, use different applications (more entertainment than practical ones), and are more likely to watch online videos and to access the internet en route than older ones. When adolescents and adults are compared considering their media use, adolescents not only spend more time on the internet but are also more likely to engage in entertainment-oriented activities. In both groups, a lower SES increases the likelihood of owning fewer devices and exhibiting more screen time. On average, females are more likely to use media for communication purposes.

A large proportion of people's leisure time is spent with media. This emphasizes dealing with these devices in a competent way. The concept behind this idea is called *media literacy,* which is discussed in the second section of this thesis. Definitions of media and models of media literacy (e.g., Groeben, 2002, 2004; Hobbs, 1997; Potter, 1998, 2016) are introduced. The development of the different dimensions of media literacy during childhood and adolescence are summarized. The goal is to show that children start to interact with media from

an early age and that their handling and comprehension of media are continuously improving. However, only a few studies have focused on the development of media literacy in adulthood (e.g., Ildirar & Schwan, 2015). Our own model of media literacy, including five scales, is presented: *media sign literacy, distinction between reality and fiction, knowledge of media law, knowledge of media effects,* and *production skills*. Therefore, the assessment tool WMK is designed. Media sign literacy describes the ability to decipher symbols effectively, while the distinction between reality and fiction regards how well adults can tell when medial presentations show reality or distort it. Knowledge of media law asks whether young users are aware of the legal framework of media use. Knowledge of media effects focuses on the realization that media impact our minds and can influence us unknowingly. Production skills investigate whether a user does not just have theoretical knowledge of media but can also create content themselves.

In the third section, the influence of media literacy on the political and learning processes is discussed. One salient characteristic of a written text is its stability, enabling a learner to read sections anew. To retrieve information from a written text, three mental representations have to be created (e.g., Zwaan & Singer, 2003). They are called *text surface,* referring to the exact wording of a text; *text base,* which is the content of a text; and the *situation model,* a representation of a text's context, which is essential for understanding the text (Zwaan & Radvansky, 1998). Prior knowledge (Ainley et al., 2002) and reading proficiency (Stanovich, 2000) positively influence learning. Audiovisual texts are transient; they provide both auditory and visual inputs. A positive impact on learning from audiovisual texts was found for prior knowledge (Peters & Webb, 2018) and familiarity with a program (Vandergrift, 2007). Inferences are easy to draw because audiovisual texts deliver considerable contextual information (Field, 2000; Ridgway, 2000). Auditory texts are similarly transient. When enough information is extracted from a text through a combination of bottom-up and top-down processes (Lynch, 2006), understanding takes place (Buck, 2001). Prior knowledge enhances (Buck, 2001; Lynch, 2006) the use of meta-cognitive strategies (Selamat & Sidhu, 2013) and good language proficiency positively impacts learning from an auditory text (Berne, 2004).

It is not easy to answer the question of whether one medium is superior for learning over another. Factors such as age and quality of the text influence the results. Overall, children under the age of 12 years profit most from audiovisual texts. So far, it remains unclear whether auditory texts are superior to written texts (e.g., Diakidoy et al., 2005) or whether they bring the same learning profit (e.g., Gunter et al., 2000). In adolescence, concomitant with cognitive

development, the effectiveness of learning media changes. Adults profit more from written texts than from audiovisual texts (e.g., Byrne & Curtis, 2000). Some studies have found better learning outcomes from written texts compared to auditory texts (e.g., DeFleur et al., 1992), while others have found the same learning results (e.g., Wannagat et al., 2017). Audiovisual and auditory texts seem to be equally good for adult learning (e.g., Hayes et al., 1986); however, research regarding the comparison of the latter two is scarce. In this thesis, media's potential to enhance the learning process is discussed. Each medium has a different influence on information processing, but other factors, such as prior knowledge or the use of metacognitive, moderate this influence. When learning from multimedia, the interaction between several media has to be taken into account. The learning process can be enhanced by combining different types of media if the material is prepared according to research findings and Mayer's (2002) cognitive theory of multimedia learning. In this way, a reduction in cognitive load takes place, and more resources can be invested in the learning process itself (Mayer & Moreno, 2003). Inferences can be drawn from any kind of medium, but the information used to answer questions on the text varies. High media-literate children possess better reading proficiency (Nieding et al., 2017), text comprehension, and learning outcomes (Diergarten et al., 2017) than low media-literate children. Adolescents with high computer proficiency have better mathematics and reading abilities (Paino & Renzulli, 2013). However, research on adults is missing. The influence of media literacy on adult learning is one focus of the empirical part of this thesis.

The media not only influence the knowledge acquisition process but they can also impact political decisions. The internet serves as the main source of information on political topics for young adults (e.g., Pasek et al., 2006), which can foster participation (Delli Carpini & Keeter, 1996). Traditional forms of political participation are used less and less; many citizens participate online (Jenkins et al., 2019), but online participation can enhance offline participation (e.g., McLeod et al., 2009). For this reason, some regard the internet as a tool to foster political participation (Kahne et al., 2013). The "how" in internet use matters, as it bears the danger of harmful influences. They can be reduced by media literacy (Craft et al., 2017). Previous research has shown a positive link between media literacy and online participation (e.g., Hargittai & Shaw, 2013), as well as offline political activities (e.g., Ashley et al., 2017). Delli Carpini and Keeter (1996) assumed that more interest in politics leads to increased participation. In study I of this thesis, the question of whether media literacy is a factor that fosters interest in politics—as the first link in the chain toward political participation—is investigated. Internet use and media literacy are similarly connected with political efficacy (e.g.,

Geers et al., 2020). Even a slight increase in political efficacy can increase political participation (e.g., Hoffman et al., 2013). Additionally, political efficacy and self-perceived media literacy help to build political knowledge (Dudley & Gitelson, 2002). Media literacy training can increase political knowledge and efficacy directly (e.g., Geers et al., 2020). Often, political efficacy is conceptualized as its subcomponent internal political efficacy, which describes the belief that you can comprehend and effectively participate in politics.

The summary given provides a background for the empirical studies of this thesis and reveals several gaps in current research. Some of these open questions are addressed in the empirical studies. In the second part of the thesis, the empirical work and its results are presented. First, a placement of the original studies in the current state of research takes place.

## II.  Empirical Part

The theoretical part provided an introduction to the research on media literacy and its influence on cognitive and political variables. In this part, gaps in research are pointed out, and our own studies that try to close the mentioned gaps are presented. Additionally, the methodology used and the results are presented and discussed. In the following section, a placement of the original studies in the current state of research will take place. The empirical findings and methods introduced in the theoretical section will be considered. The specific research questions are discussed in the description of the studies.

### 1.  Placement in the Current State of Research and Implications for Own Work

The studies in this section focus on media literacy's connection with cognitive and political variables. Studies I and II draw from the same sample and are not actually separate studies. To facilitate reading, however, they are presented separately and referred to as separate studies. In study I, our own media literacy tool, the WMK, is evaluated. Furthermore, the correlation among media literacy, interest in politics, and political self-concept is investigated. In the previous chapter, the impact of media literacy on political participation and political efficacy was outlined.

Study I considers the association between interest in politics and media literacy because if a correlation exists, it could serve as a precursor and mediator of the link between media literacy and political participation. Another mediating variable could be political self-concept, as the related construct IPE is associated with both media literacy and political participation. Its connection with media literacy is similarly investigated in study I. Delli Carpini and Keeter (1996) stated that political knowledge should increase the likelihood of political participation, and, as the internet serves as the main source of information (e.g., Shah et al., 2001), it should play a crucial role in promoting political participation. Media literacy is positively correlated with political activities (e.g., Ashley et al., 2017; Hargittai & Shaw, 2013). Media literacy training fosters political knowledge (e.g., Geers et al., 2020). People with deeper knowledge feel more confident to join political acts and thus are more likely to participate. Another variable that mediates between media literacy and political participation seems to be political efficacy. It is correlated with both media literacy (Ashley et al., 2017; Geers et al., 2020) and political participation (Baumgartner & Morris, 2006; Hoffman et al., 2013; Kenski & Stroud, 2006). In study I, the question of whether media literacy similarly fosters interest in politics and political

self-concept is examined. The fundamental assumption is that to evaluate the quality of information, competent handling of media is crucial.

Study II also poses several research questions. The first is that the development of media literacy takes place between 13 and 19 years of age. Second, the association between media literacy and mathematical and reading skills (academic abilities); finally, media literacy's association with school grades (academic attainment).

Study III determines an explanation for why media literacy positively influences academic abilities and attainment. Therefore, the influence media literacy has on the efficiency of learning from written, audiovisual, and auditory texts is investigated. Two kinds of learning outcomes are considered: knowledge acquisition, which is the retention of information stated directly in the text, and inferential knowledge, which involves going beyond explicitly stated facts. Additionally, a comparison of the two kinds of learning outcomes from the three types of texts is performed to identify which medium is most beneficial for learning.

So far, it has been assumed that media use has a great impact on our society, as both adults and adolescents spend a considerable part of their leisure time with media. Chapter I.1. provides an overview of media use in two Westernized countries: the USA and Germany. For this reason, it is proclaimed that a competent handling of media should be fostered, which is referred to as *media literacy*. However, neither *media* nor *media literacy* has an agreed-upon definition. Several models of media literacy coexist, making comparisons of studies difficult. Additionally, no model has so far been tested empirically. The same is true for tools assessing media literacy. None of the existing tools have met the criteria necessary for the investigation in this study. An instrument that is based on a theoretical model, measuring the whole construct of media literacy and including a practical part, is required. Several tools, for example, that proposed by Lee et al. (2015), are self-reports, excluding objective measurement, which are prone to distortions due to overestimation of skills or overstatement out of embarrassment. Multiple-choice tests allow an objective assessment but still hold the possibility of guessing. Existing practical tools, like that proposed by Goldhammer et al. (2013), focuses on just one component of media literacy: ICT skills. Consequently, the WMK (media literacy test of Würzburg) was constructed, combining a test for the broad construct with practical applications. The WMK contains 183 items aiming at the five scales of *media sign literacy, distinction between reality and fiction, knowledge of media law, knowledge of media effects,* and *production skills*. A pilot study was conducted to identify the appropriate items. The procedure will be presented in

chapter II.2.3.1. The reliability of the tool and the quality of the model are tested in study I. Media use demonstrably enhances attentional control, verbal ability, working memory, and academic attainment (e.g., Alloway et al., 2013), reading literacy (e.g., Jackson, von Eye, Witt, Zhao, & Fitzgerald, 2011), and performance on tasks involving visual-spatial perception and control of attention (e.g., Ventura et al., 2012). Media sign literacy, a component of media literacy, has a positive impact on the precursors for mathematical, reading, and writing skills in preschoolers (Nieding et al., 2017) and can explain inter-individual differences in children between four and six years of age in terms of comprehension and learning from different kinds of media (Diergarten et al., 2017). Students with higher computer proficiency show better abilities in mathematics and reading (Paino & Renzulli, 2013). The abovementioned studies focused either on media use or on just one component of media literacy. In this thesis, the influence of the complete construct on adults is investigated. As Diergarten et al. (2017) pointed out, singular qualities of media literacy can moderate the learning efficiency of media. Investigations have shown that, depending on the age of the subject, information can be gained with a different efficiency from the different kinds of media. For adults, written texts seem to be most profitable (e.g., Byrne & Curtis, 2000; DeFleur et al., 1992), and audiovisual and auditory texts gain comparable results (e.g., Hayes et al., 1986). Study III focuses on the comparison of the three learning media and the role media literacy plays in this process.

This section provides an overview of existing research as a context for the following studies. In the next section, the methods used in all studies will be presented.

## 2. General Methods

In this section, the methods that were commonly used in all three studies are introduced. An overview of the pilot study, the sample, and the used material is presented. In addition, specific differences among the studies are outlined in the description of each study.

### 2.1. Sample

As mentioned before, studies I and II were conducted on the same sample; thus, they are not really two separate studies but presented separately to facilitate reading. As a comparison of adolescents and young adults was conducted in study II, two samples were drawn, one of about 13-year-olds and the other of about 19-year-olds. In study I, as this difference did not matter to the research questions, they were analyzed as one sample. The sample consisted of 101 adolescents ($n = 50$; $M_{age} = 13.1$ years, $SD_{age} = 1.9$ years) and young adults ($n = 51$; $M_{age} = 19.1$ years, $SD_{age} = 1.5$ years). Girls and women comprised the majority of the overall sample

(58%), with a female ratio of 44% among adolescents and 71% among young adults. They were recruited through advertisements in local media, on the internet, and in the form of letters distributed to students through cooperation with schools. Letters to the parents asking for their written consent were only sent after the school principals gave their permission. The testing lasted 2.5–3 hours and took place in the laboratories of the Department of Psychology in Germany. Although carefully recruited, the sample became selective in terms of education level. Most participants either attended *Gymnasium* (N = 39), which is the highest level of secondary education in Germany, or, after graduation, studied at university (N = 48). Twelve attended *Realschule* (intermediate education level), and only two attended *Hauptschule* (basic education level). Therefore, education level was not considered in the analysis. No participants were excluded.

The sample of study III originally consisted of 94 young adult university students. They were recruited through advertisements on the internet and university recruiting software. Two participants had to be excluded because they either knew the documentary, which was used as learning material in this study, or scored lower than three standard deviations below the medium on the media literacy or intelligence tests. Another set of data had to be excluded because one participant withdrew their declaration of consent at the end of the study. A total of 91 participants formed the final sample ($M_{age}$ = 23.11 years; $SD_{age}$ = 2.41 years; f = 74). The testing lasted 75–90 min and took place in laboratories at the Department of Psychology in Germany. A between-subject design was used. The written text group included 31 participants, and the audiovisual and auditory text groups comprised 30 participants each. There was no significant age difference between the groups, and the sexes were distributed evenly.

### 2.2. General Procedure

The subjects were invited to the laboratories of the Department of Psychology. Each subject first received a set of questionnaires and a pen, and no more than five subjects were tested at one time. To begin, each subject filled out a questionnaire on socio-demographic and personal data at their own pace. All subjects then completed an intelligence test at the same time. After that, the order of the tests was changed between the studies. The specific procedure of each study will be presented in the section concerning the studies. Each investigation included computer-based items. The WMK was programmed using HTML5 and JavaScript and was presented on a 17" computer, each with a mouse and headphones.

### 2.3. Material

In this section, the tools that were deployed in all studies are introduced. The instruments that were exclusive for a specific study will be described below in the section concerning the respective study.

#### 2.3.1. Media literacy

In order to construct a reliable tool, a pilot study with 34 psychology students was conducted. As stated above, the final tool used in the main study is called the Würzburger Medienkompetenztest (WMK) [media literacy test of Würzburg], comprising 183 items across the five scales related to *media sign literacy, distinction between reality and fiction, knowledge of media law, knowledge of media effects* and *production skills*. The items refer to both classical media and contemporary devices like tablets, smartphones, and social media as the everyday living environment in which young people are immersed, making these devices essential for participation in today's social world. After performing an item analysis for difficulty and discrimination, 135 remaining items formed the final instrument. The scales contained between 14 and 52 items, each of which scored one point. Tasks such as evaluation of short movies were presented along with practical tasks in a computer-based test on a 17'' PC; other questionnaire-based items were completed using paper and pencil. Items were divided by instruction pages, allowing subjects to take a break as and when needed. Items used in this test can be found in the appendix as far as a depiction in print is possible (items which include e.g. videos will be described).

The first scale, *media sign literacy*, was the most extensive, ranging across seven subskills and 52 items. Knowledge about mobile devices, video game play, and corresponding icons was tested by means of multiple choice questionnaires. Knowledge of film montage required subjects to identify cutting mistakes in a scripted reality format. Richter et al.'s (2010) TECOWI (technisches Computerwissen) technical computer knowledge scale was also revised. For instance, an item requested a correct assignment of key combinations to a command. Another aspect of media sign literacy is the ability to read maps and graphs. A number of items required interpretation of Google Maps information, as well as other interpretation tasks on paper. For instance, participants had to select the correct route to a given goal from four Google Maps pictures. One task involved reading and interpreting diagrams and charts depicting the exports of an imaginary country. Subjects also had to navigate a hypertext.

The second scale comprised 14 items assessing the ability to *differentiate between reality and fiction* in different media. Among these, subjects had to rate whether a short video showed a real event or a media presentation. Each video showed two parallel versions of scenarios such as a police patrol. Another presented several scenes from a scripted German TV reality series, each containing either logical or technical flaws. Subjects were given four alternatives and were asked to pick the one with the flaw showing that the scene was scripted rather than real documentary footage.

The third scale consisted of a questionnaire testing subjects' *knowledge of media law*. The first part included questions about personal rights and regulations at school, at university or in a business context. For example, "Does the school have to ask permission of each student before it publishes a group photo of all its students online?" Subjects had to evaluate the validity of statements, choosing either: "yes" (legally allowed)," "no" (legally not allowed) or "legal status not clear." In the second part, the legal status of copyright behaviors had to be evaluated. Examples of behaviors were given, for instance, "Making a copy of a CD and giving it to a friend". Subjects could choose between the response options: "legal", "illegal", or "legal status not clear". Items aimed at a wide range of media, including books, e-books, videos, DVDs, CDs, and the internet.

The scale *knowledge of media effects* involved a questionnaire with 25 items asking about well researched psychological effects of media. Subjects had to decide whether each statement was true or false—for example: "People who regularly follow the news are less afraid of becoming a victim of crime." The final scale examined *production skills*, in which subjects had to complete several PC-based tasks. The 18 items related to the Windows and Macintosh operating systems, as these are the most commonly used, as well as to the Firefox browser and the Facebook social network. For example, subjects had to insert a bookmark and delete the history on Firefox, manipulate data security options on Facebook, and edit pictures using iPhoto. Within each scale, subjects received one point for each correctly completed item. Some items included subtasks, each of which scored one point; dividing by the number of subtasks, the item was ultimately scored between 0 and 1. Each of the five main scales contributed with the same weight to the final score after being divided by the number of items it contained and resulting in a score from 0 to 1. The scales were added up and divided by 5, with the subject's WMK final score therefore ranging from 0 to 1.

### 2.3.2. Variety of Media Possession and Use

To assess subjects' variety of media possession and use, a short version of the *Duration and Variety of Media Use* questionnaire was used (see Nieding et al., 2017). Participants were asked, whether they owned a specific medium or not, and whether they used a medium or not (regardless whether they owned it themselves). By counting the owned and used media, variable "variety of media possession and use" was created. This variable has had a strong connection to media sign literacy in 4- to 6-year-olds (Nieding et al., 2017).

### 2.3.3. Intelligence

To estimate intelligence quotient, two scales of the Culture Fair Test 20-R by Weiß (2006) were included. The CFT 20-R has an excellent split-half-reliability with r = .92 and a retest-reliability of r = .85. The subscales in the first part of the test exhibited selectivity of $r_{it}$= .41 to $r_{it}$ = .46 for 11- to 15-year-olds; retest reliability was r = .92. We chose the subscales *classifications* and *matrices* because they showed the highest split-half reliability ($rtt_{classifications}$ = .78), with an inter-correlation of r = .39 in the CFT for children, and have been well tried in our own research (Nieding et al., 2017). Participants had 4 minutes to solve the first scale and three minutes to solve the second. Each included 15 items, and each item gained one point. The points were added up, the maximum score was 30. Results were not normed for age, as no norms existed for the individual scales.

### 2.3.4. Socio-Economic Status

Subjects were asked to name the profession of the parents. This item was used to estimate SES on the Magnitude-Prestige Scale (Wegener, 1985, 1988), as this is highly correlated with actual SES (Hadjar, 2004).

### 2.3.5. Overview of the Empirical Studies

Table 1 summarizes the most important aspects of the pilot study and the three main studies.

Table 1. *Overview of the studies.*

| | N(n) / females (f) | Age | Independent variable | Material | Dependent variable and Correlates |
|---|---|---|---|---|---|
| Pilot study | 34 | Adults | | WMK | |
| Study I | 101 / f = 57.4 % | Adolescents and adults | VMUP, WMK | CFT-20R, ISS, KFN-CSAS-II, OP, PI, PT, SCP, SES VMUP, WMK | IP, SCP |
| Study II | $n_{adolescents} = 50$ / $f_{adolescents} = 44.0\%$; $n_{adults} = 51$ / $f_{adults} = 70.6\%$ | Adolescents vs. adults | Age, VMUP, WMK | AG, CFT-20R, M-PA, RC, RS, SES, VMUP, WMK, | AG, M-PA, MTS, RC, RS |
| Study III | 91 / f = 81.3 % | Adults | Type of text (written, audiovisual, auditory), WMK, VMUP | AG, CFT-20R, InQ, PK, 3 types of text, SES, TBQ, VA, VMUP, WMK | InQ, TBQ |

Note: AG = average grades; CFT-20R = Culture Fair Test-20 revised; InQ = inference questions; ISS = internet addiction scale; KFN-CSAS-II = computer addiction scale; M-PA = mathematical test for personnel selection (used for the adults); MTS = mathematical test for students (used for the students); OP = openness to experience; IP = interest in politics; PK = prior knowledge; PT = perspective-taking; RC = reading comprehension; SES = socio-econimic status; RS = reading speed; SCP = self-concept of competence on political topics; TBQ = text-based questions; VA = verbal ability; VMPU = variety of media possession and use; WMK = Würzburger Medienkompetenztest (media literacy test of Würzburg); Study I and study II were conducted on the same sample.

### 2.4. Statistical Analysis

In all the analyses conducted, a significance level of α = .05 was chosen. If the p-value of a test is smaller than alpha (*p* < α), the test result is considered statistically significant. A low p-value indicates a low probability of receiving a result, such as the one given if the null hypothesis were true. In this case, a 5% or less chance exists that the observed result occurred by chance.

*T-tests*. Independent sample t-tests are used to determine whether the means of the two sets of data from the independent groups are significantly different. This is applied, for example, for comparing the results of 13- and 19-year-olds. The data must be numeric, continuous, and normally distributed. Generally, observations should be independent and outliners considered. When multiple t-tests on the same data take place, a p-value correction takes place.

*Correlations*. Correlations are applied if the strength and direction of a relationship between two linearly related variables are of interest. One example is the link between media literacy and intelligence. The value of the correlation coefficient r ranges from -1 to +1. Every value over 0 describes a positive connection; for example, highly media-literate subjects are more intelligent. A negative value indicates a negative relationship. This means that more intelligent people should be less media-literate and vice versa. An association is stronger when it approaches +1 or -1; r = 0 describes no connection. In the following studies, Pearson's product–moment correlation coefficient (Pearson, 1895) is applied. For this test, the relationship between both variables should follow linearity (a straight relationship) and homoscedasticity (data are equally distributed over the regression line). Each variable has to follow a normal distribution. To evaluate the strength of the correlation, Cohen (1988) conceived the *effect size*. He classified the correlation coefficients from r = .10 to r = .29 as signifying a small association, r = .30 to r = .49 as medium, and r > .50 as a large relationship.

*Hierarchical regressions*. Hierarchical regressions are a type of multiple regression. Multiple regressions are used to examine the relationship between several predictor variables (independent variables) and one criterion (dependent variable). A multiple regression requires at least two predictor variables, but only relevant variables should be included, as the whole model should be reliable. Statistical requirements are linearity of the model, normal distribution of included variables, homoscedasticity, and constant variance of the criterion. The impact of the influence of a predictor variable on the criterion is measured by the beta value. A higher β indicates a greater influence. To assess the association between the observed and the statistically

predicted values, R is used. $R^2$ describes the overlap between these two values. Adjusted $R^2$ refers to the estimate of $R^2$ when the same model is used with a new dataset. Hierarchical regression specifically examines how predictors are selected and entered into the model. Variables can be added and removed in this process. It is used to statistically identify variables with the most predictive power. In hierarchical regression, variables are removed or added in several steps. In this way, the model with the best predictive power can be identified.

*Path analyses*. Path analyses are used to examine causal relationships (Wright, 1930). They can illustrate (inter-)relationships graphically, so an overview of various causations can quickly be gained. In path analyses, regression weights are similarly gained, and exogenous and endogenous variables are distinguished. Exogenous variables have their causes outside of the model, while endogenous variables have them inside of the model. Recursive models are unidirectional, whereas non-recursive models allow reciprocal effects. In the statistical analysis of study I, a non-recursive model is applied.

The quality of the own model can be tested through goodness-of-fit tests. In large samples, the standardized root mean square residual (SRMR) and root mean square error of approximation (RMSEA) are used to measure the model fit. An excellent model would have the SRMR p-value equal to 0, a good model has a $p_{SRMR} < .05$, and a model is still adequate when it receives $p_{SRMR} < .10$. The p-values of RMSEA should be smaller than .05 ($p_{RMSEA} < .05$). Additionally, the Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) are applied. Both these indices are the so-called incremental tests, comparing a base model ($H0$-hypothesis) with the existing model. Both indices should approach 1 for a perfect model fit (CFI = 1; TLI = 1). A CFI > .95 indicates a good model fit, CFI > .90 indicates adequate model fit, and all values of CFI < .90 indicate a bad fit. A TLI > .97 signifies good model fit, while TLI > .95 indicates adequate model fit. All TLI values below .95 indicate a bad model fit; values of TLI > 1 show that more than necessary parameters are specified in the model. Generally, the sample should be 20 times larger than the number of included parameters. Data for a path analysis must be interval-scaled and the association should be both causal and additive. The model assumes that the error terms between the variables are uncorrelated. One drawback of the path analysis is that it cannot provide information about the direction of causality.

This section provides information on the materials and statistical methods used in the three studies. In the following section, the empirical studies are presented.

## 3. Empirical Studies

### 3.1. Study I: Association between Media Literacy, Interest in Politics, and Political Self-Concept

For the present purposes, the hypothesis of whether people with a higher level of media literacy score higher on interest in politics and on political self-concept is examined. The control variables were perspective-taking, openness, sex, SES, intelligence, variety of media possession and use, and age; the exclusion criterion is an existing computer or internet addiction. Hierarchical regressions and a path analysis are conducted to test the theoretical model and to specify potential causal connections. Additionally, an evaluation of the WMK is conducted.

#### 3.1.1. Aim of Study I and Research Questions

*Interest in Politics and Political Self-Concept*

As stated above, concerns are widespread that interest in politics might decline even and new media are discussed as a remedy. Not just using the Internet is of importance, but a competent kind of use, summarized as media literacy, matters. Direct connections between media literacy and interest in politics (Kahne et al., 2012a) and the use of digital learning environments and political participation were found (Kahne & Bowyer, 2019). Most studies that were concerned with media literacy and its impact in political variables, like participation or efficacy, regarded interest in politics as a control variable. The author assumes that interest as an important variable that links media literacy with political participation. Indeed, Craig (1979) could show that political efficacy, interest in politics and political participation are associated. Most of the above studies confined their attention to the Internet medium. This is considered a weakness, as the Internet is neither comprehensive nor the sole source of information.

Thus, the first hypothesis proposes that people with a higher level of media literacy should also show a higher level of interest in politics (H 1).

It is assumed that the person's self-concept of their own competence in political issues mediates between media literacy and political participation. As it happens, news media literacy increases people's confidence to engage in online political activities (e.g. Kahne et al., 2012a, Wang, 2007). Additionally, media literacy trainings have a positive impact on confidence in own political competence (Kahne & Westheimer, 2006; Pasek, et al., 2008).

In summary, the second hypothesis assumes that people with a higher level of media literacy should also show a better political self-concept (H 2).

### Control variables

*Openness for Experiences and Perspective-Taking*

As control variables, we included users' personality traits openness to experience and perspective-taking (Davis, 1983; Paulus, 2011), as they interact with media literacy and interest in politics or political self-concept. Openness is positively associated to critical thinking (Clifford et al., 2004), which is a core component of media literacy. Kahne et al. (2012) found that digital media literacy activities are linked to higher online exposure to diverse perspectives, which has been shown to foster perspective-taking and political tolerance (Mutz, 2006; Price et al., 2002), with lower outgroup antagonism than in offline exposure (Williams, 2007). Kellner and Share (2007) argued that contemporary media offer minority and repressed groups the capacity to voice their own meanings, inviting the dominant culture to share their experiences. They state that in this way, critical media literacy offers a means of promoting multicultural literacy (Cortés, 2000; Courts, 1998; Weil, 1998). This is, of course, an optimistic view, as the possibility of expressing one's meaning does not necessarily mean that it will be perceived or understood in the same way by those consuming this content. Vecchione and Caprara (2009) found that adults who described themselves as more open also exhibited greater political efficacy and consequently participated more. Bekkers (2005) found that people who report more perspective-taking also volunteer more, hold multiple memberships, and are more active citizens. It is surmised here that subjects with more interest in politics and a better self-concept in that area will also be characterized by more perspective-taking.

*Further Control Variables*

With regard to further control variables, the so-called digital-divides, which refers to the disproportionality of access or use of ICT (internet and computer technology), were focused on. Sex and SES were included as typical factors (DiMaggio et al., 2001; Norris, 2001), as women spend less time online (Best & Krueger, 2005; Bimber, 2000; Norris, 1999), visit different websites than men, and use the Internet differently (Wasserman & Richmond-Abbott, 2005), although this gap between the sexes is already narrowing (DiMaggio et al., 2001; Van Dijk, 2005). Overall, European males participate more in politics than females (Maraffi, 2007). SES was also included here because online users are generally more educated and have higher incomes than non-users (Jung, Qiu, & Kim, 2001; Norris, 1999), with recent evidence that this effect is increasing; Better educated people are more likely to seek information online while those who are less educated tend to use the Internet for entertainment (Shah, Kwak, & Holbert,

2001). Intelligence was controlled for, the possibility that IQ is a hidden third variable affecting media literacy, interest in politics, and political self-concept, should be excluded. There is a known correlation between intelligence and media sign literacy in children (Nieding et al., 2016). Further control variables were age and variety of media possession and use, as experience seems likely to influence media literacy, interest in politics, and political self-concept. Potential subjects who were either computer- or Internet-addicted were excluded from the study.

### 3.1.2. Method

### 3.1.2.1. Design and Sample

As stated above, the two different age samples were regarded as one. Using a correlational, cross sectional design, our complete sample consisted of 101 German adolescents and young adults between 13;1 and 20;0 ($M_{age}$ = 16;01; $SD_{age}$ = 3.02, f = 58%).

### 3.1.2.2. Tasks and Test Instruments

Media literacy, intelligence, SES, and variety of media possession and use were assessed as described in III.2.3.

*Socio-demographic questions*

Subjects had to answer a questionnaire about their socio-demographic status, including their age, sex, education level, and parents' profession. This last item was used to estimate socioeconomic status on the Magnitude-Prestige Scale (Wegener, 1985, 1988), as this is highly correlated with actual SES (Hadjar, 2004).

*Interest in politics and political self-concept*

Interest was rated on a 7-point scale ranging from *not at all* to *very much*. The political self-concept was assessed using a German adaptation of the Self-Description Questionnaire III by Schwanzer et al. (2005). In this questionnaire, the subscale *self-concept of competence in political topics* contained questions about whether a subject finds it easy to join a discussion about politics and to think in political terms.

*Perspective-taking*

*Perspective-taking* (PT) was assessed using the Saarbrücker Personality Questionnaire (SPF; Paulus, 2011), a German adaptation of the Interpersonal Reactivity Index (IRI; Davis,

1983), with four items for each of the four aspects perspective-taking, fantasy, empathic concern, and personal distress. PT describes the ability to spontaneously regard an object from the perspective of another person.

*Openness to experience*

To assess openness, the scale *Openness to Experience*, which includes four items with two reversed, from the German version of the 10-Item Big Five Inventory (BFI-10; Rammstedt, 2007) was used.

*Computer and internet addiction*

To exclude subjects with addiction problems, a *computer addiction scale* (KFN-CSAS-II; by Rehbein, Kleimann, & Mößle, 2009) was used; *Internet addiction* was measured on the ISS (Internetsuchtskala; internet addiction scale) developed by Hahn and Jerusalem (2010). No subject was excluded from the analysis because of an existing addiction.

### 3.1.2.3. Procedure

As study I and II are not separate studies but one very comprehensive study, the entire procedure will be described here. Like that, variables which will be relevant for study II will be introduced in advance. Each subject first received a set of questionnaires and a pen; no more than five subjects were tested at one time. To begin, each subject filled out the questionnaire on socio-demographic and personal data at their own pace. All subjects then completed the intelligence test at the same time. The reading and mathematical tests were conducted after the IQ test, before participants filled out the SPF and the media use questionnaire separately. When a subject had finished, they moved on to the computer-based items. The experiment was programmed using HTML5 and JavaScript and was presented on a 17" computer, each with a mouse and headphones. The PC-based test was followed by the questionnaires about *knowledge of media effects* and *knowledge of media law*, *BFI-10*, *self-concept*, and *addiction*.

### 3.1.3. Results

*Test-quality*

The preconditions for a factor-analyses were not met, because we had less than four participants for each variable, (Backhaus et al., 2003), thus reliability analysis were conducted. The results on the WMK subscales were acceptable, ranging from $M_{Media\ sign\ literacy} = .53$ ($SD_{Media\ sign\ literacy} = .15$) to $M_{Production\ skills} = .72$ ($SD_{Production\ skills} = .18$), with an overall mean of $M_{Media}$

_literacy_ = .63 (*SD*_Media literacy_ = .12; see Table 2). The overall reliability of the complete test was excellent, with a Cronbach's alpha of .91. As the alpha value automatically improves with the number of items, the reliability of each subscale was estimated separately. This ranged from an acceptable value of α_Distinction of reality and fiction_ = .65 to an excellent α_Production skills_ = .85 (Table 3). The scales were all highly inter-correlated (*p* < .01), indicating good construct validity (Table 4).

Table 2. *Mean values and standard deviations: age, media literacy, and respective subscales; interest in politics and political self-concept; PT and openness.*

| | Mean value (SD) | Mean value: females (SD) | Mean value: males (SD) |
|---|---|---|---|
| Age [years; months] | 16;1.2 (3.02) | 16;8.2 (2; 9.3)** | 15;2.0 (2; 9.1)** |
| Media literacy | .63 (.12) | .64 (.10) | .60 (.14) |
| Distinction between reality and fiction | .55 (.16) | .56 (.17) | .54 (.15) |
| Knowledge of media law | .59 (.15) | .63 (.13)** | .55 (.17)** |
| Media sign literacy | .53 (.15) | .52 (.12) [**] | .55 (.18) [**] |
| Knowledge of media effects | .68 (.15) | .73 (.13)** [**] | .61 (15)** [**] |
| Production skills | .72 (.18) | .75 (.15) | .68 (.21) |
| Interest in politics | 3.68 (1.77) | 3.86 (1.59) | 3.44 (1.97) |
| Political self-concept | 9.72 (2.69) | 9.98 (3.12) | 9.36 (3.08) |
| PT | 13.73 (2.67) | 14.19 (2.4)* | 13.12 (2.95)* |
| Openness | 4.87 (1.98) | 4.57 (1.94)* [*] | 5.44 (3.08)* [*] |

*Significant group differences in t-tests * p < 0.05; ** p =< 0.01*

*[Significant group differences in* MANCOVA *with age as control variable * p < 0.05; ** p < 0.01]*

Table 3. *Internal consistency (Cronbach's α) of media literacy and the subscales media sign literacy, distinction between reality and fiction, knowledge of media law, knowledge of media effects and production skills.*

|  | Media literacy | Media sign literacy | Distinction between reality and fiction | Media law | Knowledge of media effects | Production skills |
|---|---|---|---|---|---|---|
| Cronbach's alpha | .91 | .83 | .65 | .70 | .67 | .85 |
| Number of Items (N) | 135 | 52 | 14 | 26 | 25 | 18 |

Table 4. *Correlations between media literacy and the scales* distinction between reality and fiction, knowledge of media law, media sign literacy, knowledge of media effects *and* production skills.

|  | Media literacy | Media sign literacy | Distinction between reality and fiction | Knowledge of media law | Knowledge of media effects |
|---|---|---|---|---|---|
| Media sign literacy | .77** |  |  |  |  |
| Distinction between reality and fiction | .79** | .55** |  |  |  |
| Knowledge of media law | .68** | .42** | .48** |  |  |
| Knowledge of media effects | .76** | .43** | .48** | .44** |  |
| Production skills | .79** | .64** | .45** | .38** | .54** |

*Note: *$p < .05$; **$p < .01$

*Media possession and use*

On average, subjects owned six different media devices ($M = 5.87$; $SD = 1.53$). All participants reported having a TV, a radio, and Internet access at home, and 95 % owned a smartphone. Participants spent most of their time watching TV and on social networks, with 78.2 % using both at least several times per week, and 92.1% had a social network account. Other media used at least several times a week included radio (used by 67%), books (51.5 %,) newspapers (20.8 %), and magazines (8 %).

*Correlations*

As a first step in the analyses, the correlations between media literacy and the above variables were tested for, using Pearson's product-moment correlation coefficient (see Table 5). The highest positive correlation was between media literacy and age ($r = .72$; $p < .01$). Other highly significant positive correlations with media literacy ($p < .01$) included intelligence ($r = .60$), variety of media possession and use ($r = .58$), interest in politics ($r = .52$), PT ($r = .36$), political self-concept ($r = .41$), and father's SES ($r = .23$). Interest in politics was correlated with variety of media possession and use ($r = .42$), age ($r = .37$), PT ($r = .30$), and intelligence ($r = .26$). Political self-concept showed positive correlations with interest in politics ($r = .65$), variety of media possession and use ($r = .29$), and age ($r = .25$); no links were found to other variables (including intelligence).

*Partial correlations*

Age—the variable most highly correlated with media literacy—was also found to be highly correlated with almost all other variables (see Table 5). As the impact of intelligence should be excluded on the results, the data were re-analyzed with partial correlations, using age and intelligence as control variables (see square bracketed items in Table 5). In this case, the links between media literacy and PT and variety of media possession and use disappeared, and other correlations diminished, but remained significant, including media literacy's links with interest in politics ($r = .43$), political self-concept ($r = .38$), and father's SES ($r = .28$). Consequently, hypothesis 1 and 2 could be confirmed.

Table 5. *Correlations between media literacy, interest in politics, political self-concept, age, intelligence, variety of media possession and use, socio-economic status (SES) of mother and father, PT, and openness. [Partial correlations between media literacy, interest in politics, political self-concept, variety of media possession and use, socio-economic status (SES) of mother and father, PT, and openness, controlled for age and intelligence.]*

| | Media literacy | Age | Intelligence | Interest in politics | Political self-concept | Variety of media possession and use | SES father | SES mother | PT |
|---|---|---|---|---|---|---|---|---|---|
| Age | .72** | | | | | | | | |
| Intelligence | .60** | .45** | | | | | | | |
| Interest in politics | .52** [.43**] | .37** | .26** | | | | | | |
| Political self-concept | .41** [.38**] | .25* | .11 | .65** [.67**] | | | | | |
| Variety of media possession and use | .58** [.27] | .67** | .31** | .42** [.25] | .29** [.24*] | | | | |
| SES father | .23** [.28*] | .12 | .14 | .15 [.11] | .04 [0.4] | .13 [.07] | | | |
| SES mother | .13 [-.04] | .06 | .28** | -.01 [-.11] | -.10 [-.14] | .05 [.01] | .46** [.58**] | | |
| PT | .36** [.19] | .25* | .21* | .30** [.22*] | .18 [.14] | .23* [.09] | .10 [.15] | .04 [-.05] | |
| Openness | -.08 [.06] | -.08 | -.08 | .18 [.24*] | -.04 [-.02] | .03 [.11] | .05 [.07] | -.17 [-.18] | -.11 [-.07] |

Note: * $p < 0.05$; ** $p < 0.01$; Sex: women coded as 0, men coded as 1.

*Hierarchical regressions and path analysis*

As a next step, a hierarchical regression was performed to investigate the theoretical impact of age, intelligence, openness to experience, PT, variety of media possession and use, and media literacy on interest in politics as the dependent variable (Table 6). It included variables that showed significant associations in partial correlation and those, which were mostly in line with the theoretical assumptions. Only media use showed no significant results. Two models were tested, the first of which analyzed the impact of the control variables intelligence and age on interest in politics while the second introduced the other variables. The first model predicted 10% of the variance; the second model increased the explained variance to 36% ($\Delta R^2 = .26$; $p = .00$). Media literacy proved to be the biggest influence ($\beta = .54$), while intelligence made no significant contribution in either model. Another hierarchical regression was performed with political self-concept as criterion in relation to age, intelligence, interest in politics, variety of media possession and use, and media literacy (see Table 6). Again, two models were tested; with intelligence and age as control variables, the first model predicted only 8% of variance. However, the second model predicted 50 % of variance, and interest in politics had a beta weight of $\beta = .63$. None of the other factors contributed significantly to the explained variance.

To further test our model in light of these findings, we conducted a path analysis with political self-concept as criterion and interest in politics as predictor. Secondly, as predictors for interest in politics served age, openness to experience, PT, variety of media possession and use, and media literacy. Given the relatively large sample, SRMR and RMSEA were used as measures of model fit. Both showed satisfactory results ($p_{SRMR} = .003$; $p_{RMSEA} = .000$); CFI reached 1.00 and TLI 1.03. Figure 5 shows the distinct influence of each variable on interest in politics and on political self-concept. Media literacy remains the most powerful predictor, and media literacy and openness are the only significant factors. The TLI indicates an overfitting of the model. This suggests that some variables do not add significantly to the explanatory power of the model

Table 6. *Hierarchical regression analyses for interest in politics and political self-concept.*

| | Variable | *B* | SE *B* | *ß* | p | R | R² | Δ Change in R ² |
|---|---|---|---|---|---|---|---|---|
| *Interest in politics* | | | | | | | | |
| Model 1 | Intelligence | 0.68 | 1. 73 | 0.05 | = .697 | .32 | .10 | |
| | Age | 0.18 | 0.07 | 0.30 | = .012 | | | |
| Model 2 | Intelligence | - 2.00 | 1.71 | - 0.13 | = .250 | .60 | .36 | .26*** |
| | Age | - 0.09 | 0.09 | - 0.16 | = .301 | | | |
| | Openness | 0.19 | 0.08 | 0.22 | = .024 | | | |
| | PT | 0.10 | 0.07 | 0.15 | = .139 | | | |
| | Variety of media possession and use | 0.22 | 0.15 | 0.19 | = .149 | | | |
| | Media literacy | 8.26 | 2.34 | 0.54 | = .001 | | | |
| *Political self-concept* | | | | | | | | |
| Model 1 | Intelligence | - 0.91 | 3.07 | - 0.04 | = .768 | .27 | .08 | |
| | Age | 0.30 | 0.12 | 0.29 | = .017 | | | |
| Model 2 | Intelligence | - 3.28 | 2.64 | - 0.13 | = .217 | .70 | .50 | .48*** |
| | Age | - 0.04 | 0.14 | - 0.04 | = .772 | | | |
| | Interest in politics | 1.10 | 0.17 | 0.63 | < .001 | | | |
| | Variety of media possession and use | 0.16 | 0.24 | 0.08 | = .512 | | | |
| | Media literacy | 3.76 | 3.81 | 0.14 | = . 326 | | | |

*** $p < .001$

Media literacy

.72**

Age

.25**

Perspective taking

Variety of media
possession

Openness

.36**

.58**

.67**

.46**

Interest in
politics

.65**

Political self-
concept

.22*

p(RMSEA) = .000     CFI = 1.00
p(SRMR) =  .003     TLI = 1.03
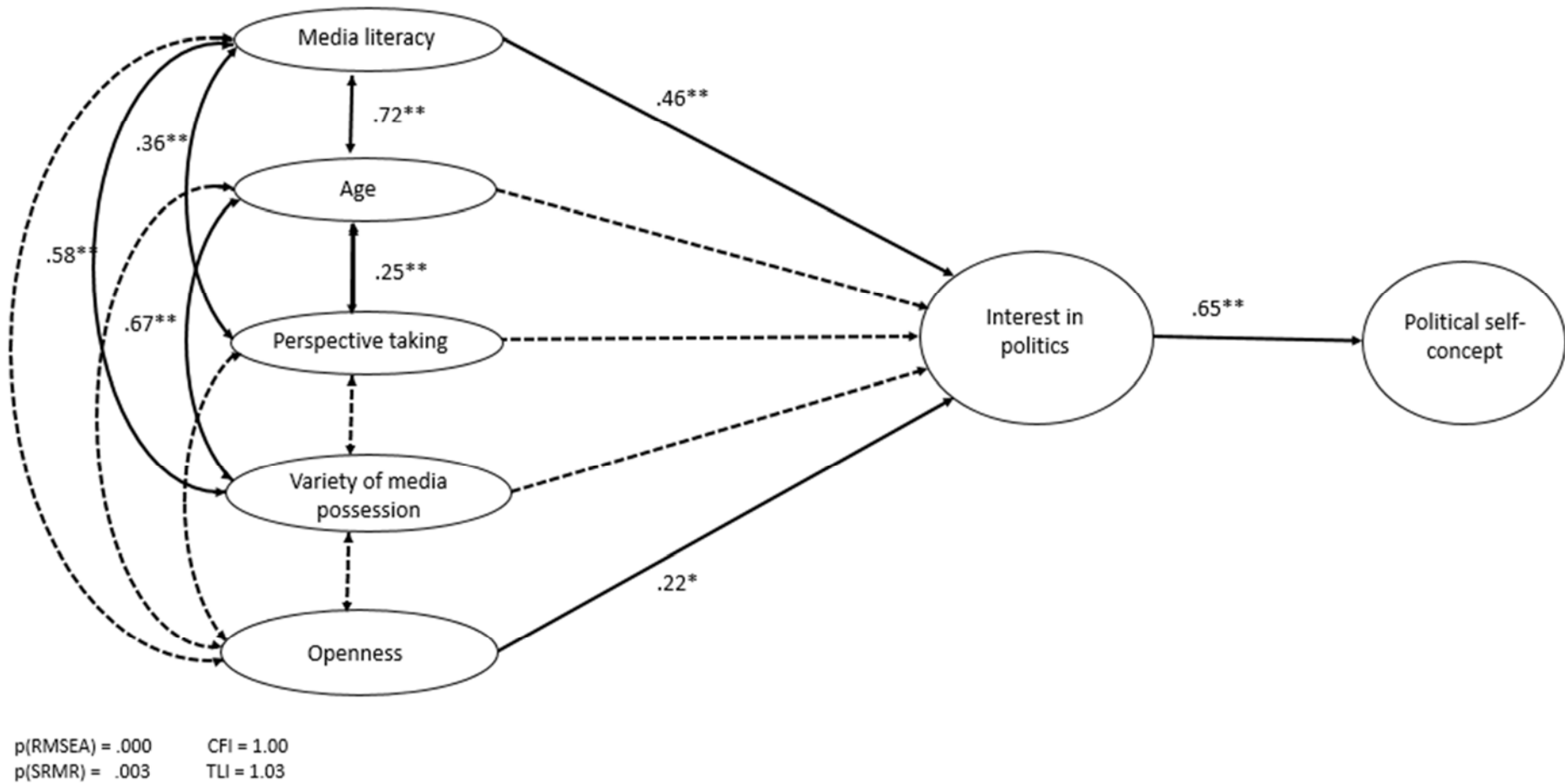
*Figure 5.* Path analysis: relationship between media literacy, age, PT, variety of media possession and use, openness, interest in politics, and political self-concept. (Non-significant relations are represented by dashed lines.)

### 3.1.4. Discussion

The aim of the present study was to investigate links between media literacy, interest in politics, and political self-concept, controlling for age, intelligence, openness to experience, and PT. Correlations confirmed the two hypotheses, results showed that subjects with a higher level of media literacy display more interest in politics and a better political self-concept. More media-literate subjects reported more PT but not more openness to experience. Those who were more interested in politics reported more openness and PT, but there was no difference in openness or PT as a function of political self-concept. The hierarchical regressions and path analysis show that media literacy and openness have a direct influence on interest on politics. Political self-concept was found to be directly determined by interest in politics only.

Former studies found that people with a higher IQ usually report more interest in politics and more participation (Deary et al., 2008). In study I, only the correlation between intelligence and interest in politics was significant, but intelligence had no apparent influence on interest in politics in hierarchical regressions, as. One possible explanation is that intelligence's impact on interest in politics was explained by its correlation with age and media literacy. Both, age and media literacy, influence interest in politics in correlations in regression and – for age indirectly via media literacy - in path analysis. Sunshine Hillygus (2005) found another possible explanation why intelligence did not add significantly to hierarchical regression. In her research, she could show that education rather than intelligence influences political engagement. Given the composition of the sample of study I, both variables, education level (see above) and intelligence were broadly similar. Intelligence had a comparatively high average with little deviation in our cohort (M = .77; SD = .12). These two explanations seem most likely to account for why intelligence did not contribute significantly to the tested model. Although media literacy and intelligence are positively correlated, they seem to be distinct constructs, as the former was found to influence interest in politics and self-concept while the latter did not.

Even though former studies found an association between openness to experiences and political participation (e.g. Vecchione & Caprara, 2009), study I could not find a connection between openness and political self-concept. An indirect connection could occur, as I consider self-concept a pre-stage and mediator of political participation. In that case, the results align with earlier findings. Additionally, openness seems a better predictor of non-political participation such as membership of cultural organizations or volunteering (Bekkers, 2005). Although Vecchione and Caprara (2009) found that openness had a significant influence on

political efficacy and participation in adults, they failed to establish this link in adolescents, which suggests that the young age of our sample may be of relevance. PT showed no effect on interest in politics and had only a distant influence on political self-concept. One possible explanation is that the relation to memberships and volunteering found by Bekkers (2005) may also have included non-political activities.

Taken together, these results strongly indicate the crucial role of media literacy in stimulating interest in politics, which fosters political self-concept and may ultimately lead to further political participation.

### 3.1.4.1. Limitations and Future Directions

On most of the scales of the WMK, our sample's mean result was slightly above the medium range of M = .5 and was normally distributed (see Table 2). The only exception was in the case of *production skills*, where the average was *M* = .72. Nevertheless, it was decided not to alter the items, as the sample consisted mainly of adolescents at the highest education level and university students. It remains likely that the tasks will prove appropriate for the general population.

Future research might usefully investigate the assumption that political knowledge increases likelihood of participation, and that media literacy may therefore play a crucial role in political participation (Ashley et al., 2017; Delli Carpini & Keeter, 1996; Geers et al., 2020). Political knowledge might be a further intermediate step between media literacy and political participation, as knowledge can enhance the political self-concept (Ashley et al., 2017), which in turn fosters political participation, as shown in this study. It would also seem useful to directly assess the link with political participation as mediated by interest in politics and political self-concept. There are already studies confirming the link between time spent online and political participation in adolescents and adults (Kahne & Bowyer, 2019), and of a connection with certain forms of action, including blogging, joining discussions, or forwarding emails with political content (De Vreese, 2007; Quintelier & Vissers, 2008; Solop, 2000). This effect is more pronounced in young adults, as they are more likely than older adults to search for political information online (Jung et al., 2001; Lupia & Philpot, 2002). Although young people exhibit less classical political participation, they report greater civil participation and community involvement (Eden & Roker, 2002; Zukin, 2006). Kahne et al., (2013) see great promise in this trend, as engagement in other participatory cultures may serve as a gateway to participation in political life.

### 3.1.4.2. Conclusion

In line with other research, the present findings confirm that media literacy should be considered an essential part of adolescents' education. As well as protecting adolescents against negative media influences, media literacy teaches them how to exploit and learn efficiently from the media, as well as promoting skills that form engaged citizens, enhancing their motivation and competence to participate in social life (Kellner & Share, 2007). According to UNESCO, one benefit of communication media is that, by promoting international dialog, they play a crucial role in encouraging tolerance (Peréz Tornero & Varis, 2010). The new media literacy movements emphasize cultural diversity and intercultural dialog (Peréz Tornero & Varis, 2010), making media literacy a core competency for participating in and enhancing twenty-first century society.

### 3.1.5. Summary of Study I

The aim of this study I was to investigate the link between media literacy as a broad construct and interest in politics and political self-concept. Using a cross-sectional correlational design, the sample comprised 101 adolescents and young adults ranging in age from 13 to 20 years. Hierarchical regressions and path analyses revealed the strong impact of media literacy on interest in politics; the only other significant factor was openness to experience. Interestingly, age and intelligence did not contribute significantly. Political self-concept was predicted only by interest in politics. The WMK proved to be an adequate tool to assess media literacy.

In the following section, the second study will be introduced. It was conducted on the same sample. The focused shall be moved from societal variables that to academic skills and achievement. Further, the comparison of two age groups shall take place, in order to evaluate whether a development of media literacy takes place in adolescents and if the development takes place equally in all scales.

### 3.2. Study II: The Impact of Media Literacy on Mathematical Skills, Reading Skills, and on School Grades

For present purposes, the question whether people with a higher level of media literacy also show a higher reading speed and better comprehension, mathematical abilities, and average grades was regarded. Additionally, media literacy's development during adolescence will be examined. As control variables, sex, SES, intelligence, variety of media possession and use,

and age will be considered. Hierarchical regressions and path-analyses shall be conducted to illustrate the associations.

### 3.2.1. Aim of Study II and Research Questions

The aim of the second study was to investigate the influence of media literacy on adolescent and young adult academic attainment and abilities. It was assumed that students with higher levels of media literacy would report better school grades and achieve better results in mathematics and reading tests. These two academic skills were selected because they create the foundation for further learning. So far, there is little research showing a connection between media literacy and school attainment. Evidence of a direct positive connection between media literacy and educational success comes from research with preschoolers. In a longitudinal study of children that began at age four, it was found that an initial high level of media sign literacy had a positive effect on the precursors for mathematical, reading, and writing skills in preschool (Nieding et al., 2017). In another longitudinal study, Paino and Renzulli (2013) found that third grade students who were rated higher in computer proficiency by their teachers showed better academic abilities in mathematics and reading in the fifth grade. Additionally, computer and mathematical literacy are correlated in sixth graders (Ic & Tutak, 2018); associations between components of media literacy and reading skills have also been found (e.g., Nieding et al., 2017; Paino & Renzulli, 2013). Further evidence for a positive association between media literacy and academic performance comes from training studies. Hobbs and Frost (2003) introduced a one-year media literacy curriculum to eleventh graders. Compared to the control group, their writing quantity and quality, ability to identify the purpose, target audience, and construction techniques in media messages, and identification of omitted information all showed significant improvement.

Children today do not learn solely from written texts; other media are becoming increasingly important. In a meta-analysis, Takacs et al. (2015) showed that multimedia features can to a certain degree compensate for a missing a teaching adult in developing the story comprehension of children. Children who are more media-literate are likely to profit even more from these modern texts in terms of vocabulary and text comprehension. Indeed, Diergarten et al. (2017) found that media literacy is an important factor to explain inter-individual differences in children between four and six years old in comprehension and learning from different kinds of media. Of course, reading abilities are the foundation for successfully handling modern media. When searching information in hypertext, for instance, being able to navigate successfully through the pages is of no use if the content of the text is not understood. A quicker

and easier processing of the sign systems used in media eases the acquisition of new information, to the great advantage of the learner. There is evidence that media literacy becomes even more important for reading non-classical media, as the reading comprehension process is different in classical text reading (Coiro & Dobler, 2007; Schilling, 2012). Similar applications like drawing inferences and even more complex applications, like navigating through hypertext when reading texts online, are required, suggesting that a more elaborate process of self-directed text construction must take place (Coiro & Dobler, 2007; Schilling, 2012).

Taken together, components of media literacy can promote mathematical skills (e.g., Nieding et al., 2017; Paino & Renzulli, 2013). New media can be applied successfully as instruction aids or in place of instructors in mathematical classes for children of different age groups (Longnecker, 2014). For instance, when acquiring early mathematical skills, primary school children can profit more from tablet intervention than from regular teacher instruction (Pitchford, 2015). If research findings on young children prevail (Diergarten et al., 2017), students with a higher level of media literacy should profit more from these interventions.

The studies above often focused on just one medium, like personal computers (PCs), or only indirectly accessed media literacy. As stated above, results concerning the correlation between media literacy and academic outcome have not yet been clarified, and this study intends to close this gap. In line with former research on young children, it will be examined whether the competent handling of a great variety of media plays a role in the academic outcomes of students. Therefore, academic attainment and abilities will be assessed separately.

It is hypothesized that adolescents and young adults with higher levels of media literacy should also show better reading abilities (H1), demonstrate better mathematical skills (H2), and report higher grades (H3). As presented above, media literacy undergoes crucial development during childhood, but there is still a lack of research concerning its development during adolescence. In accordance with Potter (1998, 2013), it is assumed that advanced skills must be acquired and that constant development of these acquired skills must take place. The fourth hypothesis (H4) is that young adults will show a higher level of media literacy than young adolescents.

The control variables mentioned in study I were considered in this research question as well. Intelligence was included as a control variable since it is correlated to media sign literacy in kindergarten children (Nieding et al., 2017). Additional control variables were sex and—for H1, H2, and H3—age. The variety of media possession and use was also assessed, because

media literacy can only be acquired through practical use. As mentioned in the previous part, computer and internet addiction were assessed to exclude affected participants.

### 3.2.2. Method

### 3.2.2.1. Design and Sample

The samples of the adolescents and young adults (see chapter II.2.1) were now regarded separately. A correlational, cross-sectional design was used.

### 3.2.2.2. Tasks and Test Instruments

For the instruments regarding media literacy, variety of media possession and use, intelligence, computer and internet addiction, see II.3.1.2.2.

*Socio-demographic questions*

This questionnaire contained questions about exact age (years and months), sex, education level, final grade point average (for the older subjects), or current grades in different school subjects (for the younger cohort).

*Reading comprehension and speed*

The Lesegeschwindigkeits- und Verständnistest (LGVT; reading speed and comprehension test), a reading test designed by Schneider et al. (2007) for adolescents aged 12 to 19, was used to assess reading speed and comprehension. Its re-test reliability ranges between $r_{reading\ speed} =$ .84 and $r_{reading\ comprehension} = .87$. Maxima of $Max_{reading\ comprehension} = 46$ and $Max_{reading\ speed} = 100$ (percentile rank of words read in six minutes) could be reached. Both reading comprehension and speed were transferred to T-values, which we converted into scales between 0 and 1, ensuring that each subject could score between 0 and 1. Participants had six minutes for this test. Reading comprehension in this context refers to the understanding of the text base, not the construction of a situation model (see chapter I. 3.1.1.1.1.).

*Mathematical skills*

The adolescents' mathematical ability was assessed using a curricular assortment of 15 tasks (Behörde für Bildung und Sport Hamburg [Authority for Education and Sports Hamburg], 2006), including percentage calculation, calculating areas, geometry, transforming units, and calculating mean values. For the adults, a shortened version of the Mathematiktest für die Personalauswahl (M-PA; mathematical test for personnel selection, Jasper & Wagener, 2013)

was applied to assess general age-appropriate competencies in arithmetic. Tasks included fractional arithmetic, transforming units, square roots, and logarithms. The internal consistency of this shortened scale was .94. Both age groups had eight minutes to solve the tasks. The sum of correct answers was divided by 15 for the adolescents and by 14 for the adults, resulting in a final score from 0 to 1.

### 3.2.2.3. Procedure

As study II was conducted on the same sample as in study I, the procedure was similar to the one described above (see chapter II.3.2.2.3). The reading and mathematical tests were conducted after the IQ test, before participants filled out the media use questionnaire.

### 3.2.3. Results

*Media possession and use*

Different from study I, media possession and use will be outlined separately for each age group. For the 13-year-olds, watching TV was the most popular leisure time activity: 84% reported consuming it at least several times per week, followed by PC (75.0%), radio (68.0%), social media (64.0%), books (48.0%), newspapers (24.0%), and magazines (12.2%). As to the 19-year-olds, PC was used at least several times per week by 96.1%, followed by social media (92.2%), TV (72.5%), radio (56.9 %), books (54.9%), newspapers (17.6%), and magazines (3.9%).

*T-tests*

Independent group t-tests for age as an independent variable (13- vs 19-years of age) and media literacy, media literacy scales, intelligence, reading abilities, mathematical ability, and school attainment as dependent variables were administered. The results showed significant group differences for the final media literacy score and for scales, with all $p$-values < .001. As predicted in H4, an enhancement of media literacy in all dimensions emerged during adolescence, while adults ($M = .70$; $SD = .08$) significantly outperformed adolescents ($M = .53$; $SD = .09$) in total media literacy score ($t(84) = 9.33$, $p < .001$) and in all scales.

Table 7 provides an overview of the mean scores and standard deviations for the named variables for both age groups. Both groups scored lowest in media sign literacy ($t(91) = 6.27$; $p \leq .001$) and highest in production skills ($t(91) = 6.65$; $p \leq .001$). The younger cohort scored similarly low on distinction between reality and fiction. The age groups did not differ in reading

speed or comprehension. Adults showed significantly better results (with *p*-values < .001) in intelligence ($t(99) = -5.01$), mathematical ability ($t(98) = 11.88$), and average grades ($t(86) = 5.51$). It is important to note that intelligence was not normalized to age. As no differences between sexes occurred, results are not reported.

Table 7. *Means and standard deviations of the scales of media literacy, intelligence, reading ability, mathematical ability, and average grades for both age groups.*

| | | $M_{13}$ $(SD_{13})$ | $M_{19}$ $(SD_{19})$ |
|---|---|---|---|
| Media literacy | Media sign literacy | .45*** (.10) | .61*** (.15) |
| | Distinction between reality and fiction | .45*** (.10) | .64*** (.16) |
| | Knowledge of media law | .52*** (.13) | .66*** (.14) |
| | Knowledge of media effects | .61*** (.14) | .76*** (.12) |
| | Production skills | .62*** (.18) | .82*** (.10) |
| | **Total score** | **.53*** (.09)** | **.70*** (.08)** |
| Intelligence | Classification | .65*** (.13) | .81*** (.14) |
| | Matrices | .78* (.12) | .84* (.12) |
| | **Total score** | **.71*** (.11)** | **.82*** (.11)** |
| Reading ability | Total score comprehension | .65 (.26) | .67 (.25) |
| | Total score speed | .54 (.24) | .60 (.23) |
| Mathematical ability | Total score | .39*** (.17) | .81*** (.19) |
| Average grades | | 2.66*** (.80) | 1.83*** (.65) |

*Note: Significant group differences were observed (13- vs. 19-year-olds) in t-test *p < .05; **p < .01; ***p = < .0*

*Correlations*

Table 8 displays the correlations between media literacy, variety of media possession and use, age, intelligence, reading comprehension and speed, mathematical abilities, and average grades. As predicted in H1, H2, and H3, media literacy was significantly correlated with academic abilities and attainment: reading comprehension ($r$ = .33), reading speed (.39), mathematical abilities (.71), and average grades (-.55; in the German grading system, lower marks represent better results; grades range from 1, very good, to 6, failed). Additionally, media literacy was connected to variety of media possession and use (.58), age (.72), and intelligence (.60). Intelligence was correlated significantly with all variables of academic attainment and ability, along with variety of media possession and use (.31). Variety of media possession and use showed significant results with mathematical abilities (.52) and average grades (-.30), but not with reading skills. Reading skills were inter-correlated (.52), but only reading speed was significantly correlated with mathematical ability (.20), and no reading skills correlated with average grades. Mathematical ability showed a significant association with average grades (-.53).

Table 8. *Correlations between media literacy, variety of media possession and use, age, intelligence, reading comprehension, reading speed, and average grades.*

| | Media literacy | Variety of media possession and use | Age | Intelligence | Reading comprehension | Reading speed | Mathematical ability |
|---|---|---|---|---|---|---|---|
| Variety of media possession and use | .58*** | | | | | | |
| Age | .72*** | .67*** | | | | | |
| Intelligence | .60*** | .31** | .45*** | | | | |
| Reading comprehension | .33** | .17 | .05 | .21* | | | |
| Reading speed | .39*** | .12 | .15 | .22* | .52*** | | |
| Mathematical ability | .71*** | .52*** | .77*** | .56*** | .19 | .20* | |
| Average grades | -.55*** | -.30** | -.51*** | -.50*** | -.14 | -.17 | -.53*** |

*Note:* $*p < .05$; $**p < .01$; $***p \leq .001$

Table 9. *Regression analyses to predict academic abilities and achievement.*

| | Variable | *B* | SE *B* | *β* | p | R | R² | ΔR² |
|---|---|---|---|---|---|---|---|---|
| **Reading comprehension** | | | | | | | | |
| Model 1 | Intelligence | .45 | .21 | .22 | = .039 | .22 | .05* | |
| Model 2 | Intelligence | .09 | .26 | .05 | = .732 | .33 | .11** | .06* |
| | Media literacy | .61 | .26 | .30* | = .024 | | | |
| **Reading speed** | | | | | | | | |
| Model 1 | Intelligence | .50 | .20 | .26 | = .016 | .26 | .07* | |
| Model 2 | Intelligence | .08 | .24 | .04 | = . 74 | .39 | .15** | .08** |
| | Media literacy | .71 | .25 | .36 | = .005 | | | |
| **Mathematical ability (complete sample)** | | | | | | | | |
| Model 1 | Age | .06 | .01 | .63 | < .000 | .82 | .68*** | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Intelligence | .75 | .16 | .33 | < .000 | | | |
| Model 2 | Age | .05 | .01 | .54 | < .000 | .83 | .69*** | .01 |
| | Intelligence | .61 | .18 | .27 | = .001 | | | |
| | Variety of media possession and use | -.00 | .02 | -.01 | = .916 | | | |
| | Media literacy | .39 | .24 | .17 | = .107 | | | |
| **Mathematical ability (adolescents)** | | | | | | | | |
| Model 1 | Intelligence | .67 | .23 | .43 | = .006 | .43 | .19** | |
| Model 2 | Intelligence | .62 | .28 | .40 | = .036 | .44 | .19 | .00 |
| | Variety of media possession and use | .01 | .06 | .03 | = .827 | | | |
| | Media literacy | .12 | .37 | .06 | = .737 | | | |
| **Mathematical ability (young adults)** | | | | | | | | |
| Model 1 | Intelligence | .83 | .22 | .50 | < .000 | .50 | .25*** | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model 2 | Intelligence | .64 | .23 | .38 | = .008 | .56 | .32*** | .07 |
| | Variety of media possession and use | -.01 | .02 | -.05 | = .690 | | | |
| | Media literacy | .64 | .31 | .29 | = .047 | | | |

**Average grades**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model 1 | Age | -.09 | .03 | -.32 | = .002 | .60 | .36*** | |
| | Intelligence | -.69 | .66 | -.41 | = .000 | | | |
| Model 2 | Age | -.05 | .04 | -.19 | = .184 | .63 | .39*** | .03 |
| | Intelligence | -2.03 | .72 | -.31 | = .006 | | | |
| | Variety of media possession and use | .03 | .07 | .05 | = .689 | | | |
| | Media literacy | -2.24 | 1.06 | -.30 | = .039 | | | |

*Note: *p < .05; **p < .01; ***p = < .001*

112

*Hierarchical regressions and path-analysis*

To evaluate the differential influences of age, intelligence, media literacy, and variety of media possession and use on academic attainments and abilities, hierarchical regressions were conducted (see Table 9). For each dependent variable, only predictors that showed significant results in correlation analysis were considered.

Reading comprehension was predicted by intelligence and media literacy. As intelligence served as a control variable, it was inserted in the first model, predicting 5% of variance. When media literacy was added, 11% of variance was explained. The same procedure was used concerning reading speed. The first model explained 7% of variance, the second showed 15%. As soon as media literacy was inserted, intelligence made no significant contribution.

Mathematical skills were predicted by age, intelligence, variety of media possession and use, and media literacy. Model 1 included the two control variables age and intelligence, which explained 68% of variance. After adding variety of media possession and use and media literacy, 69% was explained, so neither variable made a significant explanatory contribution. The subsamples showed a strong group difference concerning mathematical skills; therefore, separate regressions were conducted. For adolescents, intelligence alone explained 19% of variance; when variety of media possession and use and media literacy were added, no change occurred (Model 2). In the group of young adults, Model 1 explained 25% of variance, while Model 2 explained 32%, but $\Delta R^2$ was not significant. Variety of media possession and use did not contribute significantly.

Average grades were predicted by age, intelligence, variety of media possession and use, and media literacy. The first model, which used age and intelligence, explained 36% of variance; the second, adding variety of media possession and use and media literacy, explained 39%. Age lost its significant explanatory contribution, while variety of media possession and use showed no significant effect.

As some of the variables in the regressions were inter-correlated, two path analyses were conducted to shed light on their interplay and detect any indirect influences. Neither variety of media possession and use nor age contributed significantly to predict the academic variables in hierarchical regression, but variety of media possession and use and age were associated with media literacy; thus, I wanted to evaluate whether they could be predictors of media literacy.
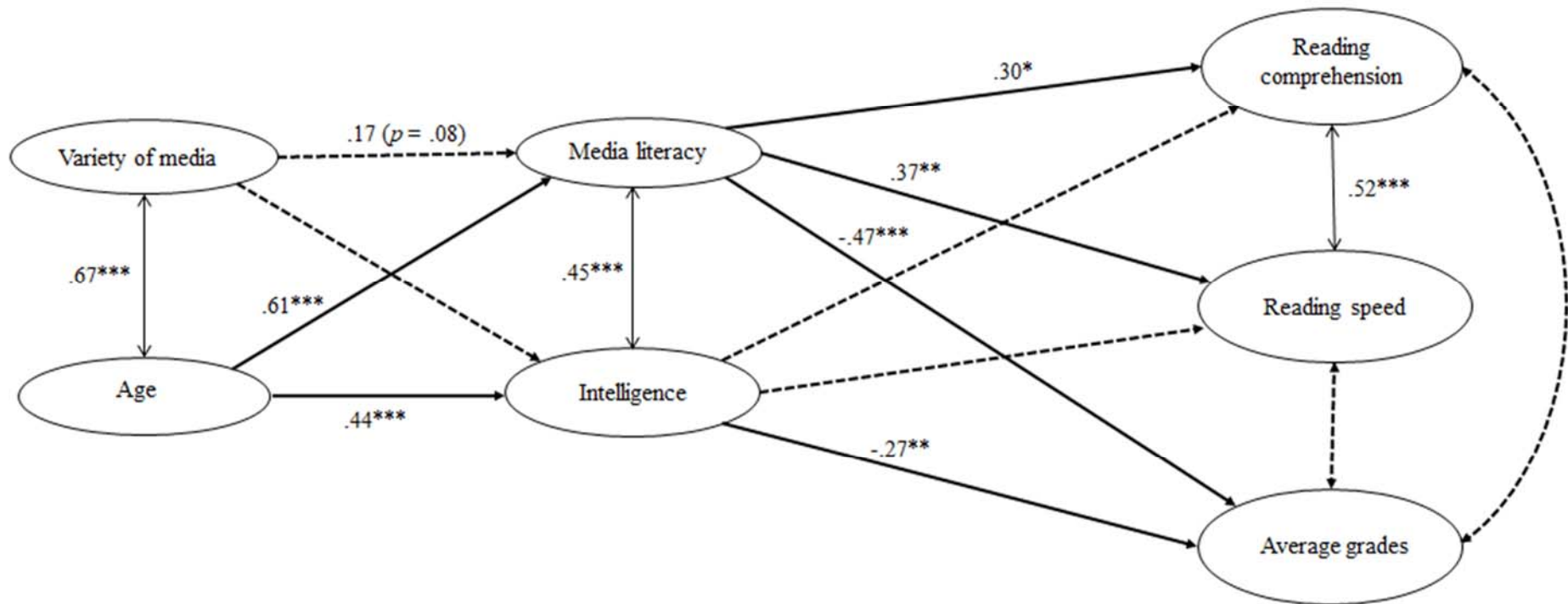
*Figure 6.* Path-analysis depicting the influence of variety of media possession and use and age on media literacy and intelligence, and the impact of media literacy and intelligence on reading literacy and average grades. Non-significant relations are presented with dashed lines.

Figure 6 shows the interplay of the variables. Age and variety of media possession and use served as predictors of media literacy and intelligence. Media literacy and intelligence were used as predictors for reading comprehension and speed and average grades. The model had an excellent fit ($p_{SRMR}$ = .033; $p_{RMSEA}$ = .042; CFI = .944; TLI = .815). Age ($\beta_1$ = .61) influenced media literacy more than variety of media possession and use did ($\beta_2$ = .17); variety of media possession and use did not quite reach the significance level. Age and variety of media possession and use showed a high inter-correlation ($r$ = .67). Age predicted intelligence ($\beta_3$ = .44), while variety of media possession and use had no significant influence. Intelligence did not show a direct effect on either reading skill. However, intelligence was correlated with media literacy ($r$ = .45), which in turn affected reading skills. Intelligence ($\beta_4$ = -.27) and media literacy ($\beta_5$ = -.47) both had an impact on average grades, with media literacy having the stronger one.

The effect of media literacy and intelligence on the mathematical abilities of young adults was analyzed separately. The analysis for 13-year-olds was omitted for methodological reasons (see the discussion below). Media literacy ($\beta_1$ = .32; $p$ < .01) had a stronger impact on mathematical abilities than intelligence ($\beta_2$ = .28; $p$ < .01), but both predictors were inter-correlated (.60; $p$ < .001). The model had an excellent fit ($p_{SRMR}$ = .00; $p_{RMSEA}$ = .00; CFI = 1.00; TLI = 1.00).

### 3.2.4. Discussion

As proposed in H1 to H3, media literacy did indeed correlate with all academic abilities and attainment. It had stronger correlations with mathematical skills than with reading skills. However, it was also correlated with our control variables, intelligence and age. Hierarchical regressions and path analyses confirmed the assumption that media literacy is a stronger predictor for reading skills and average grades than intelligence. This is also true for young adults concerning mathematical skills, according to path analysis. The results show that media literacy is becoming an even more important competence and that the processes found in kindergarten children are maintained during later development. The findings of study II agree with Paino and Renzulli's (2013) predictive value of student computer skills on academic success. They attributed this connection to an increase in cultural capital and a Pygmalion effect[3], because they relied on teachers' evaluations of children's PC proficiency. However,

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[3] The Pygmalion effect describes the phenomenon that high expectations in another person can lead to an enhanced performance in a specific area.

Paino and Renzulli (2013) did not assess student proficiency with personal computers directly; nor did they consider school grades and academic skills separately. As media literacy was assessed directly in study II, the possibility of self-fulfilling prophecies was avoided. Another interpretation could be that the teachers' appraisals were likely adequate. H4 was confirmed as well, as media literacy and its subcomponents develop significantly during adolescence. The most differences occurred in production skills ($\Delta M = .20$) and distinction between reality and fiction ($\Delta M = .19$), while the fewest differences were in knowledge of media law ($\Delta M = .14$).

Concerning reading skills, the predictors media literacy and intelligence only explained a small proportion of variance: 11% for reading comprehension and 15% for reading speed. There may be no causal connection between those factors; rather, reading skills and media literacy may interact with each other. Media sign literacy is important for the acquisition of reading skills (e.g., Nieding et al., 2017), but many types of media require reading skills for an individual to profit from them. There are several other variables that influence student reading abilities, such as prior reading skills, phonological processing (Wagner & Torgesen, 1987), and mastery of vocabulary (Paris, 2005). They were not included in study II, as it focused on the impact of media literacy rather than the development of reading skills. Media literacy had no significant effect on mathematical skills among adolescents. For adults, however, media literacy was more relevant than intelligence. The instrument used to assess mathematical skills could be a reason for the lack of effect in the younger cohort. The 13-year-olds only reached a mean of .39 ($SD = .17$), showing that the tasks in this study were too difficult, especially when the composition of our sample is taken into consideration (see below). Thus, the results for the adults can be regarded as having greater validity. Although they were remarkably successful in the mathematical tasks, these results are in line with their academic careers. In terms of average grades, media literacy was more influential than intelligence.

Why is media literacy more important than intelligence for all investigated variables, at least when adults are considered? Former research has shown that media-literate preschoolers achieve better learning results from hypermedia and films (Diergarten et al., 2017). Children with a higher level of media literacy appear to be more adept at processing and operating medial sign systems. For this reason, they could find it easier to collect information; additionally, they drew more accurate inferences. If this process continues into adolescence and adulthood, it is clear why media literacy plays such an important role in academic careers. Of course, both constructs—intelligence and media literacy—share a common base, which is also reflected in their high correlation. The unshared part of media literacy appears to be crucial for learning

efficiently from media, including the manipulation of internal representations and cognitive organization of the interplay between internal and external representations, symbolic organization, deciphering media content, and the ability to draw inferences from media contents. Although variety of media possession and use was associated with media literacy, it had no effect on academic abilities or attainment. Thus, it is hypothesized that variety of media possession and use could be a predecessor of media literacy. Although variety of media possession and use did not quite reach significance as a predictor of media literacy, this factor should not be disregarded. A close connection between these two constructs has already been found (e.g., Nieding et al., 2017). The number of devices with which a user interacts plays a role in the acquisition of media literacy. Of course, this is not a one-way street; highly media-literate people will also be more willing to explore additional media.

### 3.2.4.1. Limitations and Future Directions

One limitation of study II is that most participants in the younger cohort attended Germany's highest level of secondary education, and almost all adults were university students. Moreover, the sample included more females than males, and they formed the larger portion of the older sample. This made a comparison of any effect of sex difficult. The gap in media use between males and females was already on the verge of closing over a decade ago (e.g., DiMaggio et al., 2001; Van Dijk, 2005), so no great effect due to the sex disproportionality of the sample is expected. Additionally, the tool for the assessment of mathematical skills in 13-year-olds turned out to be too difficult. Therefore, a better, more age-appropriate test must be selected in subsequent studies. Future research should focus on the underlying processes of media literacy's success in influencing academic abilities and attainment. In line with research on preschoolers (Diergarten et al. 2017), it is assumed that more media-literate participants can achieve a better learning outcome from media. To verify this assumption, study III was carried out (see chapter II.3.3.).

### 3.2.4.2. Conclusion

Study II suggests that media literacy has an important impact on academic abilities and attainment. It showed that students require more than intelligence to learn efficiently from media and to have academic success. There are several reasons why teachers refrain from using PCs in the classroom, such as perceived inflexibility of the curriculum or a lack of supporting materials (Baek, 2008).

### 3.2.4.3. Summary of Study II

Study II investigated the influence of media literacy on reading speed and comprehension, mathematical abilities, and average grades. Additionally, media literacy's development during adolescence was examined. The sample consisted of two subgroups, 50 adolescents with a mean age of 13.1 and 51 young adults with a mean age of 19.1 years. The computer-based test WMK was utilized to assess media literacy; reading and mathematical skills were measured with existing tools. Hierarchical regressions and path-analyses revealed that media literacy had an impact on all academic variables, even when controlled for intelligence. Additionally, significant media literacy development seems to take place during adolescence.

In the following section, the last study will be presented. A short version of the WMK will be tested and the influence of media literacy on the effectiveness of learning from three different kinds of media (a written, an auditory, and an audio-visual text) shall be examined. Additionally a comparison between the media concerning learning outcome will take place.

### 3.3. Study III: The Impact of Media Literacy on Learning from Different Kinds of Texts and a Comparison of the Learning Results of these Texts

Within the extensive body of literature on the role of educational media in learning, the possible impact of media literacy remains unexamined. The present study investigates the influence of media literacy on learning from audiovisual, written, and auditory texts. In a sample of 91 young adults, a short version of the WMK will be applied to assess media literacy. Text-based and inference questions will be used to measure learning from audiovisual, written, and auditory texts. The influence of intelligence, verbal ability, media usage, prior knowledge, and socio-economic status will also be assessed. Hierarchical regression analyses will be used to examine the associations.

### 3.3.1. Aim of Study III and Research Questions

In the third study, the hypotheses that media literacy enhances young adults' learning from the following three different kinds of text was examined: an audiovisual text, a written text, and an auditory text. Learning was assessed by text-based and inference questions in multiple-choice format. As stated in the former section, an eased decoding of sign systems should diminish cognitive load and thereby facilitate learning.

The goal was to evaluate whether the impact of media literacy as a broad construct persists in adulthood compared to media sign literacy for children. These three kinds of media that differ in their presentation modality were used to show that media literacy influences all three. A

scientific film documentary about the element thorium was chosen as the audiovisual text. Parallel versions on the same topic were designed as written and auditory texts. Thus H1 states that media literacy has a positive influence on learning (text-based questions and inferences) from three kinds of texts. The second research question focuses on the comparison of learning results between these three different media, assuming that adults should learn best from the written text (e.g., Byrne & Curtis, 2000). Since the literature concerning the comparison between audiovisual and auditory presentation with adults is still inconclusive, no a directed hypothesis is stated, instead adding it as an exploratory question.

To sum it up, H1 states that media literacy has a positive influence on learning (text-based questions and inferences) from three kinds of texts (written, auditory, and audiovisual). H2 assumes that learning outcome (text-based and inferential questions) should be best from a written text, with no supremacy of audiovisual versus auditory text among each other.

As expounded in the theoretical part, prior knowledge has been shown to influence learning from audiovisual texts (Peters & Webb, 2018), written texts (Ainley et al., 2002), and auditory texts ( Buck, 2001; Lynch, 2006) alike; thus it was considered as a control variable.

To measure media literacy, the self-designed computer-based test WMK was used. Tasks included knowledge and practical items aiming at a broad range of commonly used media and different operating systems. Intelligence was included as a control variable since intelligence is also correlated to media sign literacy in kindergarten children (Nieding et al., 2016) and to school attainment and achievement in adults in study II (see also Braun et al., 2018). Additionally, intelligence correlates with media literacy and variety of media use in adults (see study I and Braun et al., 2018). Further control variables were sex, socio-economic status (SES) of the parents, verbal ability, and age. Variety of media possession and use was also included because media literacy is also acquired by practical use.

### 3.3.2. Method

### 3.3.2.1. Design and Sample

As presented in chapter II.2.1, 91 participants formed the final sample. In the written text condition 31 participants were tested, in the audiovisual and the auditory text groups 30 participants each. There was no significant differences (age, sexes) between the groups.

### 3.3.2.2. Tasks and Test Instruments

For the instruments concerning variety of media possession and use, intelligence, and reading comprehension and speed, see study I (chapter II.3.2.2.2.).

*Media Literacy*

The original WMK instrument included 135 items, each aiming at one of following five scales: *media sign literacy, distinction between reality and fiction, knowledge of media law, knowledge of media effects,* and *production skills*. From a former study with 110 young adults (Braun et al., 2018), those items with the highest discrimination were extracted and a short version with 32 items (many including several tasks) of the WMK was constructed. Items from each scale were chosen. A short version of the test was used to evaluate whether a more time-efficient version is feasible, thus allowing a broader use in future studies. The tasks and questionnaires were presented as a computer-based test on a PC with a 17-inch screen. Instruction pages divided the items to give participants the possibility to take a break whenever needed.

*Verbal ability*

In order to assess subjects' verbal ability, the WST (Wortschatztest; vocabulary test) by Schmidt & Metzler (1992) was used. It consists of 40 tasks, each including one target and five distractor words. The items are aligned in increasing level of difficulty. Subjects have to identify the target word in each line. The split-half-reliability is r = .95, internal consistency α = .94. Norms exist for participants from 20 to 90 years of age.

*Socio-democratic questions*

The socio-democratic questionnaire contained questions about age, sex, education level, final grade and grades in different school-subjects (Mathematics, German, Foreign Languages, Physics, Chemistry, Biology), and parents' profession. Analogous to the former studies, this last item was used to estimate socioeconomic status on the Magnitude-Prestige Scale (Wegener, 1985, 1988), as this is highly correlated with actual SES (Hadjar, 2004).

*Prior knowledge*

Participants rated whether they conceived themselves as a layman or an expert on thorium and atomic physics on a scale of one to seven. Participants could gain a maximum of seven points for prior knowledge.

*Learning material*

As learning material in the audiovisual text condition, a short film clip (9 minutes, 4 seconds) of an educational documentary by the German-French broadcaster ARTE (ARTE & Tonelotto, 2014) was chosen. It was cut to better serve the study's purposes. Many expert interviews and talks were included. The image track was not necessary to understand the explanations. The content concerned thorium, an atomic element. First, the discovery of thorium and its physical properties were introduced. Additionally, a comparison to uranium took place. Both are potential nuclear fuels, but thorium cannot be split up directly as uranium can. The first is additionally not fit to be used for atomic bombs, while uranium is. Secondly, different types of reactors that considered the differential properties of thorium and uranium were introduced. Light-water reactors, which function with uranium-oxide pellets, require a great deal of material and hold the danger of overheating, resulting in explosions. Molten salt reactors are presented as a possible solution as they do not hold these disadvantages. This topic was chosen because it is highly specific and commonly unknown to students not majoring in the natural sciences, which none of the participants did.

The second group received an adapted transcript of the film clip as two pages of printed text on a laminated sheet (printed on both sides). The content was completely identical; only the structure differed, bringing it in line with a common educational text. For instance, the audiovisual text included flashbacks, which are unusual in a written educational text, thus the order of the presentation of information was changed. To parallel time as well, participants had a maximum time of nine minutes. For the auditory text condition, the transcript was read by a female reader and recorded as an mp3 (6 minutes, 32 seconds). Participants listened to the sound recording; neither in this nor in the audiovisual condition were participants enabled to rewind, while re-reading was possible in the reading condition within the given nine minutes. Although this proceeding may include an advantage for participants in the reading condition, it was chosen as it most likely resembles the natural learning environment. It was assumed that a person usually re-reads when learning from a written text but does not rewind a documentary film.

*Text-based and inference questions*

All groups received the same 22 questions in a forced-choice format with four alternatives (one correct answer and three distractors) on the PC—half of the questions aiming at explicit text information (text-based questions) and the other half on inferences beyond the explicit

information. Questions were tested beforehand with ten representative participants to ensure that an adequate level of difficulty was achieved. All questions concerned the verbal content, not the picture track, and participants could reach a maximum of 11 points per scale. The difference between reading comprehension test as measured in the former studies by the LGVT and inference test is that while the former ask whether explicitly stated information from the text is understood, the inferences assess the information that is drawn from the text in a greater context. In the text comprehension test LGVT (see chapter II.3.2.2.2.), for example, participants have to pick the right word out of three alternatives to complete a sentence. While this is a good method to investigate whether somebody has understood the meaning of the sentence, it gives no clue whether the information is further processed or understood on a deeper level.

### 3.3.2.3. Procedure

Each participant first received a set of questionnaires and a pen; no more than five participants were tested at one time. In the beginning, participants answered a questionnaire concerning socio-demographic items. After finishing, they completed the WST and the CFT as group tests. Each participant received the learning material; either the written text was handed out, or the video or auditory recording was started on a PC with a 17-inch screen. A PC-mouse and headphones were attached to each PC. Participants in the auditory condition listened to the sound recording through the headphones, and during this time the screen of the laptop was blank; the investigator started the recording for each participant separately. In the audiovisual condition, the investigator likewise started the film for each participant separately on the laptop, and the audio track was heard through the headphones. After that, participants had to rate their prior knowledge. No pretest was used before the text was presented as this might have activated knowledge structures (Viteri et al., 2014). However, it was important to let participants rate their prior knowledge before the text-based and inference questions began. Otherwise, participants might have adjusted the self-evaluation to the difficulty of the questions. After finishing the text-based and inference questions, the media use questionnaire was filled out. Lastly, the computer-based WMK followed. The tool was programmed with HTML5 and JavaScript. Participants who knew the documentary previously were excluded from analysis.

### 3.3.3. Results

*Procedure of analyses*

For the analyses of the data, first, correlation and partial correlations with intelligence and prior knowledge as control variables are regarded. Second, MANCOVAs are performed to evaluate whether the kind of text has an influence on the learning outcome. Subsequently, t-tests are used to show which condition facilitates learning the most. Lastly, hierarchical regression analyses are conducted to compare whether intelligence, media literacy, or prior knowledge have more influence on knowledge acquisition and/or text inferences.

*Correlations and partial correlations*

Table 10 displays the correlations between text-based questions, inference questions, media literacy, variety of media use and possession, intelligence, prior knowledge, verbal ability, average grades, and SES. As text-based questions, inference questions, and media literacy were correlated with the control variables intelligence and prior knowledge, and variety of media use and possession with intelligence, partial correlations were conducted (see square bracketed items in Table 10). When controlling for intelligence and prior knowledge, text-based questions were only associated with inference questions ($r = .27$). Inference questions were associated with media literacy (.26) and average grades (-.26). Media literacy was correlated additionally with verbal ability (.42). Average grades correlated significantly with the SES of the father (-.23) and the mother (-.23).

Table 10. *Correlations between text-based questions, inference questions, media literacy, variety of media possession and use, intelligence, prior knowledge, verbal ability, average grades, SES of the father, and SES of the mother. [Partial correlations between text-based questions, inference questions, media literacy, variety of media possession and use, verbal ability, average grades, SES of the father, and SES of the mother, controlled f or prior knowledge and intelligence.]*

| | Text-based questions | Inference questions | Media literacy | Variety of media use and possession | Intelligence | Prior knowledge | Verbal ability | Average grades | SES father |
|---|---|---|---|---|---|---|---|---|---|
| Inference questions | 39*** [.27**] | | | | | | | | |
| Media literacy | .19 [.07] | .40*** [.26*] | | | | | . | | |
| Variety of media use and possession | .11 [.04] | .08 [-.05] | .16 [.09] | | | | | | |
| Intelligence | .21* | .35** | .26* | .25* | | | | | |
| Prior knowledge | .30** | .40** | .30** | .15 | .21* | | | | |
| Verbal ability | .14 [.10] | .18 [.14] | .43*** [.42***] | .13 [.12] | .06 | .11 | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Average grades | -.07 [-.01] | -.31** [-.26*] | -.17 [-.10] | .06 [.12] | -.25* | -.04 | -.14 [-.12] | | |
| SES father | -.17 [-.21] | -.14 [-.17] | -.04 [-.04] | .00 [.01] | -.02 | .04 | .11 [.11] | -.22* [-.23*] | |
| SES mother | .00 [-.05] | .07 [.01] | .14 [.10] | -.06 [-.08] | .06 | .13 | .06 [.04] | -.23* [-.23*] | .07 [.07] |

*Note.* *p < .05; **p < .01; ***p =< .001;

Table 11. *Percentage of male and female participant; means and standard deviations of age, media literacy, intelligence, the 6 questionnaire scores, and socioeconomic status of the parents.*

|  | % | *M (SD)* | Min | Max |
|---|---|---|---|---|
| Sex |  |  |  |  |
|     Males | 18.68 |  |  |  |
|     Females | 81.32 |  |  |  |
| Age [years.month] |  | 23.11 (2.41) | 18.42 | 29.46 |
| Media literacy |  | .60 (.09) | .36 | .81 |
| Intelligence |  | 23.36 (3.02) | 15.00 | 30.00 |
| Prior knowledge |  | 1.97 (1.11) | 0.00 | 6.00 |
| Audiovisual text text-based questions |  | 7.53(1.70) | 4.00 | 11.00 |
| Audiovisual text inference questions |  | 6.77 (2.10) | 1.00 | 10.00 |
| Written text text-based questions |  | 8.68 (1.47) | 6.00 | 11.00 |
| Written text inference questions |  | 7.29 (1.95) | 3.00 | 11.00 |
| Auditory text text-based questions |  | 6.70 (1.74) | 3.00 | 10.00 |
| Auditory text inference questions |  | 5.90 (1.77) | 2.00 | 9.00 |
| **Total text-based questions** |  | **7.65 (1.82)** | **3.00** | **11.00** |
| **Total inference questions** |  | **6.66 (2.01)** | **1.00** | **10.00** |

*Text-based knowledge and inferences from audiovisual, written, and auditory text*

The descriptive data show that participants answered more than half of the items correctly on each scale. Regarding the two question types, inference items had a mean score of $M = 6.66$ ($SD = 2.01$; Min $= 1.00$; Max $= 11.00$) and text-based questions of $M = 7.65$ ($SD = 1.82$; Min $= 3.00$; Max $= 11.00$). Table 11 gives an overview of the means, standard deviations, minimum, and maximum of all scores for media separately. When entered into a MANCOVA with prior knowledge as control variable, sex had no influence on text-based questions ($F_{\text{text-based questions}}(1, 89) = .59$; $p = .44$; $\eta p^2 < .01$) or inferences ($F_{\text{inference questions}}(1, 89) = 2.33$; $p = .13$; $\eta p^2 = .03$).

A second MANCOVA with condition (audiovisual vs. written vs. auditory text) as the independent variable and text-based questions and inference questions as dependent variables was conducted. The control variables were media literacy, intelligence, and prior knowledge. The results show a significant main effect of the condition (type of text) on text-based questions ($F(2, 91) = 11.22$; $p < .001$; $\eta p^2 = .21$) and inference questions ($F(2, 91) = 4.49$; $p < .000$; $\eta p^2 = .10$). Thus, the kind of text influences the quality of learning. Considering the control variables, text-based questions were only influenced by prior knowledge ($F(1, 91) = 4.66$; $p = .03$; $\eta p^2 = .05$). Inference questions were influenced by prior knowledge ($F(1, 91) = 7.48$; $p < .01$; $\eta p^2 = .08$), intelligence ($F(1, 91) = 5.69$; $p = 0 .02$; $\eta p^2 = .06$), and media literacy ($F(1, 91) = 8.22$; $p < .01$; $\eta p^2 = .10$).

For text-based questions, *t*-tests revealed significantly better results in the written ($M_{\text{written}} = 8.68$; $SD_{\text{written}} = 1.47$) compared to the audiovisual condition ($M_{\text{audiovisual}} = 7.53$; $SD_{\text{audiovisual}} = 1.70$); ($t(59) = -2.82$; $p < .01$). Participants of the written text condition performed significantly better than those of the auditory text condition ($M_{\text{auditory}} = 6.70$; $SD_{\text{auditory}} = 1.74$); ($t(59) = 4.79$; $p < .001$), and the audiovisual group and the auditory text group performed equally well ($t(58) = 1.88$; $p = .07$). Thus participants in the written text condition had the best results regarding text-based questions, whereas participants in the audio and the audiovisual conditions showed no difference. Concerning inference questions, no difference between written and audiovisual text was found ($t(59) = -1.01$; $p = .32$); ($M_{\text{audiovisual}} = 6.77$; $SD_{\text{audiovisual}} = 2.10$; $M_{\text{written}} = 7.29$; $SD_{\text{written}} = 1.95$). The written text group performed significantly better than the auditory text group ($t(59) = 2.91$; $p < .01$). Audiovisual and auditory texts results showed no difference ($M_{\text{auditory}} = 5.90$; $SD_{\text{auditory}} = 1.77$); ($t(58) = 1.73$; $p = .09$; $Mf = 6.77$).

Overall, the learning outcome was best in the written text condition, while no difference between the other two forms of media was found for both types of questions.

*Influences on text-based knowledge and inferences*

The first hierarchical regression analysis was conducted to validate the proportion of influence prior knowledge and intelligence have on text-based questions. Media literacy's influence was not examined as correlations showed no connection to text-based questions. Prior knowledge and intelligence explained 11.2% of the variance. Prior knowledge was the only significant factor in the model ($\beta$ = .26; p = .01). The model parameters are indicated in Table 12.

A second hierarchical regression analysis was conducted to calculate whether intelligence, media literacy, or prior knowledge explains more variance in regard to inference questions. The first block of the stepwise regression included intelligence and prior knowledge; in the second block media literacy was added. Intelligence and prior knowledge explained 23.4% of the variance in the results for inference questions, and media literacy accounted for another 5.8%, yielding 29.2% of the total explained variance. The change in $R^2$ was significant. All factors added significantly to the model. Prior knowledge had the greatest impact ($\beta$ = .27; $p < .01$), followed by media literacy ($\beta$ = .26; $p < .01$) and intelligence ($\beta$ = .23; $p = .02$). Especially the minimal difference between the former two should have no practical relevance.

In conclusion, prior knowledge was the most important factor in explaining drawing inferences from media, with a marginal superiority to media literacy. Media literacy explained more variance than intelligence but has no impact on text-based knowledge.

Table 12. *Regression analyses to text-based and inference question-scores.*

| | Variable | *B* | SE *B* | *β* | p | R | $R^2$ | $\Delta R^2$ |
|---|---|---|---|---|---|---|---|---|
| **Text-based questions** | | | | | | | | |
| Model 1 | Intelligence | 1.00 | .06 | .16 | = .128 | .34 | .11 | |
| | Prior knowledge | .43 | .17 | .26 | = .012 | | | |
| **Inference questions** | | | | | | | | |
| Model 1 | Intelligence | .19 | .06 | .28 | = .004 | .48 | .23 | |
| | Prior knowledge | .61 | .17 | .34 | = .001 | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Model 2 | Intelligence | .15 | .06 | .23 | = .018 | .54 | .29 | .06** |
| | Prior knowledge | .49 | .17 | .27 | = .005 | | | |
| | Media literacy | 5.63 | 2.12 | .26 | = .009 | | | |

*Note. *p* < .05; ***p* < .01;

### 3.3.4. Discussion

The goal of this study was to evaluate whether media literacy is a significant factor influencing learning from media. For this purpose, three groups of subjects were compared. One received a written text, another an auditory version, and the last an audiovisual text with the same content. All groups answered the same text-based and inference questions. Additionally, a media comparison between written, auditory, and audiovisual texts concerning learning outcomes took place. First, the results for inference questions will be discussed, followed by the results for text-based questions. After that the results concerning the media comparison, and, lastly, the limitations of this study will be discussed.

Inference questions were correlated with intelligence and prior knowledge. When controlling for these factors, they were found to be associated with media literacy and average grades. Hierarchical regression revealed that inference questions were equally influenced by intelligence, media literacy, and prior knowledge. The three parameters explained 29.2% of the variance.

Inferences require drawing further assumptions about the educational topic at hand beyond explicitly stated information. As state above, text understanding occurs at three different text levels. Inferences support building the situation model, which is often interpreted as a true understanding of a text (Zwaan & Radvansky, 1998). Because of inferences' important role in the process of the construction of situation models, the results of study III support Ohler's (1994) assumption that media literacy fosters the creation of a more elaborated situational model. Additionally, the result that knowing the sign system of a medium facilitates drawing inferences for adults is in line with our findings with children (Diergarten & Nieding, 2015). It facilitates processing and operating symbol systems used in diverse media; thus, less cognitive capacity is needed for decoding these symbols, which can be invested in comprehending the educative message. Although basic media literacy skills can be taken for granted in adults socialized in the Western world (see Potter, 1998, 2016), a higher level of media literacy could

also have a facilitating effect in adulthood by releasing cognitive capacity for a deeper learning process.

Text-based questions were correlated with intelligence and prior knowledge. In regression analyses, only prior knowledge was a significant predicting parameter. It explained only a small amount of variance, thus other factors need to be considered in further research (see below). Why did media literacy and intelligence have no impact on text-based questions? As stated above, almost every adult in the Western world possesses basic media literacy skills (see Potter, 1998, 2016). Apparently, adults in general have sufficient media literacy to extract facts from educational learning material. This could explain why text-based questions were not influenced by media literacy. An alternative explanation could be that our items were too easy, as participants scored fairly high, with $M = 7.65$ ($SD = 1.82$) and a maximum score of 11. The mean of the text-based questions differed significantly from the mean of the inference questions ($M = 6.66$; $SD = 2.01$; $t$ (180) = -3.49; $p < .01$), showing that the latter were more difficult. Moreover, intelligence did not have an effect on these kinds of questions, either, supporting the second explanation.

What could the reason be that media literacy is equally important as intelligence for learning ($z = 0.44$, $p = .66$ [Pearson & Filon, 1989])? Of course, both constructs, intelligence and media literacy, share a common core, which is also reflected in their correlation. Media sign literacy and intelligence both require the ability to interpret and work with symbols. In particular, intelligence tests, such as the one employed in study III, require operations such as the classification of figurative objects and recognition of patterns within these objects. Although the intelligence and media literacy tests drew on different symbol sets, some underlying skills are common between them and therefore explain the shared variance. However, as intelligence and media literacy influenced inference questions equally strong, media literacy cannot be reduced to intelligence. The unshared part of media literacy seems to be crucial for learning efficiently from media, including the manipulation of internal representations and cognitive organization of the interplay between internal and external representations, symbolic organization, deciphering media content, and the ability to draw inferences from media contents.

Prior knowledge is the most important explanatory factor for text-based questions and is also important for inference questions. Moreover, it seems to be more important for the integration of new information than mere intelligence. In this sample, prior knowledge was

more strongly associated with media literacy than intelligence. A possible interpretation of this finding is that media literacy acts as a basis for the acquirement of prior knowledge as media is the primary source of information in our society. The importance of prior knowledge on learning processes replicates previous findings on the effects of expertise (Schneider, 2010; Schneider et al., 1998; Woloshyn et al., 1992). The impact of prior knowledge on knowledge acquisition can be explained by CLT (Sweller, 1988) in that it reduces the intrinsic cognitive load and consequently relieves the working memory; thereby more resources can be invested in the learning process. In contrast to former findings with children (Diergarten & Nieding, 2015), intelligence and media literacy did not influence text-based questions. It may be that prior knowledge is such a strong influencing factor for adults that other skills become less influential.

An additional significant factor influencing learning from television is verbal ability because it fosters automatic processing, releasing capacity for encoding in the working memory (Eckhardt et al., 1991). However, no association between the verbal ability of our participants and learning outcome was found. One explanation could be a result of the homogeneity of our group, in which little variation in verbal ability was found ($M = 32.6$; $SD = 2.96$). The SES of the father and the mother were associated with averages grades even when controlling for intelligence and prior knowledge ($r = -.23$). The connection has a negative value because in Germany grades range from 1 (very good) to 6 (insufficient). These results show that the background of the parents continues to influence the academic success of their grown-up children.

Regarding media comparison, a general superiority of written texts in regard to text-based questions compared to auditory and audiovisual texts was found; however, no difference was found between the two latter. Future research, perhaps with more participants, is necessary to evaluate whether a difference in learning success between learning from audiovisual compared with auditory texts exists. Concerning inference questions, the performance of participants in the written text condition significantly exceeded that of those in the auditory group, but not those in the audiovisual group. Auditory and audiovisual texts showed no difference. These results are in line with the literature (e.g. Byrne & Curtis, 2000). The superior recall related to written texts is often explained by the fact that more control over information processing can be exercised in the reading process than in the processes of viewing audiovisual texts (Kozma, 1991). With written texts, readers are given the possibility to process information at their own pace, re-read passages, and look up details, thereby facilitating the storage of information

(Furnham & Gunter, 1985). Merkt et al. (2011) conducted a study with film clips that included interactive features such as stopping the video or browsing. These activities corresponded to the control mechanism readers have over printed texts. Indeed, Merkt et al.'s (2011) results showed that learning with printed and interactive audiovisual texts were comparable. Additionally, adults in Western culture are experts in the orthographical sign system. Starting by about the age of 10, readers draw on the lexical route, recognizing words automatically instead of deciphering them. This automatic process saves a great deal of time and energy (Coltheart, 2005).

There is evidence that under certain conditions adults benefit more from an audiovisual presentation (Walma van der Molen & van der Voort, 2000b). This seems to be the case when the additional visual information is not semantically identical to the auditory information. Like Mayer (2005) expected in his Cognitive Theory of Multimedia Learning, redundant information inhibits rather than facilitates learning. Alternatively, if the pieces of information between two modalities differs too much, as is often the case with adult news, the pieces of information from the two channels of the working memory are harder to combine, leading to a cognitive overload and thus reducing performance (Mousavi et al., 1995). In study III, a scientific documentary was used, comparable to an adult news format, where both animations and auditory comments delivered complex non-redundant information. This could explain why adults achieved better outcomes in the written text condition than in the audiovisual text condition—it is possible that cognitive overload occurred.

### 3.3.4.1. Limitations

Despite several results of note, study III contains limitations. Not all factors influencing learning could be considered. For instance, there is evidence that prior knowledge and working memory capacity act independently but additively in learning tasks (Hambrick & Oswald, 2005). The latter, however, was not assessed. Future studies could integrate this variable.

Self-evaluation rather than on an objective test to measure prior knowledge was used. This could distort the results as participants might overrate their own expertise or overstate their knowledge to avoid potential embarrassment (see Lee et al., 2015). However, as the participants in study III rated their prior knowledge comparatively low, this effect would have had no influence here. Considering all, it was decided against a prior knowledge test as it would have influenced participants' knowledge of the topic and further learning processes beyond those that would take place in the media-based learning settings (Viteri et al., 2014). To avoid this

problem in future research, approaches that employ two dates of assessment could be taken. In the first session, prior knowledge could be assessed. In the second session, about two weeks later, the learning study could take place. When participants are made to believe that both sessions are unrelated studies, this—in combination with the intervening time—could inhibit knowledge activation.

Another shortcoming of study III was that the three conditions are not completely comparable as the audiovisual text was taken from an educational documentary, but the written and auditory texts were constructed for our study upon the audiovisual text. Although a didactical adaption took place, an original educational text might produce results that differ from those using our version. However, this procedure was preferred over choosing an original educational text on a similar topic because the latter would have made group comparison more difficult. Moreover, the answering format was a multiple-choice format, which is easier than open questions, as it merely requires recognition (Roebers & Schneider, 2000). It was likewise chosen to enable a better comparability between the subjects.

As Rey (2010) points out, many variables confound a comparison between different kinds of media, such as the quality of the instructional material, familiarity with the presentation mode, the possibility for interactivity, motivation, etc. In the case of study III, the auditory group differed in regard to study time—their presentation only lasted six minutes and 32 seconds, while the film took about nine minutes. Participants in the written text condition also had a maximum of nine minutes, resulting in a drawback for the auditory group. The reason for the shorter study time in the auditory condition was the time it took the reader to enunciate the text aloud at an adequate pace. The audiovisual presentation varied between auditory information and visual input, thus taking more time. No participant in the reading group needed the entire amount of allotted time. However, much care was taken to control for the named interfering variables and to make the conditions comparable; for example, quality and content were parallelized.

Lastly, the written text contained no illustration, which can compensate for a low reading proficiency (Holmes, 1987). The text was designed this was to allow a comparison of pure media, but it again differed from a 'natural' written text in a text book.

### 3.3.4.2. Conclusion

Despite its limitations, the recent work contributes to the literature on adults' learning from media. Similar to a study with young children (Diergarten & Nieding, 2015), text-based and inference questions were assessed separately, and because of that study III was able to show that despite their association, they have different influencing factors. Study III highlights the influence media literacy has on adults' learning and adds media literacy to the lists of factors that should be assessed in future studies. In further research, additional variables that should relieve germane load according to Sweller's (1988) model could be integrated. Examples include meta-cognition (judgments of learning) and the individual working memory span.

The way media literacy is imparted to students varies greatly between different countries (Komaya, 2012; Eickelmann et al., 2019). Media literacy becomes especially important when self-directed learning is taken into consideration, for instance, when children have to learn from home, such as in the COVID-19-crisis. Additionally, the promotion of media literacy should become a priority in government and vocational training in companies and universities for adults. These measures can enable an adult to take responsibility for his/her qualification, result in better qualified employees, and enhance the effectiveness of further training.

### 3.3.5. Summary

Study III investigated the influence of media literacy on learning from audiovisual, written, and auditory texts. Additionally, the questions which medium achieves best learning results was posed. In a sample of 91 young adults, a computer-based test was applied to assess media literacy. Text-based and inference questions were used to measure learning from audiovisual, written, and auditory texts. The influence of intelligence, verbal ability, media usage, prior knowledge, and socio-economic status was also assessed. Hierarchical regression analyses showed that media literacy was a significant predictor of text inferences even when controlling for other relevant factors, such as intelligence. Both text-based and inference question results were best for written text; no significant difference was found between audiovisual and auditory texts. For inferences, the written text brought no significant advantage over the auditory text. In the next section, a summary, comparison and discussion of the studies shall take place. Suggestions for improvements will be made. The implications of the findings shall be discussed and further research questions proposed.

# III. General Discussion

The aim of the three studies, as described in chapter II.3., was to identify the influence of media literacy on cognitive and political variables. Studies I and II are actually one comprehensive study, with a sample of 13-year-olds and a sample of 19-year-olds, but to allow a more understandable presentation, they are described separately. First, a model of media literacy needs to be defined and an assessment instrument needs to be developed. For this reason, study I (chapter II.3.1.) included an evaluation of the media literacy test WMK. This study investigated whether media literacy has a positive influence on interest in politics and political self-concept, considering the two subsamples as one sample. Study II (chapter II.3.2.) was concerned with the question of whether high media-literate adolescent and young adult subjects exhibit better academic skills (mathematics; reading) and academic achievement (grades) compared to less media-literate subjects. Additionally, to give information on a potential development during adolescence, a group of 13-year-olds was compared to a group of 19-year-olds concerning their media literacy. Study III (chapter II.3.3.) was a continuation of study II. It investigated whether media literacy helps young adults to better learn from three kinds of media—a written, an auditory, and an audio-visual text—and which medium achieves the best learning results. Additionally, a short version of the WMK was tested in study III. A summary and evaluation of the findings of the empirical studies are given in the following section. After that, a critical discussion is conducted and practical implications are depicted. Finally, an outlook on further research is attempted.

## 1. Summary and Evaluation of the Main Findings

What are the main findings of the three studies concerning media literacy described above? A summary of the studies and the results will be given in the following sections. Additionally, a comparison with an interpretation will be made.

### 1.1. Media Literacy and Political Factors

Study I examined the link among media literacy, interest in politics, and political self-concept. A sample of 101 13- to 20-year-olds was drawn. Media literacy was assessed by the WMK, interest in politics, and political self-concept by using existing tools. The control variables were intelligence, age, openness to experiences, perspective-taking, and sex. A variety

of media possession and use was included, as a positive connection with media literacy was found in previous studies. Computer and internet addiction were the exclusion criteria.[4]

Study I also served as an evaluation of the WMK. The results showed that the difficulty of the WMK was acceptable for the complete test. Crohnbach's alpha indicated excellent overall reliability. On most of the scales, the sample's mean result was normally distributed, with a slightly above the medium range. As the sample was highly educated, the items were not altered, assuming that the tasks would be appropriate for the general population. The scales were highly inter-correlated; thus, good construct validity could be assumed. In chapter II.1.2.1., the instrument is described in detail.

The results of study I showed that subjects with a higher level of media literacy indicated more interest in politics and a better political self-concept. Additionally, they reported more perspective-taking; openness to experience was not affected. Political interest correlated positively with openness and perspective-taking, but political self-concept did not affect the latter two variables. The hierarchical regressions and path analysis showed that media literacy and openness to experiences had a direct influence on interest in politics, while political self-concept was only directly determined by interest in politics. Usually, people with a higher IQ are more interested in politics and participate more (Deary et al., 2008). In hierarchical regressions, intelligence had no influence on interest in politics or political self-concept. Possible explanations could be that the effect of intelligence from the correlations could be explained by age and media literacy, or that our sample was too homogeneous in terms of intelligence. Another explanation could be that the education level rather than intelligence is of importance (Sunshine Hillygus, 2005). Media literacy and intelligence seem to be distinct constructs, as the former was found to influence interest in politics and self-concept, while the latter did not.

The control variables' openness to experiences and perspective-taking also had little impact. Previous research confirmed a link between openness to experiences and political participation (e.g., Vecchione & Caprara, 2009), but study I could not replicate these findings. If the self-concept is considered a pre-stage of participation, an indirect influence might exist. Another explanation could be that openness is a better predictor of non-political participation, such as membership in cultural organizations or volunteering (Bekkers, 2005). Moreover, the positive association between openness and participation was so far only confirmed for adolescents

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[4] A description of the assessment tools can be found in chapter in chapters III.2.3. and III.3.1.2.2.

(Vecchione & Caprara, 2009), which suggests that the young age of our sample may be of relevance. Perspective-taking showed no effect on interest in politics and had only a mediated influence on political self-concept. Maybe the relation to membership and volunteering found by Bekkers (2005) also included non-political activities, which were not represented in this study. Further research could focus on fostering political knowledge through media literacy. Political knowledge acts as an intermediate step between media literacy and political participation, because it can enhance the political self-concept (e.g., Ashley et al., 2017), which is a means to stimulate political participation.

In conclusion, the findings of study I suggest that by stimulating interest in politics, media literacy could, mediated through political self-concept, foster political participation. Additionally, media literacy is positively correlated with perspective-taking, which is also a desirable trait. The WMK proved to be a satisfactory tool for assessing media literacy.

In study II, the focus was shifted to academic variables. A summary will follow in the section below.

### 1.2. Media Literacy and Cognitive Factors

### 1.2.1.   Association between Media Literacy and Academic Outcome

As stated before, studies I and II were conducted as one study and are only presented separately to help the reader better understand the discrete research questions. Study II posed the question of whether media literacy impacts academic abilities and attainment. The latter was assessed using school grades. Academic abilities included mathematical skills, reading speed, and reading comprehension. These skills were selected for study II, as they form the basis for further learning. Media literacy was measured using the WMK, reading, and mathematical skills with existing tools. A second research issue concerned the development of media literacy taking place in adolescence. Previous studies often stopped after childhood. Therefore, two samples, one group of 50 13-year-old adolescents and another group of 51 19-year-old young adults, were compared. Unlike study I, these two samples were not analyzed as one in study II.

The hypotheses of study II were that adolescents and young adults with higher levels of media literacy possess better reading abilities (H1), mathematical skills (H2), and receive higher school grades (H3). An additional assumption in line with Potter's (1998, 2013) development theory of media literacy was that advanced media literacy skills are acquired and further developed during adolescence (H4). Thus, the group of young adults should show a higher level

of media literacy than adolescents. The control variables were intelligence, sex, and age. A variety of media possession and use was included as a possible precursor of media literacy. The exclusion criteria were computer and internet addiction.

Study II showed that a significant development of media literacy takes place during adolescence ($\Delta M$ = .17). Media literacy was significantly correlated with mathematical and reading skills, as well as with school grades for adults. The association with mathematical skills was greater than that with reading skills. Regarding adolescents, no connection with mathematical skills was found. To control for the influence of age and intelligence, which were both associated with media literacy, hierarchical regressions and path analyses were conducted. They revealed that media literacy had a greater impact on grades and academic abilities than intelligence. However, in hierarchical regressions, mathematical skills were only influenced by media literacy in the sample of young adults. Unlike previous research (e.g., Paino & Renzulli, 2013), these findings cannot be simply explained by the expectation effects of other people, as a direct assessment of media literacy took place. However, a path analysis for the complete sample did not yield significant results in terms of all goodness-of-fit indices. Most probably, often a bidirectional rather than a causal influence occurs, for instance, in the connection between media literacy and reading skills. Media literacy did not correlate significantly with mathematical skills in adolescents, most likely because the mathematics test for adolescents was too difficult. Media literacy had more influence on average grades than intelligence. What could explain why media literacy exceeded intelligence's influence on academic abilities and attainment? Diergarten et al. (2017) found that highly media-literate children are more proficient in collecting information and drawing inferences from hypermedia and films because they are more efficient in processing medial sign systems. Study II suggested that these findings could also be applied to adults. An investigation of this hypothesis took place in study III. A variety of media possession and use had no impact on academic abilities or attainment. As in the first study, as the sample was the same, it was unbalanced considering education level and the sex ratio. Overall, study II suggested that media literacy has a significant impact on academic attainment and abilities, even when controlled for intelligence. Therefore, more than intelligence is required to learn successfully. Additionally, media literacy is enhanced significantly during adolescence.

In study III, as hinted at above, an investigation of media literacy's potential impact on learning took place. For this purpose, a comparison between the three kinds of media was conducted.

### 1.2.2. Association between Media Literacy and Learning and a Comparison of the Learning Efficiencies of Different Media

In the third study, the impact of media literacy on learning from audiovisual, written, and auditory texts was investigated. The sample consisted of 91 young adults. A short version of the WMK was applied for the first time, including variables from all scales. To assess learning from parallelized audiovisual, written, and auditory texts, the same text-based and inference questions were posed to the three groups. The control variables were intelligence, verbal ability, media usage, prior knowledge, and SES.

The connection between media literacy and learning in adults was examined, as a longitudinal study with kindergarten children showed that media sign literacy has an impact on later school attainment (Diergarten & Nieding, 2015). Additionally, a comparison of the three kinds of texts was performed. In line with the previous findings (e.g., Byrne & Curtis, 2000), it was assumed that adults learn best from the written text. Concerning the comparison of audiovisual and auditory presentation, no hypothesis was stated, as the literature is still inconclusive. Prior knowledge was included as a control variable, as it influences learning from all three kinds of texts (e.g., Ainley et al., 2002).

The results for the inference questions are presented first. Media literacy was a significant predictor of inferences in hierarchical regressions, even when controlling for other relevant factors, such as intelligence. The subjects obtained best results in the written text condition for both text-based and inference questions; no significant difference was found between auditory and audiovisual texts. Inference questions were correlated with intelligence and prior knowledge. Partial correlation (controlling for intelligence and prior knowledge) showed an association between inference questions and media literacy, as well as with average grades. In hierarchical regression inference, questions were influenced by intelligence, media literacy, and prior knowledge (explaining 29.2% of the variance). As inferences play an important role in the process of constructing situation models, the results of study III support Ohler's (1994) assumption that media literacy fosters the creation of a more elaborated situational model. The finding that knowing the sign system of a medium facilitates drawing inferences for adults is in agreement with that obtained by Diergarten and Nieding (2015) for children. This knowledge eases the processing and operating symbol systems used in several media. As such, less cognitive capacity is needed for decoding these symbols, and can then again be invested in comprehending the educative message.

The text-based questions were positively associated with intelligence and prior knowledge. Hierarchical regression analyses found that only prior knowledge was a significant predictor for text-based questions, explaining a small portion of the variable ($R^2 = 11\%$). Why did media literacy and intelligence explain no variance in text-based questions? Apparently, adults in general have sufficient basic media literacy (e.g., Potter, 1998, 2016) to extract facts from educational learning material. Alternatively, the text-based questions were too easy ($M = 7.65$; $SD = 1.82$; $Max = 11$). Taking into account how often items were solved correctly and that intelligence did not influence such questions, text-based questions were significantly easier than inference questions ($M = 6.66$; $SD = 2.01$; $t (180) = -3.49$; $p < .01$). Why was media literacy equally important as intelligence for learning ($z = 0.44$, $p = .66$ [Pearson & Filon, 1989])? They have much in common; for example, both require the ability to interpret and work with symbols, but the unshared part of media literacy (e.g., manipulation of internal representations) seems to impact efficient learning from media. Prior knowledge was the most important explanatory factor for text-based questions and was also important for inference questions. In study III, prior knowledge was more strongly correlated with media literacy than intelligence. Possibly, media literacy acts as a means to acquire prior knowledge, as most knowledge in our society is transferred through media. The findings concerning prior knowledge confirm previous findings on the effects of expertise (Schneider, 2010; Schneider et al., 1998; Woloshyn et al., 1992). Sweller's CLT (1988) can explain the important role of prior knowledge in knowledge acquisition, as it reduces the intrinsic cognitive load and consequently relieves the working memory; thus, the freed resources can be used for the learning process.

When comparing the three kinds of texts, study III revealed a general superiority of written texts in regard to text-based questions compared to auditory and audiovisual texts, but no difference was observed between the latter two. Regarding inference questions, in line with previous research (e.g., Byrne & Curtis, 2000), the participants were better in the written text condition than in the auditory condition. However, the difference between the written and audivisual texts was not significant; auditory and audiovisual texts also led to comparable results.

The limitations of study III were that not all important variables explaining learning, such as working memory capacity (Hambrick & Oswald, 2005), were included. Additionally, prior knowledge was assessed by self-evaluation, which might distort the objective state (e.g., Lee et al., 2015). However, a prior knowledge test would have influenced the participants' knowledge of the topic and further learning processes beyond those that would take place in media-based

learning settings (Viteri et al., 2014). Moreover, the three conditions were not completely comparable, as the audiovisual text was taken from an educational documentary, but the written and auditory texts for our study were constructed based on the audiovisual text. Otherwise, a group comparison would have been more difficult. As in the previous studies, the sample was unbalanced in terms of sex and education level.

Study III showed that media literacy is an important factor for the deeper kind of learning that inference questions suggest. It can also account for the acquisition of prior knowledge, which forms a basis for constructing knowledge. Written texts seem to be superior to auditory and audiovisual texts for adult learning. In the following section, a comparison of the three studies is presented.

### 1.3. Comparison of the Studies

The summaries of the studies presented in this thesis showed that media literacy can significantly and positively influence cognitive and political factors. In conclusion, media literacy fosters interest in politics; enhances PT, reading skills, and school grades; and facilitates learning from different kinds of texts. Table 13 provides an overview of the investigated parameters and their association with media literacy. In this section, the outcomes of the studies are compared.

Table 13. *Overview of the investigated parameters and results of the three studies.*

|  | Age group | Main examined variables | Main findings |
| --- | --- | --- | --- |
| Study I | 13- to 20-year-olds | Influence of ML on PI, SCP | ML correlates with IP, but not with SCP |
|  |  |  | SCP only correlates with IP |
| Study II | 13- vs. 19-year-olds | Influence of ML on AG, M, RC, RS | ML correlates with AG, M, RC, RS |
|  |  | Comparison of ML of 13- vs 19-year-olds | Hierarchical regressions: ML is a stronger predictor for RC & RS than IQ. ML only relevant for M in 19-year-olds |
|  |  |  | ML 19-year-olds > ML 13-year-olds |
| Study III | Young Adults ($M =$ 23.11; $SD =$ 2.41) | InQ; PK; TBQ | ML influences InQ, not TBQ |

| | InQ and TBQ for written vs. audiovisual vs. auditory texts | PK main predictor for InQ and TBQ |
| --- | --- | --- |
| | | InQ: |
| | | Written > Audiovisual |
| | | Written = Auditory |
| | | Audiovisual = Auditory |
| | | TBQ: |
| | | Written > Auditory |
| | | Written > Audiovisual |
| | | Audiovisual = Auditory |

Note: AG = average grades; InQ = inference questions; IQ = Intelligence Quotient; M = mathematical skilly; IP = interest in politics; PK = prior knowledge; RC = reading comprehension; RS = reading speed; SCP = self-concept of competence on political topics; TBQ = text-based questions; ML = media literacy

The studies in this thesis have in common that media literacy has a significant correlation with intelligence. Both constructs seem to interact and mutually depend on each other. A clear distinction between the constructs is given in chapter II.1.2.2. However, the connection with intelligence is much smaller in study III. One explanation could be the composition of the sample. Studies II and I investigated adolescents and young adults, while study III investigated only adults. This is especially relevant, as intelligence was not adapted to age, but raw data were used. Additionally, in the first two studies, media literacy and parents' SES showed a relevant correlation, while the last study showed non-significant associations. It is possible that socio-economical origin loses influence in adulthood. Another explanation could be that, as study III almost consisted exclusively of university students, only those people who were able to transfer to a higher SES were captured. In future research, a more heterogeneous sample is necessary to decide on SES's impact. A variety of media possession and use was only significantly correlated with media literacy in study II. In study I, the significant correlation disappeared as soon as a partial correlation controlling for age and intelligence took place. Study III found no connection in the first place. Thus, the overall view suggests no relevant association. Possibly, quality, not quantity of use, matters, so a user who concentrates on a selection of media has more capacity to gain proficiency in these few than somebody who uses different types of media superficially.

Media literacy has a stronger influence on cognition than on other variables. Even in study I, which was concerned with political variables, media literacy was most potent in its

association with variables such as perspective-taking, which is a cognitive task. Study III showed a close link to prior knowledge. In all studies, it was correlated with intelligence. Thus, in further research, media literacy should be classified among cognitive factors. From these reflections, a general model of media literacy's impact can be derived; it will be presented in the following section.

### 1.4. A General Model

As outlined in the previous section, the investigations in this thesis were concerned with media literacy's impact on cognitive and political factors. Media literacy plays a crucial role in several areas of life, especially knowledge acquisition. The following model (Fig. 8) attempts to put the results of the studies described above in relation to each other.
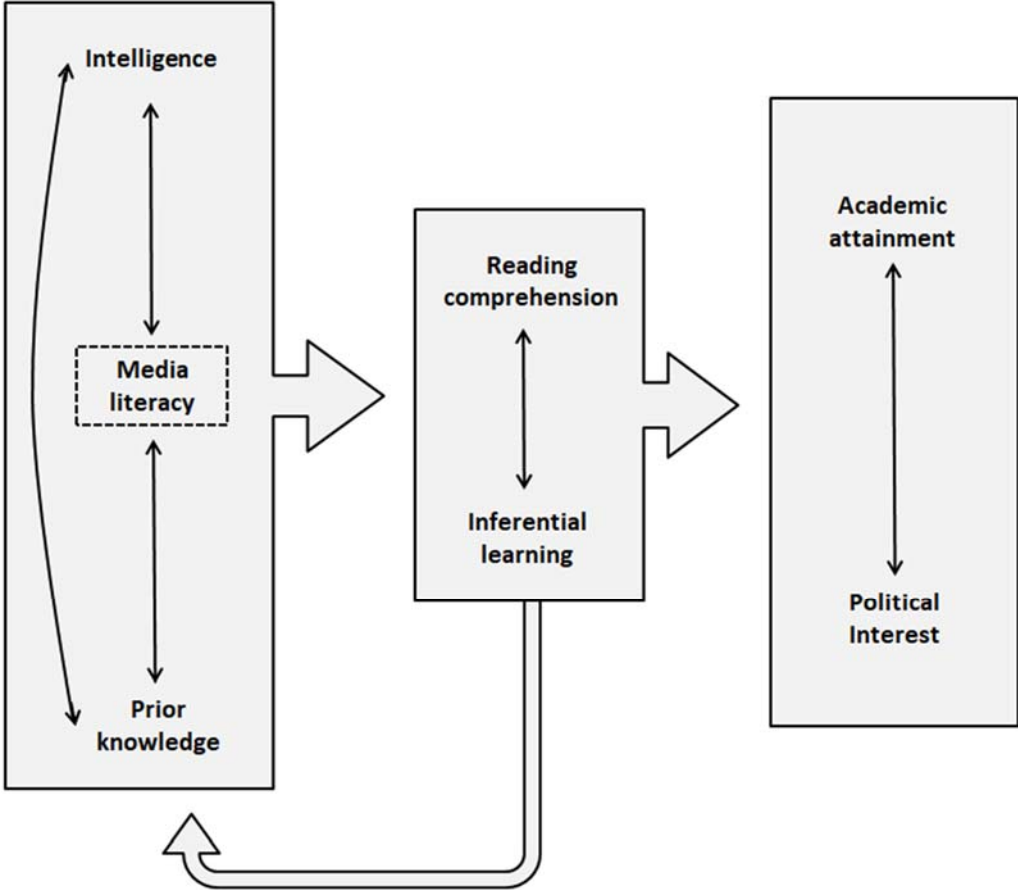


*Figure 7.* A general model of the influence of media literacy on cognitive and political factors.

Media literacy exhibits a bidirectional relation with intelligence and prior knowledge. Intelligence is a premise for acquiring media literacy, while media literacy fosters intelligence. The same is true for prior knowledge. Strong basic knowledge enhances media literacy, while media literacy enables learners to gather more knowledge. Age is omitted from this model. However, it plays a role in prior knowledge and media literacy, as experience fosters knowledge. The studies above suggest that the three factors—intelligence, media literacy, and prior knowledge—influence reading comprehension and inferential learning from texts. Reading comprehension in this context is defined as deciphering written texts. Inferential learning also refers to audiovisual and auditory texts. Learning, in turn, stimulates the construction of knowledge and media literacy. The model suggests that reading comprehension and inferential learning are the variables that mediate the influence of media literacy, intelligence, and prior knowledge on academic attainment and interest in politics. To gain good school grades, a student must be able to proficiently handle the learning material and maximally profit from the information. As presented in chapter II.3.1., interest in politics is mainly stimulated by the internet. The assumption that competent use of the internet is a fundamental for selecting information was likewise stated above. This model integrates an intermediate step, proposing that learning proficiency might be the key to the assumed association between media literacy and interest in politics. Consequently, political interest can be better stimulated if a deeper understanding exists.

Overall, the underlying effect media literacy has on learning and knowledge acquisition could be explained by the ease of automatic processes, as claimed by cognitive load theory (Sweller, 1988) and later adapted to multimedia by Mayer (2005). Media literacy could act as a means to reduce germane cognitive load (chapter I.3.1.1.1.4.).

The presented model augments Mayer's (2005) cognitive theory of multimedia learning (chapter I.3.1.1.1.4.). Mayer (2005) already emphasized the importance of prior knowledge in the learning and text understanding process. His model is extended, showing that prior knowledge is also a premise for learning. Even infants are born with innate knowledge, for instance, in physics, which acts as a basis for further learning (Spelke & Kinzler, 2007). Mayer (2005) suggested that when one informational channel is overloaded (e.g., the visual channel), learning is impaired. In contrast, the way a learner deals with a medium is of consequence. A media-literate user is more likely to direct his attention to relevant information, thus reducing mental effort. This leaves more mental capacity in the working memory for the learning process.

Additionally, some of Mayer's (2005) multimedia principles can be prevented by competent media use.

First, however, the results obtained in this thesis must be acknowledged. Therefore, in the following section, the methods used to gain the data will be discussed.

## 2. Discussion of the Methods

In the previous section, a discussion of the empirical studies considered in this thesis and their results is presented. In this section, a critical view is put on the methods used in these studies. Critical annotation, which was already made in the sections concerning the limitations of the individual studies, are only mentioned briefly.

### 2.1. Assessment of Media Literacy

Many deliberations concerning the assessment of media literacy were outlined in chapter I.2.3.7. Some additional annotations are made in this section.

The question of whether an additional own model and test of media literacy was necessary was discussed in chapter I.2.3.7. Taken together, no instrument met the needs of the studies above, including practical tasks and aiming at a broad construct of media literacy.

Most importantly, the quality of the instrument had to be evaluated. Crohnbach's alpha indicated questionable quality in two scales of the WMK, namely *distinction between reality and fiction* and *knowledge of media effects*. Taken for themselves, they would not have been chosen as valid instruments. The complete test achieved satisfying indices, but alpha automatically improved when more items were added to the analysis. Was the tool faulty, or was Crohnbach's alpha the right quality criteria? Crohnbach's alpha indicates the internal consistency of a scale by calculating the interrelatedness of items. The scales of media literacy cannot be divided apart, as one item often hits at several scales. For example, a practical application often demands media sign literacy, as well. In that case, creating separate scales is of little use. Whether separate scales exist can best be determined by a factor analysis. However, a factor analysis demands 10 sets of data per variable, which would in case of the WMK mean 1360 participants. In my opinion, the high intercorrelation of the scales also supports the assumption that media literacy as a skill can be compared with a pincushion, where each pin aims at the same core, connecting the pins or items, but each indicating an additional facet of the whole construct. In interaction with media, too many subordinate skills seem to be necessary at once. The division in scales still makes sense in order to make the construct tangible and to

visualize it. The question that both factor analysis and internal consistency cannot answer is whether the right construct is assessed. No external criterion that indicates media literacy was assessed and correlated with the WMK. This external quality analysis should take place in further research. Another limitation of the WMK, which should be mentioned, is that the pilot study consisted solely of adults, although the main instrument, the WMK, was designed to aim at adolescents similarly. As such, no statement about the fit of item difficulty for adolescents could be made before the first study was conducted. In study II, the sample of 13-year-old adolescents was regarded separately, showing an average mean for media literacy ($M = .53$; $SD = .09$). This indicates that the tasks were appropriate for the adolescent participants. A second problem on the same lines, the above-average education level, has already been discussed above. Despite the many annotations, the WMK turned out to be a comprehensive test of media literacy, which could be easily applied through a computer. In this way, its practical implementation is standardized. Moreover, it assesses more skills than any other tool available. It correlates with many cognitive variables, indicating that a certain amount of proficiency is necessary to solve the items. One last point of criticism is the short version of the WMK applied in study III. The items were identified in a different study with adolescents and adults, but in study III solely with adults. Additionally, the scales were not balanced, emphasizing some over-proportionally. Thus, the short test probably needs to be revised to make it applicable for future studies.

Even though the WMK is still open to validation by an external criterion and a greater, more varied sample is necessary for a final evaluation, it is a thorough test of media literacy. In the next section, the measurement of intelligence will be discussed.

### 2.2. Assessment of Intelligence

In this section, the assessment instrument of intelligence is discussed critically, and a delimitation between the two constructs of media literacy and intelligence is drawn.

For the assessment of intelligence, two scales of CFT-20R (Weiß, 2006) were applied. Although CFT-20R is a well-established and tried instrument, there are no norms for solitary scales. It is meant to be applied as a complete test. By taking out two scales, only an estimation of the participants' intelligence took place. Due to missing norms, raw data were used as intelligence scores, causing a correlation between intelligence and age. Additionally, CFT-20R tests the ability to identify figural relations and formally logical processes of thinking. Only this part of the intelligence was correlated to the other variables in the studies, which is especially

relevant, as media sign literacy contains a very similar kind of ability. Possibly a comprehensive test, such as the WAIS-IV (Wechsler Adult Intelligence Scale - Fourth Edition) by Wechsler (2008), would lead to lower correlations between intelligence and media literacy. However, applying a long, comprehensive test would not be feasible in the context of a study, especially as the WMK itself needs more than two hours. Estimating intelligence was an appropriate approach, especially as many components of intelligence are often correlated.

This leads to the question of whether media literacy is not per se a subcomponent of intelligence. Should it be cut back to basic cognitive functions? Nieding et al. (2017) addressed the same questions when investigating media sign literacy. They wrote that their chosen model of media literacy, especially media sign literacy, assumes that the cognitive manipulation of the symbol systems of external representations consists of a range of multidimensional and interrelated symbolic skills (e.g., Kirkham et al., 2013). This is also true of the model of media literacy in the studies of this thesis. Intelligence was added as a control variable to factor out the possibility that media literacy is nothing but mere intelligence. Both constructs seem to share a common core, as research with kindergarten children (Nieding et al., 2017) and school attainment and achievement (e.g., Niklas, 2011) have shown. Nieding et al. (2017) further argued that, while intelligence relates to internal mechanisms, external mechanisms (e.g., Rogers, 2014), such as media sign literacy, in information processing focus on the interaction between internal and external representations. As mentioned before, the unshared part of media literacy contributes significantly to learning from the media. The three studies in this thesis confirmed that media literacy can influence cognitive and political factors independently from intelligence, showing that they are indeed separate constructs.

In this section, the assessment of intelligence and its association with media literacy is discussed. Although the selection of single scales of a test and the restriction on figural items is debatable, this procedure is expedient and often used in research (e.g., Nieding et al., 2017). In the following section, the design of the studies is discussed.

## 2.3. Design of the Studies

In the previous section, single assessment tools were discussed. In this section, the design of the studies is critically considered. Note that studies I and II were conducted on the same sample.

First, all studies followed a correlational design. This means that the examined variables were assessed at one data collection point for all subjects. As the studies should answer the

question of media literacy's impact on cognitive and political factors, this design has some disadvantages. Even though the selection of a correlational design was partly prompted by practical reasons—such as recruiting participants willing to attend several measurement points—theoretical considerations were the main reason for this choice. As the WMK had not been tested before, studies were necessary to evaluate whether the construct interacted with any other variables at all. Furthermore, media literacy is not a stable trait. If, for instance, a participant with a high level of media literacy on the first data collecting point drops to an average level at the second data collecting point, statements about causality could be difficult to make. Additionally, to make a valid statement, hierarchical regressions and path analyses were applied to analyze whether a causal connection is probable.

A critic on the same lines is that between-subject designs, not within-subject designs, were applied (for a review on the comparison of between-subject and within-subject design, see Charness et al., 2012). In a between-subject design or between-group design, different groups of participants are tested by different testing factors at one point of data collection, such that each participant is only exposed to one condition. In a within-subjects or repeated-measures design, one participant tests all conditions. Each design has its advantages and disadvantages; often the advantages of one are the disadvantages of the other. Only the most important points are mentioned here. The advantages of a between-subject design are that it allows testing for more variables or levels of variables, as more participants are usually available. It can also save considerable time, which can be decisive, for instance, in healthcare, where time matters. The first disadvantage of the between-subject design is that generalization to other points of time is difficult, as the environment might change. Second, if the heterogeneity of the group is excessive, differences between the groups may arise due to differences between the groups of subjects, not the examined variables, thus distorting the results. The first and main advantage of the within-subject design is that by using the same participants in each condition, the individual difference is removed. This leads to greater statistical power. Additionally, true statements about causation and development can be made. A disadvantage is that a generalization beyond the tested cohort to other cohorts is often difficult. What does this mean for the studies described above? In study II, a group of 13-year-olds was compared with a group of 19-year-olds regarding their media literacy. The difference between these two values was interpreted as development during adolescence. To make a statement about development, one participant should have been assessed at two points of measurement several years apart. I decided against this option because, as expounded in chapter III.2.1., media change so rapidly

that a thorough adaptation of the media literacy test for the second data collecting point would have been necessary. As such, no numeric statement of development could have resulted. For this reason, a between-subjects design was preferred. In the last study, a possible design could have been to compare the learning outcomes of one participant for three different kinds of media. In that case, it would have been more valid to claim that one kind of medium is superior to another, as the factor "participant" would have been held constant. However, three different kinds of texts would have been necessary, making a comparison of the learning material difficult. As such, the equal difficulty of the learning material could not have been guaranteed. Therefore, a comparison of three groups with the same material was preferred, allowing a comparison of the learning material. A possible solution for future research could be the application of many short texts, such as within-design.

In this section, the correlational and between-subject designs of the studies were discussed critically. The advantages and disadvantages were weighted against each other. In the next section, a closer look at the covariates and propositions for further research will follow.

### 2.4. Important Covariates and Implications for Further Research

The studies described above investigated media literacy's influence on interest in politics, school attainment and abilities, and on learning from texts. In the last study, the sensory channel (auditory vs. visual) and the sign system (pictorial vs. verbal) were varied. As media literacy's impact on a variety of areas was examined, a detailed examination of each area was neglected. There are relevant covariates to be considered, and implications for further research can be derived from the studies that mentioned in this section. The suggestions stated in chapters III.1.2.1. to III.1.2.3. are summarized and put in context with other annotations.

The composition of all samples was selective regarding the digital divide, education level, SES, and sex. The associations of the factors with media use have already been thoroughly depicted in chapter I.1. Overall, the influence of the digital divide still exists, but there are developments in different directions. All samples exhibited above-average intelligence values (for further annotations about the role of intelligence, see chapter III.2.2.). Future samples have to be more balanced concerning the education level, SES, sex, and intelligence in order to allow a generalization of findings. Additionally, if the variables show little variation, associations with other factors cannot be found. The named associations are also relevant in the evaluation of the WMK. It needs to be tested on a broader, more heterogeneous sample. This is the only way in which it can be applied comprehensively. As stated above, the WMK should also be

validated on an external factor, and a modified short version should be derived from this revised WMK.

The content of the research in this thesis is rather broad. Instead of focusing on the impact of media literacy on just one set of variables (e.g., reading proficiency), a treatise of several areas was given. Of course, this happens at the expense of depth. Future research could get into more detail. Suggestions will be made in the following section.

As stated before, media literacy probably has to be classed among the cognitive variables. Nevertheless, some suggestions concerning political variables should be made. In the investigation of media literacy's impact on political factors (chapter II.2.1.), an association between media literacy and interest in politics, as well as with perspective-taking, was found. The main goal in the long run, however, was to examine the connection between media literacy and political participation. Thus, I propose designing a study aiming at identifying mediating variables. The self-concept of political competence has already proven its relevance. An association between this variable and participation is still missing to close the gap in the chain from media literacy to interest in politics to political self-concept to political participation. Possibly different mediating variables must be considered. Vecchione and Caprara (2009) found that political efficacy beliefs were able to account for differences in political participation. Political efficacy beliefs are accounted for by openness and extraversion. Extraversion was identified as the only distal predictor of adult political participation (Vecchione & Caprara, 2009). One might focus on media literacy's interaction with extraversion, and political efficacy beliefs could be investigated. Most importantly, however, a definition of political participation has to be found; some restrict it to traditional ways of participation, while others include online and civic activities (chapter I.3.2.1.). In the future, a longitudinal study is necessary to confirm a causal connection between media literacy and the named variables.

Study II was concerned with media literacy's impact on academic attainment and abilities (chapter II.2.2.). Future research that focuses more on a deep understanding of the link between media literacy and reading competence could integrate variables such as prior reading skills, phonological processing (Wagner & Torgesen, 1987), and mastery of vocabulary (Paris, 2005). As such, valid statements about media literacy's impact on the development of reading skills can be made. Despite the drawbacks discussed above, I propose a longitudinal design for studies building on study II. This is especially relevant, as study II was concerned with the development

of media literacy during adolescence. Important information could be gained by comparing results from within-subject and between-subject designs.

Study III investigated media literacy's impact on learning from written, auditory, and audiovisual texts; additionally, a comparison of the learning efficiency of these three texts was conducted (chapter II.2.3.). The most important factor influencing learning was prior knowledge. The way prior knowledge is assessed can be varied. In study III, it was measured by self-report. This followed the idea that a knowledge test might distort the results because knowledge structures could be activated (Viteri et al., 2014). A within-subject design with two measurement points could be applied, putting sufficient time between the knowledge test and the learning study. In the best case, the participants should believe that both studies are unrelated. The relationship between media literacy and prior knowledge could also be an interesting research area. A longitudinal study would be necessary to find out whether media literacy is a precursor of prior knowledge or vice versa or whether they are just correlated and influenced by a third variable. Study III showed that variables that reduce germane cognitive load (Sweller, 1988) can be relevant. Known factors are metacognition and individual working memory span (Hambrick & Oswald, 2005). The latter is interesting, as it seems to be independent from prior knowledge and to work additively with it. Research questions could be whether these two factors act compensatory and which one is more important for learning. Additionally, an association between working memory capacity and media literacy is possible. Media can serve as externalized memory devices, relieving the working memory capacity, possibly rendering the latter as a less influencing variable. A further variable could be updating capacity, an executive function of the working memory relevant for text comprehension (Morris & Jones, 1990). The working memory content is in a constant updating process; obsolete information is substituted by new, seemingly more relevant information, according to a current criterion. This happens to maintain coherence within the situation model for text understanding (e.g., Morris & Jones, 1990). Media literacy could be important in this process, as it can help a learner to decide which information is paid attention to and which is irrelevant. As for the other studies, a within-subject design could be interesting to make a statement about causation. Rey (2010) stated several variables that can confound media comparisons. One was interaction possibility. Merkt et al. (2011) found that when film clips are interactively used, their learning outcome is similar to that of written texts. Walma van der Molen and van der Voort (2000) likewise found that audiovisual texts can exceed written texts when visual information is not semantically identical to auditory information. This agrees with Mayer's (2005) assumption

that only redundant information from different channels inhibits learning. However, if the information differs excessively, integration is harder, causing cognitive overload (Mousavi et al., 1995). Further research could conduct learning studies that integrate blended media and that investigate whether the competent use of these media facilitates gathering information and drawing inferences. It could be that media literacy is even more important for modern media than traditional media.

The findings of the studies suggest that media literacy, especially media sign literacy, should be added to the list of variables that, according to cognitive load theory, reduce germane cognitive load (Sweller, 1988). It could also be considered in Mayer's (2005) cognitive theory of multimedia learning, as it can modify the way information is processed in the working memory, making an integration of information from different sensual channels more effective. An alternative could be to regard media literacy as a kind of prior knowledge that facilitates further learning.

Considering the results of the three studies, although many approaches have already been taken, much of the processes that cause media literacy's influence on several variables still need to be investigated.

### 3. Overall Conclusion and Outlook

Taken together, the studies conducted for this thesis have shown that media literacy has the capacity to influence several cognitive and political variables. It stimulates interest in politics, fosters reading comprehension and school grades, and draws inferences from different kinds of texts. As an overall conclusion, due to its broad impact, media literacy can be regarded as a resilience factor for young people's development.

Media literacy becomes especially important when self-directed learning is taken into consideration, such as when children have to learn from home during a crisis such as the COVID-19 pandemic. For the reasons noted above, media literacy should be a compulsory part of the K–12 curriculum. Scheibe (2004) stated that the integration of media literacy practices in a broad range of subjects does not only change the way students perceive and analyze material in class but a transfer to other areas of life also occurs. Thus, young people become less prone to persuasive media messages or distortions of facts. According to Hobbs (2004), it is important to stop comprehending media as mere tools but to emphasize that they can support reaching crucial 21st-century learning skills such as critical thinking, collaboration, and

creativity. There are many media literacy training programs in the United States, but they vary from state to state and from region to region (Hobbs, 2004). The picture in Europe is similar. In Germany, for instance, it is up to each school to decide whether media literacy is to be taught at all, although it is defined as an educational goal by Germany's Ministry of Education (Kultusministerkonferenz, 2012) and UNESCO (Peréz Tornero & Varis, 2010). Therefore, media literacy education should be an international priority to empower young people to be successful in the 21$^{st}$-century society. Especially the world-wide Covid-19 crisis in 2020 has shown that it is essential for teaching and learning to occur through media devices. Students who are poorly provided with modern media or who have problems applying them have a graspable drawback in education. Teachers and schools should likewise be equipped.

Extended mind theory states that the mind is not restricted to the brain or body but extends to the physical world (e.g., Wilson & Foglia, 2011). As media serve as an externalization of cognitive processes so that cognitive resources can be used otherwise, they fulfill the criteria to be referred to as "extended mind." This emphasizes the importance media devices have gained in the 21th century society and the importance of learning a responsible application of these media.

However, media literacy and media have limitations and should not be overrated. Many overstated expectations from the past have already been refuted. One example is the belief spread by the introduction of cable television in the 1970s/80s that it would contribute to the formation of grassroots democratic structures (Modick & Fischer, 1984). Forty years later, it has become clear that this hope was futile.

Nowadays, a responsible, realistic use of media with the knowledge of their potential and their drawbacks should take place. This appraisal can only be made by possessing media literacy. As Helmut Glaßl put it, „Media literacy should always imply the ability of temporary media abstinence."

## IV.    References

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# V. List of Figures

# VI.    List of Tables

# VII.  Appendix

# A Materials Studies I and II

### 1.  Socio-demographic questions

## Willkommen zum Medienkompetenztest

Bitte benutzen Sie innerhalb des Tests nur die dafür vorgesehenen Schaltflächen zum Weiterklicken und nicht die des Browsers!

Nummer Versuchsperson:

Geburtsdatum:

Geschlecht:

○ männlich   ○ weiblich

Was für eine Schule besuchst du bzw. welchen Abschluss hast du?.

○ a) ohne Abschluss
○ b) Hauptschule / (qualifizierter) Hauptschulabschluss
○ c) Realschule / mittlere Reife
○ d) Fachoberschule / Fachabitur
○ e) Gymnasium / Abitur

## Hinweis: hast du ein Schulfach nicht (gehabt), trage eine 0 ein.

Was war dein Notenschnitt insgesamt / deine Abschlussnote?

Welche Noten hattest du im letzten Zeugnis in...

Mathematik:

Deutsch:

1. Fremdsprache:

2. Fremdsprache:

Physik:

Chemie:

Biologie:

Welche Berufe haben deine Eltern?

Vater:

Mutter:

## 2. Questionnaire on Media Use

# Fragebogen zur Mediennutzung

1. Bitte geben Sie nachfolgend an, wie stark Sie sich für die nachfolgend aufgeführten Themengebiete in Medien generell interessieren.

|  | gar nicht |  |  | mittelmäßig |  |  | sehr stark |
|---|---|---|---|---|---|---|---|
| Politik | O | O | O | O | O | O | O |
| Geschichte | O | O | O | O | O | O | O |
| Religion | O | O | O | O | O | O | O |
| Wirtschaft / Börse | O | O | O | O | O | O | O |
| Prominente / „Klatsch" | O | O | O | O | O | O | O |
| Wissenschaft / Technik | O | O | O | O | O | O | O |
| Kunst / Kultur / Literatur | O | O | O | O | O | O | O |
| Soziales / Menschen | O | O | O | O | O | O | O |
| Reisen | O | O | O | O | O | O | O |
| Medien | O | O | O | O | O | O | O |
| Lokales | O | O | O | O | O | O | O |
| Sport | O | O | O | O | O | O | O |

**Thema: Zeitung**

2. Wie häufig lesen Sie **gedruckte Tageszeitungen**? (Bitte nur eine Antwort ankreuzen!)
   - O täglich
   - O mehrmals pro Woche
   - O mehrmals im Monat
   - O seltener
   - O nie → **weiter mit Frage 4**

3. Welche **gedruckten Tageszeitungen** lesen Sie? (Mehrfachauswahl möglich)
   - O BILD-Zeitung
   - O Morgenpost
   - O Freie Presse
   - O Frankfurter Allgemeine Zeitung
   - O Süddeutsche Zeitung
   - O Die Welt
   - O Andere, und zwar: _____

**Thema: Zeitschriften**

4. Wie häufig lesen Sie **Zeitschriften**? (Bitte nur eine Antwort ankreuzen!)
   - O täglich
   - O mehrmals pro Woche

○ mehrmals im Monat

○ seltener

○ nie

**Thema: Fernsehen**

5.  Wie häufig schauen Sie fern? (Auch über Internet/PC, Smartphone u.a.; Bitte nur eine Antwort ankreuzen!)

    ○ täglich

    ○ mehrmals pro Woche

    ○ mehrmals im Monat

    ○ seltener

    ○ nie → **weiter mit Frage 11**

6.  Welche Möglichkeit nutzen Sie, um **fernzusehen**? (Mehrfachauswahl möglich)

    ☐ Ich schaue nie fern → **weiter mit Frage 11**

    ☐ Eigener Fernseher

    ☐ Fernseher bei Familie, Freunden, etc.

    ☐ Internet am PC / Laptop

    ☐ Internet über Tablet (z.B. iPad)

    ☐ Internet über Smartphone

    ☐ Andere, und zwar: _____

7.  Wie lange schauen Sie an einem durchschnittlichen Tag fern? (in Stunden pro Tag)

wochentags:        ____ Stunden                    am Wochenende: ____ Stunden

**Thema: Computer / Internet**

8.  Welche Art von **Computer** besitzen Sie privat? (Mehrfachauswahl möglich)

    ☐ Desktop-Computer (PC)

    ☐ Laptop / Netbook

    ☐ Tablet-PC (z.B. iPad)

    ☐ Keinen → **weiter mit Frage 16**

9.  Wie häufig nutzen Sie Ihren primären **Computer** privat? (Bitte nur eine Antwort ankreuzen!)

    ○ täglich

    ○ mehrmals pro Woche

    ○ mehrmals im Monat

    ○ seltener

    ○ nie → **weiter mit Frage 16**

10. Wie lange nutzen Sie an einem durchschnittlichen Tag Ihren **Computer** privat? (in Stunden pro Tag)

wochentags:              ____ Stunden

        am Wochenende: ____ Stunden

11. Wie häufig nutzen Sie **soziale Netzwerke**? (Bitte nur eine Antwort ankreuzen!)

    ○ mehrmals täglich

    ○ täglich

    ○ mehrmals pro Woche

    ○ mehrmals im Monat

    ○ seltener

    ○ nie → **weiter mit Frage 19**

12. In welchen **sozialen Netzwerken** haben Sie einen aktiven Account? (Mehrfachauswahl möglich)

    ☐ Facebook

☐ StudiVZ / MeinVZ

☐ Schüler.CC

☐ MySpace

☐ Twitter

☐ Google +

☐ Xing

☐ Instagram

☐ Andere, nämlich: _____

13. Besitzen Sie ein **Smartphone** oder **internetfähiges Mobiltelefon**? (Bitte nur eine Antwort ankreuzen!)

☐ Ja

☐ Nein → **weiter mit Frage 24**

14. Welche Plattform nutzen Sie, um **Computerspiele** zu spielen? (Mehrfachauswahl möglich)

☐ Ich spiele keine Computerspiele.

☐ Computer/Laptop/Netbook

☐ Stationäre Spielkonsolen (z.B. Xbox, Wii, Playstation)

☐ Mobile Spielkonsolen (z.B. Nintendo DS, Playstation Portable)

☐ Tablet (z.B. iPad)

☐ Smartphone/Mobiltelefon

☐ Andere, und zwar: _____

15. Verwenden Sie während der Computernutzung gleichzeitig andere Medien? (Mehrfachauswahl möglich)

☐ nein

☐ Fernsehen

☐ Radio

☐ Musik (nicht Radio, z.B. mp3, CDs)

☐ Filme/Serien (<u>nicht</u> Fernsehen, z.B. Blu-ray, DVDs)

☐ Printmedien (Zeitung, Zeitschriften, Bücher)

☐ Andere, und zwar: _____

**Thema: Radio**

16. Wie häufig hören Sie **Radio**? (Auch über Internet/PC, Smartphone u.a.; Bitte nur eine Antwort ankreuzen!)

☐ täglich

☐ mehrmals pro Woche

☐ mehrmals im Monat

☐ seltener

☐ nie → **weiter mit Frage 28**

**Thema: Bücher**

17. Wie häufig lesen Sie privat **Bücher**? (Bitte nur eine Antwort ankreuzen!)

☐ täglich

☐ mehrmals pro Woche

☐ mehrmals im Monat

☐ seltener

☐ nie → **Der Fragebogen ist für Sie beendet, vielen Dank für die Teilnahme!**

## 3. WMK

## 3.1. Media Sign Literacy

Die folgenden Graphiken zeigen Informationen über die Exporte aus Zedland, einem Land, das Zed als Währung verwendet.
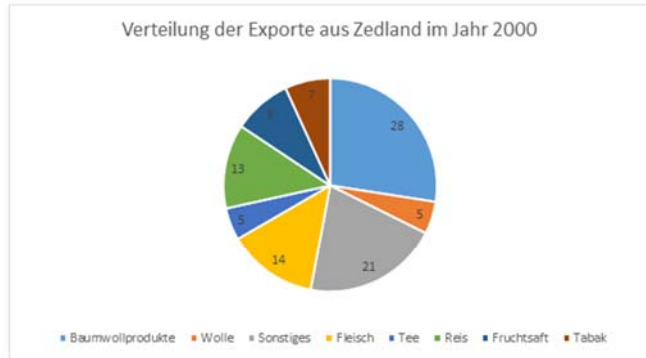


1.1. Was war der Wert des Fruchtsaftes, der im Jahr 2000 aus Zedland exportiert wurde?

○ 1,8 Millionen Zeds.  ○ 2,3 Millionen Zeds.  ○ 2,4 Millionen Zeds.  ○ 3,4 Millionen Zeds.  ○ 3,8 Millionen Zeds.

1.2. Was war der Gesamtwert der Exporte (in Millionen Zeds) aus Zedland im Jahr 1998?

○ 1,8 Millionen Zeds.  ○ 2,3 Millionen Zeds.  ○ 2,4 Millionen Zeds.  ○ 3,4 Millionen Zeds.  ○ 3,8 Millionen Zeds.

1.2. Was war der Gesamtwert der Exporte (in Millionen Zeds) aus Zedland im Jahr 1998?



2.1. Bei welcher Umfrage konnten die Leute mehrere Antworten ankreuzen?

○ Bei der Linken?  ○ Bei der Rechten?

2.2. Wie viele Personen haben keine Angabe zur "Lesedauer" gemacht?

Weiter zur nächsten Aufgabe!

3. Eine Person befindet sich an folgender Straßenkreuzung (Street fiew): Welche Karte passt hierzu?



Correct answer



Distractor 1



Distractor 2
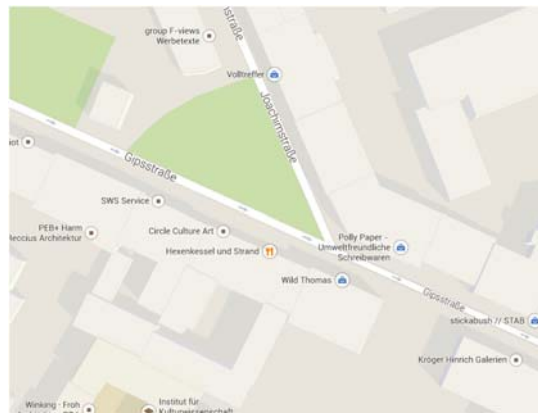


4. Ein Urlauber befindet sich am Rosa-Luxemburg-Platz und möchte zum Soho-House-Berlin gelangen. Google Maps zeigt folgenden Weg an.
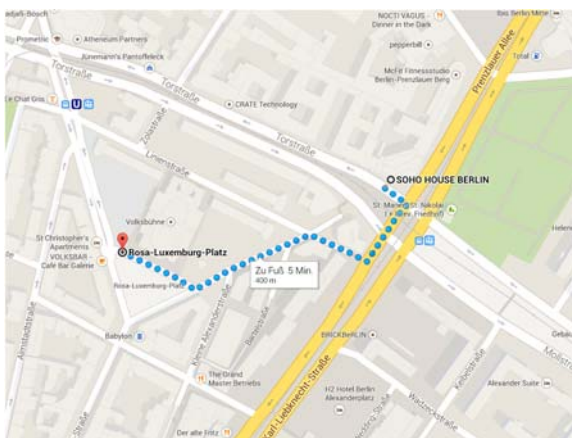


In welche Straße muss er abbiegen?

5.1. Welches Satellitenbild zeigt den gleichen Ort wie die Karte?



Correct answer



Distractor 1



Distractor 2



5.2. Welches Satellitenbild zeigt den gleichen Ort wie die Karte?
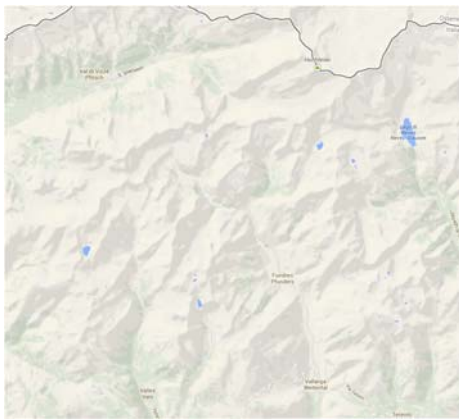


Correct answer



Distractor 1



Distractor 2

6. Wie viele Kilometer sind es zirka auf dem kürzesten Weg von dem markierten Ausgangspunkt (grünes Kreuz) bis zur Haltestelle „Rudolfplatz" (blaues Kreuz)?



□ 3,1 Kilometer   □ 1,7 Kilometer   □ 800 Meter   □ 2,4 Kilometer

7. Ein Tourist möchte auf kürzestem Weg mit der U-Bahn vom Brandenburger Tor (grünes Kreuz) zu seinem Hotel (Hotel Angleterre Berlin, rotes Kreuz). Wie sollte er fahren?
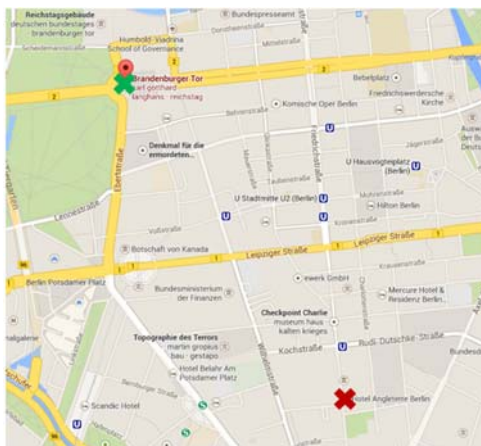


□   Von der Haltestellte „Brandenburger Tor" mit der dunkelgrün oder rosa markierten Linie bis „Yorckstraße", von dort mit der blau markierten Linie bis „Gneisenaustraße".

□   Von der Haltestellte „Brandenburger Tor" mit der dunkelgrün oder rosa markierten Linie bis „Potsdamer Platz", von dort mit der RE3 bis „Stadtmitte", danach mit der lila markierten Linie bis „Kochstraße".

□   Von der Haltestellte „Brandenburger Tor" mit der Regionalbahn zum „Alexanderplatz", dann mit der dunkelblau markierten Linie bis zu deren Endhaltestelle „Boddingstraße".

8. Ein Autofahrer möchte von Remscheid (grünes Kreuz) nach Eslohe im Sauerland (rotes Kreuz). Wie kommst er **am Schnellsten** ans Ziel? Welchen Weg sollte er wählen?
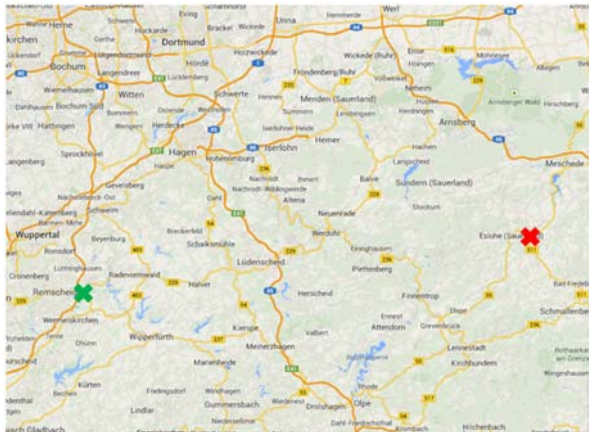


Correct answer
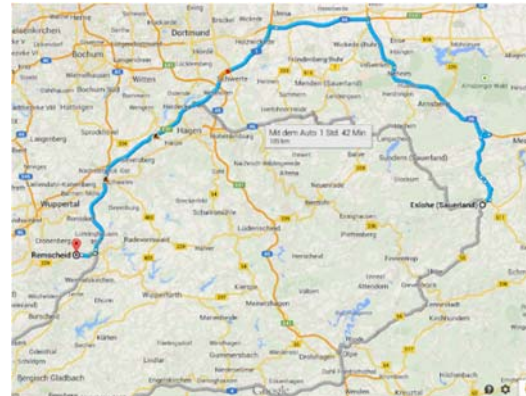
Distractor 1
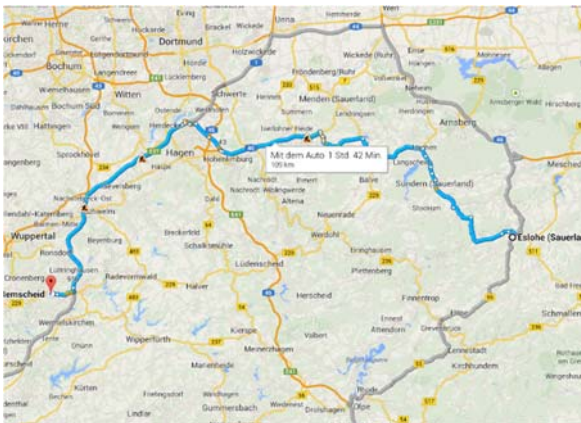
Distractor 2
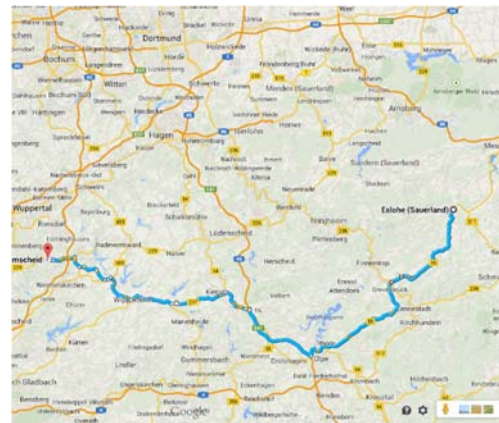
## 9. Symbole

Welches Symbol unterscheidet sich von den anderen?

(für junge Erwachsene)



Welches Symbol dient <u>nicht</u> der Benutzerabmeldung?

(für Jugendliche)



Welches Symbol ermöglicht es die erweiterten Browsereinstellungen („Extras") zu ändern?



Welches Symbol kennzeichnet eine sichere Internetverbindung?

Welches Symbol ist kein Social Media Button?

## 10. Hörfunk / Ö.R. – Private

1.  Welcher dieser Radiosender ist kein öffentlich-rechtlicher?
a) Deutsche Welle
b) Antenne Bayern
c) Bayrischer Rundfunk
d) SWR3

2.  Wofür steht die Abkürzung GfK?
a) Gesellschaft für Kommunikationswissenschaften
b) Glaubensgemeinschaft für Katholiken
c) Gesellschaft für Konsumforschung
d) Gemeinschaft fachlicher Kompetenz

3.  Welcher der folgenden Sendeanstalten unterhält keinen Hörfunksender?
a) ZDF
b) RTL
c) NDR
d) WDR

4.  Welche dieser Rundfunkanstalten gehört nicht zur ARD?
a) Radio Bremen
b) MDR
c) SR
d) NR

5.  Wofür bezahlt man einen Rundfunkbeitrag?
a) nur für Radiogeräte
b) für Radio- und Fernsehgeräte
c) nur für Fernsehgeräte
d) Fernsehgeräte, Radio und neuartige Rundfunkgeräte

6.  Was versteht man unter Hörfunk?
a) Walkie-Talkie
b) Nachrichten
c) Radio
d) Fernsehen

## 11. Tablet

1.  Welche Aussage über eine „Cloud" ist falsch?
    a)  Eine Cloud ermöglicht es, Informationen über ein Netzwerk zur Verfügung zu stellen.
    b)  Über eine Cloud können Daten ausgetauscht werden.
    c)  Auf eine Cloud kann immer nur von einem Nutzer zeitgleich zugegriffen werden.
    d)  Um eine Cloud zu verwenden, braucht man eine gültige E-Mail-Adresse.

2.  Mit welchen Apps lassen sich Hörbücher ausleihen?
    a)  Audible
    b)  Onleihe
    c)  Shazam

d) Whatsapp

3. Welches ist das Symbol für die „Dropbox"?



## 12. Produktion

1. Welches dieser Symbole ist für das Zuschneiden eines Bildes geeignet?



2. Ordne bitte folgende Tastenkombinationen den entsprechenden Funktionen zu.

   1. Strg + a       a) kopieren
   2. Strg + z       b) markieren aller Inhalte
   3. Strg + c       c) einfügen
   4. Strg + v       d) zurück
   5. Strg + x       e) ausschneiden

## 13. Computerspiele

1. Welches der folgenden Beispiele repräsentiert kein Genre für Computerspiele?
   a) Beat ´em up
   b) Jump´n´Run
   c) Sit'n' Watch
   d) Point'n'Click

2. Was ist der Unterschied zwischen „RPG" und „MMORPG"?
   a) Genre
   b) Grafikanforderungen
   c) Altersfreigabe
   d) Mitspieleranzahl

3. Welcher dieser Abkürzungen regelt in Deutschland die Altersfreigabe von Videospielen?
   a) USK
   b) FSK
   c) PEGI
   d) FSF

4. Welches ist kein Spiel des Survival Horror?
   a) Silent Hill II
   b) Dare Devil
   c) Dead Rising
   d) Resident Evil

5. Was ist kein Entwicklerstudio?
   a) $P_2$
   b) BioWare
   c) Rare Ltd.
   d) Piranha Bytes

### 3.2. Distinction between Reality and Fiction

1. Real film clips versus fictional production

The participants were asked to watch two film clips each of a real event and a production for television. Their task was to select the actual event, which was recorded for private purposes.

At first, they watched about 15 seconds of a police control. In the real version, a policeman and a policewoman stopped a scooter-driver and controlled his documents. The visual recording was fuzzy and the audio track was hard to make out. The second, the staged film clip, also showed a police control. The quality of the recording was far better and the policeman and policewoman first spoke to each other very clearly in the police car. The actors, however, were not very good.

The second set of film clips showed to versions of a wedding. The real event simple showed a wedding couple walking down the aisle in church. The second clip showed a supposed private wedding in a decorated room, where the registrar held a speech. The clip was underlain with cheerful music and the colors of the recording were very bright.

The third pair of film clips showed two fire-brigade operations. The real one was filmed at night from the first or second floor of a house. The fire-engines drove down the dark street very rapidly with flashing lights and siren. In the staged version, a practice by firefighters to put out a small fire was shown.

2. Explaining how a film clip can be identified as staged

Participants watched another clip about a police controlled, which was interrupted by single choice questions asking how they could know that no real event was portrayed.

Question to the sections:

3. Woran wird deutlich, dass diese Sendung trotz ihrer dokumentarischen Form inszeniert ist?

First scene: At first, a policeman and a policeman reach a group of people fighting in front of a bar.

- ☐ Unkenntlich machen der Bierwerbung wird versäumt.
- ☐ Erzählerstimme aus dem Off kommentiert das Geschehen.
- ☐ Streitende Personen reagieren nicht auf die Kamera.
- ☐ Einspielung von Musik erfolgt.

The second cutout shows the policemen discussing in their car.

- ☐ Am Ende des Abschnitts in Minute 0:10 folgt eine Ausblende zu schwarz.
- ☐ Die Kamera ist nach dem Schnittwechsel nicht mehr zu sehen.
- ☐ Das KFZ-Zeichen des Polizeiwagens ist unkenntlich gemacht.
- ☐ Die Einstellung des Lichts in Minute 0:51 ist künstlich erhöht.

In the third scene, the policeman reach a house where they are supposed to control a person in a flat.

- ☐ Die beiden Polizisten schauen zum Haus hinauf, ohne dass die Kamera ihren Blicken folgt.
- ☐ Der Kameramann macht plötzlich Aufnahmen aus dem Hausflur des Verdächtigen heraus ohne sichtbar die Schwelle passiert zu haben.
- ☐ Die gesamte Szene spielt in derselben Location unter einer verhältnismäßig hohen Schnittfrequenz.
- ☐ Der Kameramann macht wiederholt Aufnahmen der Darsteller in Momenten, in denen sie keinen Text aufsagen müssen.

3. Die folgenden Beiträge stammen alle aus einem Forum zu Hundehaftpflichtversicherungen. Ein Forenbeitrag unterscheidet sich von den anderen. Welcher Beitrag ist das und aus welchem Grund?

**Thema:** Hundehaftpflichtversicherung

+ Antworten

| | Themen-Optionen ▾ | Thema durchsuchen ▾ | Anzeige ▾ |

**■ 03-10-2013  17:03** #1

Miranka ●
Experte

Beiträge: 45
registriert seit Mai 2009

**Welche Hundehaftpflicht habt ihr?**

Hi, aus gegebenem Anlass möchte ich euch mal fragen, was für eine Hundehaftpflichtversicherung ihr habt. Wie hoch habt ihr versichert und was für einen Beitrag zahlt ihr?
lg

💬 Zitieren

**■ 03-10-2013  17:28** #2

Fido ●
Experte

Beiträge: 91
registriert seit Jan 2008

**Welche Hundehaftpflicht habt ihr?**

Bin bei der Gothaer Versicherung. Kein Leinenzwang, Deckungssumme 3 Millionen Euro, jährlich etwa 45 Euro Beitrag.
Hab noch nie Leistungen in Anspruch nehmen müssen, kann daher zur Abwicklung von Versicherungsfällen nichts sagen.

💬 Zitieren

**■ 03-10-2013  17:31** #3

Grashuepfer ●
ist öfter hier

Beiträge: 12
registriert seit Jul 2010

**Welche Hundehaftpflicht habt ihr?**

Ich bin bei der agila für 5,- mon versichert mit 80,- selbstbeteiligung. gruss

💬 Zitieren

**■ 03-10-2013  17:41** #4

Moehri ●
ist neu hier

Beiträge: 1
registriert seit Okt 2013

**Welche Hundehaftpflicht habt ihr?**

Hallo ihr Lieben,
mein hund hat das Haus verlassen, ist über die Straße gerannt und schon hat es gekracht. hund ist heile geblieben nur die Autos nicht =) Zum Glück hat meine Versicherung, die HUK24, bezahlt. Sie bietet unverzichtbaren Schutz schon ab rund 66 € im Jahr an und schließt darin auch Aufenthalte im Ausland mit ein. Eine hohe Versicherungssumme (15 Mio €) gilt dabei pauschal für Personen-, Sach- und Vermögensschäden. zudem sind durch das Tier verursachte Schäden an gemieteten Wohnräumen mitversichert. Alles in allem eine super Sache bei der HUK24.
Viele Grüße

💬 Zitieren

**■ 07-10-2013  18:10** #5

Pixelstall ●
ist neu hier

Beiträge: 0
registriert seit Mai 2010

**Welche Hundehaftpflicht habt ihr?**

wir haben bei der uelzener abgeschlossen, aber mit OP-Versicherung, Haftpflicht, Unfall, Rechtsschutz für 13,-€ monatlich

die OP- versicherung hab ich deshalb genommen, da bei nem großen Hund doch eher mal was sein kann ( Magendrehung, Gelenke und solche Sachen und denn kann es schnell teuer werden...) meine Kleinen haben ne einfache Haftpflicht, aber da müßte ich nachsehen was ich bezahle...

4. Bringe bitte die folgenden Bilder in die richtige Reihenfolge:

Wähle die Bilder passend zu den verschiedenen Phasen des Produktionsprozesses fiktionaler Medieninhalte, wie z.B. Spielfilm oder Fernsehserie, aus und ordne sie entsprechend an. Beachte dabei die Bildunterschriften. Falls Du Dir über die Zuordnung eines Bildes im Unklaren bist, ordne es dem Produktionsverlauf zu, bei dem Du es als relevanter betrachtest.

Der Regisseur

Die Nachbearbeitung

Die Drehbuchautorin

Die Berichterstattung

Die Recherche

Der Filmdreh

Die Produktionsfirma

Das Ereignis

Die Schauspieler

Die folgenden vier Seiten stammen je alle aus derselben Zeitschrift. Eine oder mehrere Seiten wurden nicht von der Redaktion verfasst. Bitte kreuze die entsprechende(n) Zahl(en) an!

6. Im Folgenden zeigen wir dir eine Seite aus einer Zeitung. Kannst du herausfinden, was alles Werbung ist?



7. Wie du wahrscheinlich weißt, werden viele Fotos bevor sie entwickelt werden am Computer bearbeitet. Manchmal passieren dabei Fehler. Auf den Bildern werden dann Sachen gezeigt, die es in Wirklichkeit gar nicht gibt. Im Folgenden siehst du 18 Bilder, wovon bei 9 solche Fehler passiert sind. Findest du heraus, bei welchen?
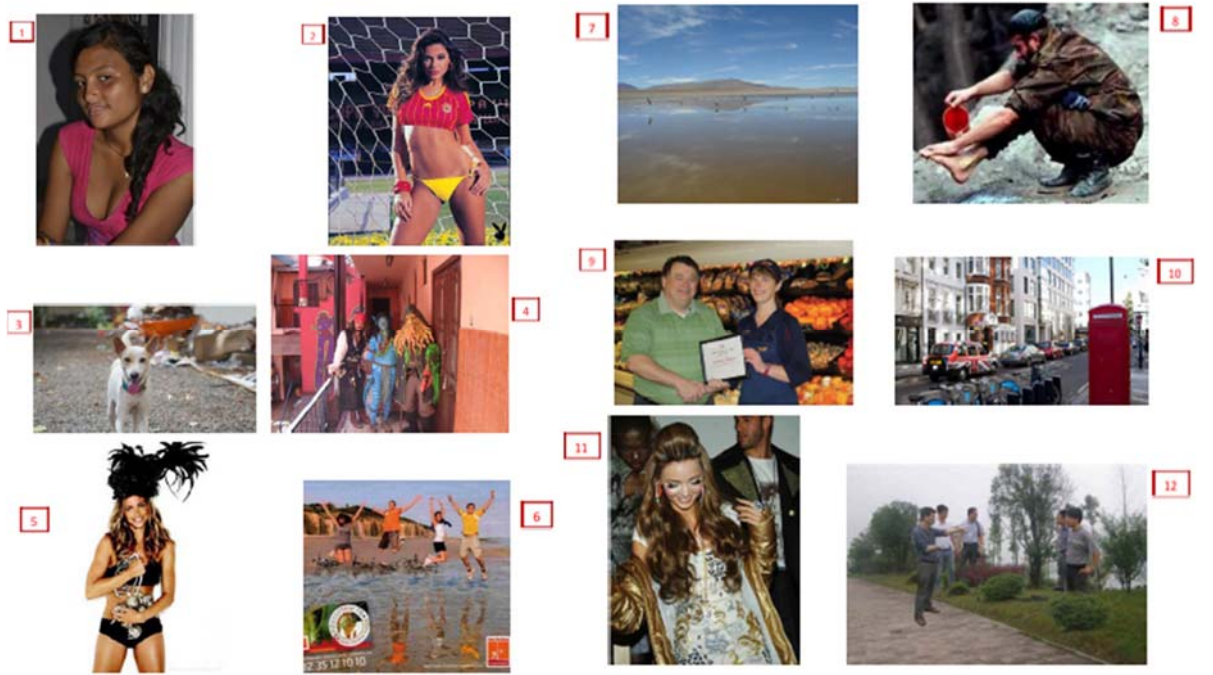
### 3.3. Knowledge of Media Law

Questionnaire for adolescents

Lies bitte folgende Aussagen zum Urheberrecht in der Schule genau durch und entscheide, ob sie stimmen oder nicht. Mit „Grauzone" ist gemeint, dass es hierzu noch keine Gesetzte gibt oder widersprüchliche Urteile bestehen.

| 1.   Urheberrecht in der Schule | Ja | Nein | Grau zone |
|---|---|---|---|
| Muss die Schule jeden Schüler fragen, wenn z.B. ein Foto der Schulversammlung ins Internet gestellt wird? | | | |
| Muss man, wenn man Fotos von Schülern unter 18 Jahren ins Internet stellen will, deren Eltern fragen? | | | |
| Muss man, wenn man nur sehr kurze Zitate (**3%** des Textes) in Referaten verwendet, die Quelle angeben? | | | |
| Muss man, wenn man nur kurze Zitate (**mehr als 3%** des Textes) in Referaten verwendet, die Quelle angeben? | | | |
| Muss man die Erlaubnis des Urhebers einholen, wenn man für das eigene Referat **weniger als 5%** des Originalwerks in Form von Fotos/Videos/Folien verwendet und dabei die Quelle angibt? | | | |
| Muss man die Erlaubnis des Urhebers einholen, wenn man für das eigene Referat **5-10%** des Originalwerks in Form von Fotos/Videos/Folien verwendet und dabei die Quelle angibt? | | | |
| Muss man die Erlaubnis des Urhebers einholen, wenn man für das eigene Referat **als 10-15%** des Originalwerks in Form von Fotos/Videos/Folien verwendet und dabei die Quelle angibt? | | | |
| Muss man die Erlaubnis des Urhebers einholen, wenn man für das eigene Referat **mehr als 20%** des Originalwerks in Form von Fotos/Videos/Folien verwendet und dabei die Quelle angibt? | | | |
| Dürfen Lehrer im Unterricht ganze Filme von selbst gekauften DVDs zeigen? | | | |
| Dürfen Lehrer selbst aufgenommene Sendungen aus dem Fernsehen zeigen? | | | |
| Dürfen Lehrer Sendungen aus dem Fernsehen zeigen, wenn diese tagesaktuell sind? | | | |

| | | | |
|---|---|---|---|
| Dürfen Lehrer kurze Texte aus Büchern kopieren, ohne den Verlag zu fragen? | | | |
| Dürfen Lehrer für die Schulklasse ein ganzes Buch kopieren, solange die Kopien im Klassenverband bleiben, ohne den Verlag zu fragen? | | | |
| Dürfen Lehrer eine Seite aus einem Buch kopieren und den Schülern als Hausaufgabe mitgeben ohne den Verlag zu fragen? | | | |
| Dürfen Lehrer ganze Schulbücher online stellen, wenn es nur mit Passwort zugänglich ist, ohne den Verlag zu fragen? | | | |
| Gibt es beim Erstellen der Schülerzeitung Ausnahmen zum allgemeinen Urheberrecht, da sie nur für die Schüler der Schule gedacht ist? | | | |
| Muss man, wenn man bei Schulfesten Lieder von CDs abspielt, Gebühren an die GEMA zahlen, obwohl man die CDs selbst gekauft hat? | | | |

Lies bitte die folgenden Aussagen sorgfältig durch und beurteile, ob die jeweilige Handlung strafbar bzw. gesetzlich verboten ist oder nicht.

| 2.   Urheberrecht bei Filmen/Musik/Streams | Ja | Nein | Grau-zone |
|---|---|---|---|
| Add-ons benutzen, um Filme von youtube herunter zu laden | | | |
| Musik/Filme aus dem Internet herunterladen, ohne zu bezahlen, wenn man unter 14 Jahre alt ist | | | |
| Kopien von Filmen, die man selbst aus dem Internet herunter geladen hat, zum Download anbieten | | | |
| Streams von Filmen anschauen, die andere auf Plattformen wie z.B. kinox.to gestellt haben | | | |
| Add-ons, wie z.B. Stealthy für Firefox  benutzen, um die youtube-Ländersperre zu umgehen | | | |
| Filme aus dem Fernsehen aufnehmen | | | |
| 3.   Urheberrecht und CDs/DVDs | | | |
| Eine Kopie von einer CD anfertigen | | | |
| Eine Kopie von einer CD an Freunde verschenken | | | |
| Eine geschenkte Kopie einer CD brennen und die gebrannte CD weiterverschenken | | | |
| Den Kopierschutz einer CD/DVD umgehen | | | |
| Auf die eigene Website einen Link zu einem **inländischen** Hersteller eines Brennprogramms setzen, dessen Software das Aushebeln von Kopierschutzmethoden ermöglicht | | | |
| Auf die eigene Website einen Link zu einem **ausländischen** Hersteller eines Brennprogramms setzen, dessen Software das Aushebeln von Kopierschutzmethoden ermöglicht | | | |
| Auf der eigenen Website als Hintergrund Musik von einer selbst gekauften CD abspielen, ohne an die GEMA zu zahlen | | | |
| Auf der eigenen Website als Hintergrund Musik von einer gebrannten CD abspielen, ohne an die GEMA zu zahlen | | | |
| Den Kopierschutz von DVDs umgehen, wenn es sich um Sicherheitskopien für einen selbst handelt | | | |
| 4.   Urheberrecht und Bücher/ebooks | | | |
| Bücher aus der Bibliothek kopieren, wenn man die Kopie nur für sich selbst verwendet | | | |
| Die Datei von ebooks, die man selbst erworben hat, im Original-Download weiterverkaufen | | | |

| | | | |
|---|---|---|---|
| ebooks, die man selbst erworben hat, für den Eigengebrauch speichern oder kopieren | | | |
| **5. Urheberrecht im Internet** | | | |
| Auf Facebook als Profilbild ein Foto aus dem Internet von Madonna oder Spiderman verwenden | | | |
| Ungefragt ein Profil anlegen und den Namen sowie das Bild einer anderen Person benutzten, z.B. von einer Person aus deiner Parallelklasse, verwenden | | | |
| Fotos, die andere gemacht haben, auf der eigenen Website zeigen, ohne dass diese zustimmen | | | |
| Fotos/Filme ins Internet stellen, auf/in denen andere Personen zu sehen sind, ohne diese zu fragen? Hier sind nur Fälle gemeint, in denen die Personen auch das Aufnahmeobjekt sind! | | | |

Questionnaire for adults

Lesen Sie bitte folgende Aussagen zum Urheberrecht an der Universität genau durch und entscheiden, ob sie stimmen oder nicht. Mit „Grauzone" ist gemeint, dass es hierzu noch keine Gesetzte gibt oder widersprüchliche Urteile bestehen.

| **1. Urheberrecht an der Universität** | Ja | Nein | Grau zone |
|---|---|---|---|
| Muss die Universität jeden Studierenden fragen, wenn z.B. ein Foto der Zeugnisverleihung ins Internet gestellt wird? | | | |
| Muss man, wenn man Fotos von Studierenden unter 18 Jahren ins Internet stellen will, deren Eltern fragen? | | | |
| Muss man, wenn man nur sehr kurze Zitate (**3%** des Textes) in Referaten verwendet, die Quelle angeben? | | | |
| Muss man, wenn man nur kurze Zitate (**mehr als 3%** des Textes) in Referaten verwendet, die Quelle angeben? | | | |
| Muss man die Erlaubnis des Urhebers einholen, wenn man für das eigene Referat **weniger als 5%** des Originalwerks in Form von Fotos/Videos/Folien verwendet und dabei die Quelle angibt? | | | |
| Muss man die Erlaubnis des Urhebers einholen, wenn man für das eigene Referat **5-10%** des Originalwerks in Form von Fotos/Videos/Folien verwendet und dabei die Quelle angibt? | | | |
| Muss man die Erlaubnis des Urhebers einholen, wenn man für das eigene Referat **10-15%** des Originalwerks in Form von Fotos/Videos/Folien verwendet und dabei die Quelle angibt? | | | |
| Muss man die Erlaubnis des Urhebers einholen, wenn man für das eigene Referat **mehr als 20%** des Originalwerks in Form von Fotos/Videos/Folien verwendet und dabei die Quelle angibt? | | | |
| Dürfen Dozenten im Seminar ganze Filme von selbst gekauften DVDs zeigen? | | | |
| Dürfen Dozenten selbst aufgenommene Sendungen aus dem Fernsehen in Seminaren zeigen? | | | |
| Dürfen Dozenten Sendungen aus dem Fernsehen in Seminaren zeigen, wenn diese tagesaktuell sind? | | | |
| Dürfen Dozenten kurze Texte aus Büchern kopieren und an die Studierenden verteilen, ohne den Verlag zu fragen? | | | |
| Dürfen Dozenten für die Seminarteilnehmer ein ganzes Buch kopieren, solange die Kopien unter den Seminarteilnehmern bleiben, ohne den Verlag zu fragen? | | | |

| | | | |
|---|---|---|---|
| Dürfen Dozenten eine Seite aus einem Buch kopieren und den Studierenden als Aufgabe mitgeben ohne den Verlag zu fragen? | | | |
| Dürfen Dozenten ganze Lehrbücher online stellen, wenn es nur mit Passwort zugänglich ist, ohne den Verlag zu fragen? | | | |
| Gibt es beim Erstellen der Fachschaftszeitung Ausnahmen zum allgemeinen Urheberrecht, da sie nur für die Studierenden des Fachbereichs gedacht ist? | | | |
| Muss man, wenn man bei Universitätsfesten Lieder von CDs abspielt, Gebühren an die GEMA zahlen, obwohl man die CDs selbst gekauft hat? | | | |

Lies bitte die folgenden Aussagen sorgfältig durch und beurteile, ob die jeweilige Handlung strafbar bzw. gesetzlich verboten ist oder nicht.

| 2. Urheberrecht bei Filmen/Musik/Streams | Ja | Nein | Grau zone |
|---|---|---|---|
| Add-ons benutzen, um Filme von youtube herunter zu laden | | | |
| Musik/Filme aus dem Internet herunterladen, ohne zu bezahlen, wenn man unter 14 Jahre alt ist | | | |
| Kopien von Filmen, die man selbst aus dem Internet herunter geladen hat, zum Download anbieten | | | |
| Streams von Filmen anschauen, die andere auf Plattformen wie z.B. kinox.to gestellt haben | | | |
| Add-ons, wie z.B. Stealthy für Firefox benutzen, um die youtube-Ländersperre zu umgehen | | | |
| Filme aus dem Fernsehen aufnehmen | | | |
| **3. Urheberrecht und CDs/DVDs** | | | |
| Eine Kopie von einer CD anfertigen | | | |
| Eine Kopie von einer CD an Freunde verschenken | | | |
| Eine geschenkte Kopie einer CD brennen und die gebrannte CD weiterverschenken | | | |
| Den Kopierschutz einer CD/DVD umgehen | | | |
| Auf die eigene Website einen Link zu einem **inländischen** Hersteller eines Brennprogramms setzen, dessen Software das Ausheben von Kopierschutzmethoden ermöglicht | | | |
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| Auf der eigenen Website als Hintergrund Musik von einer selbst gekauften CD abspielen, ohne an die GEMA zu zahlen | | | |
| Auf der eigenen Website als Hintergrund Musik von einer gebrannten CD abspielen, ohne an die GEMA zu zahlen | | | |
| Den Kopierschutz von DVDs umgehen, wenn es sich um Sicherheitskopien für einen selbst handelt | | | |
| **4. Urheberrecht und Bücher/ebooks** | | | |
| Bücher aus der Bibliothek kopieren, wenn man die Kopie nur für sich selbst verwendet | | | |
| Die Datei von ebooks, die man selbst erworben hat, im Original-Download weiterverkaufen | | | |
| ebooks, die man selbst erworben hat, für den Eigengebrauch speichern oder kopieren | | | |
| **5. Urheberrecht im Internet** | | | |

| | | | |
|---|---|---|---|
| Auf Facebook als Profilbild ein Foto aus dem Internet von Madonna oder Spiderman verwenden | | | |
| Ungefragt ein Profil anlegen und den Namen sowie das Bild einer anderen Person benutzten, z.B. von einem deiner Kommilitonen. | | | |
| Fotos, die andere gemacht haben, auf der eigenen Website zeigen, ohne dass diese zustimmen | | | |
| Fotos/Filme ins Internet stellen, auf/in denen andere Personen zu sehen sind, ohne diese zu fragen? Hier sind nur Fälle gemeint, in denen die Personen auch das Aufnahmeobjekt sind! | | | |

## 4.1. Knowledge of Media Effects

Die folgenden Aussagen beziehen sich auf mögliche Wirkungen, die Medien (z.B. Fernsehen, Zeitung, Buch, Internet) auf den Zuhörer/Zuschauer/Leser ausüben können. Welche dieser beschriebenen Wirkungen gibt es nach dem derzeitigen Stand der Forschung tatsächlich?

| Mögliche Medienwirkung | Ja stimmt | Nein stimmt nicht |
|---|---|---|
| In traditionellen, kulturellen oder religiösen Einheitsgesellschaften üben Massenmedien einen größeren Einfluss aus als in modernen, vielfältigen Gesellschaften. | | |
| Das häufige Zeigen von Ausländern im Zusammenhang mit Kriminalität, insbes. als Täter, fördert ihnen gegenüber Ablehnung bis hin zu Gewalt, wie z.B. Übergriffe auf Asylantenheime. | | |
| Je häufiger Medien über eine Sache, z.B. fehlende Plätze in Kindertagesstätten, berichten, desto deutlicher wird diese in der Gesellschaft als Problem wahrgenommen. | | |
| Wer sehr oft pornographische Inhalte anschaut, schätzt die Häufigkeit bestimmter sexueller Praktiken, wie z.B. Sado Maso, und außerehelichem Sex in der Bevölkerung realistischer ein. | | |
| Videospiele können sich je nach Inhalt günstig z.B. auf das räumliche Vorstellungsvermögen, das Wissen über Gesundheit oder über die eigenen Fähigkeiten auswirken. | | |
| Kinder schauen in der Woche durchschnittlich weniger als drei Stunden Fernsehwerbung. | | |
| Medienberichte zu tagesaktuellem Geschehen, wie z.B. in Tageszeitungen, legen neben den Themen auch die Sichtweise fest, aus der ein Thema betrachtet wird. *Zum Beispiel zählt eine Nachrichtensendung nur Vorteile der Massentierhaltung auf, ohne die Nachteile zu nennen, und beeinflusst damit die Meinungsbildung des Zuschauers einseitig.* | | |
| Im Vergleich zu anderen Medien, bei denen man nur hört, wie z.B. Radio, oder nur sieht, wie z.B. Comics, steigert Fernsehen die Kreativität. | | |
| Menschen schätzen den Einfluss von negativen Berichten in den Medien auf andere genauso groß ein wie auf sich selbst. | | |
| Gefühle können irrtümlich und unbewusst auf ein Ereignis außerhalb des Mediums zurückgeführt werden. *Zum Beispiel führt das Gruseln durch den Horrorfilm zu mehr Ärger über den lärmenden Nachbarn.* | | |
| Die Medien tragen zur Erziehung von Kindern durch die Vermittlung von Normen und Werten bei. | | |
| Das Schauen von Kindersendungen, wie z.B. Sesamstraße oder Löwenzahn, unterstützt sehr junge Kinder beim Lernen der Sprache, weil dadurch der Wortschatz vergrößert wird. | | |
| Ob man von einem Videospiel abhängig wird, der Drang zu spielen also unkontrollierbar wird, hängt zum großen Teil davon ab, wie gewalthaltig das Videospiel ist. | | |

| | | |
|---|---|---|
| Das Sehen von Vorurteilen in den Medien beeinflusst unmerklich die eigenen Überzeugungen und Handlungen. *Zum Beispiel erwartet ein Polizist eher bei einem Schwarzen das Tragen einer Schusswaffe als bei einem Weißen.* | | |
| Der Großteil von animierten Kinderfilmen, wie z.B. bei *Pixar*, zeigt körperliche Gewalt, die mit dem Ziel eingesetzt wird, jemand anderen zu verletzen und zu "besiegen". | | |
| Wer regelmäßig die aktuellsten Nachrichten verfolgt, hat weniger Angst, Opfer von Gewalttaten zu werden. | | |
| Entscheidungen einer Firma werden häufiger und stärker von ihren Erwartungen in Bezug auf zukünftige Medienmeldungen beeinflusst als von bereits erschienenen Medienberichten. | | |
| Häufiges Fernsehen, insbesondere von Unterhaltungssendungen wie z.B. Serien oder Comedysendungen, wirkt sich fördernd auf das Lernen von Lesen und Rechtschreibung aus. | | |
| Fernsehschauspielerinnen sind meist überdurchschnittlich schlank und attraktiv. Das kann mitunter die Entwicklung einer Essstörung beim Zuschauer unterstützen. | | |
| Das häufige Sehen von Gewalt in Fernsehen oder Videospielen hat im echten Leben keinen Einfluss darauf, wie stark das Mitgefühl für ein Opfer von Gewalt ist. | | |
| Das große Medienecho nach Amokläufen an Schulen hat keinen Einfluss auf die vorherigen Überlegungen eines zukünftigen Täters zur Ausführung einer solchen Tat. | | |
| Die Mehrheit der in einer Studie untersuchten Kinderfilme, wie z.B. von Disney, stellt Schlanksein als eine gute weibliche Eigenschaft und Übergewicht als schlecht, böse und unattraktiv dar. | | |
| Ob man ein Produkt kauft, wird eher durch die konkreten Erfahrungen des Käufers beeinflusst als durch dessen emotionale Reaktionen auf Werbung, wie z.B. Lachen über die lustige Anzeige. | | |
| Das vermehrte Fernsehen in den letzten Jahrzehnten ist eine bedeutende Ursache für den Anstieg von Übergewicht in der Bevölkerung. | | |
| Menschen in einer unbefriedigenden Lebenssituation, wie z.B. Arbeitslosigkeit, schauen eher Unterhaltungssendungen ohne Bezug zum eigenen Lebensumfeld und fühlen sich stärker mit den dort auftretenden positiven Figuren verbunden. *Zum Beispiel schauen Städter eher Sendungen über das Dorfleben und Dorfbewohner Sendungen über das Stadtleben.* | | |
| Vom Fernsehen lernt man weniger als von anderen Medien, wie z.B. einem Hörspiel oder Buch. | | |
| Medienberichte über Menschen, die Krisensituationen selbstbewusst bewältigen, bewirken, dass Menschen unter ähnlichen Belastungen eher keinen Selbstmord begehen. | | |
| Informationen aus unglaubwürdigen Quellen, wie z.B. Boulevardzeitungen, erscheinen einem mit der Zeit immer weniger überzeugend. | | |
| Längerfristiges intensives Anschauen von Gewalt im TV trägt zu aggressivem Verhalten bei. | | |
| Häufige und lange Aufenthalte in der Onlinecommunity Facebook können langfristig zu tiefer Niedergeschlagenheit beim Nutzer führen. | | |
| Fernsehserien über einen bestimmten Beruf, wie z.B. einen Anwalt, verbreiten vermeintliches Wissen über diesen Beruf und beeinflussen damit das Berufsbild. | | |
| Damit Medien auf Personen wirken können, müssen sie direkten Kontakt mit den Medien haben, z.B. durch Zeitunglesen oder Fernsehen. | | |

## 4.2. Production Skills
### Items for Windows

*1. Tabelle erstellen*

Wähle unter den folgenden Menüoptionen eines Textverarbeitungsprogramms jenes aus, das bei dem Erstellen einer Tabelle den ersten Schritt bzw. Click darstellt.

Correct answer
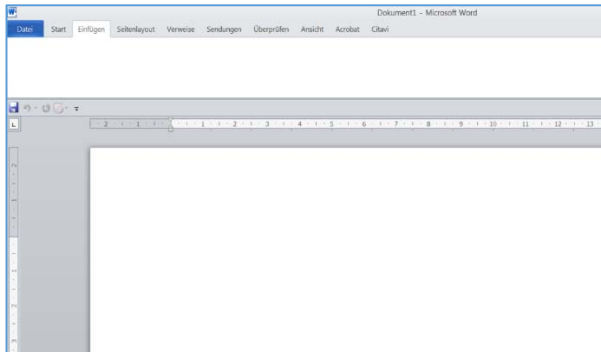


Distractor 1
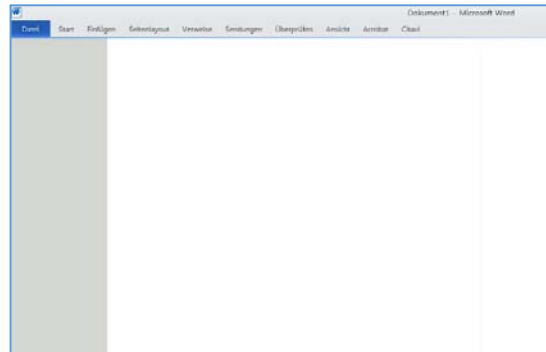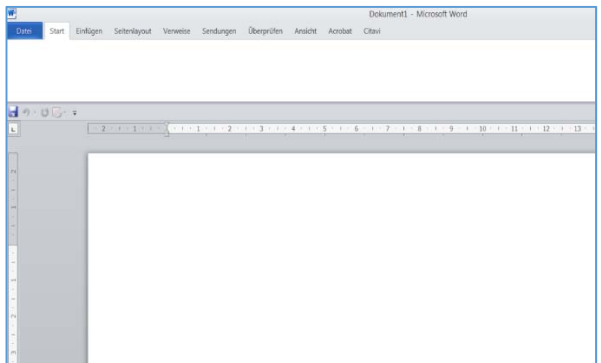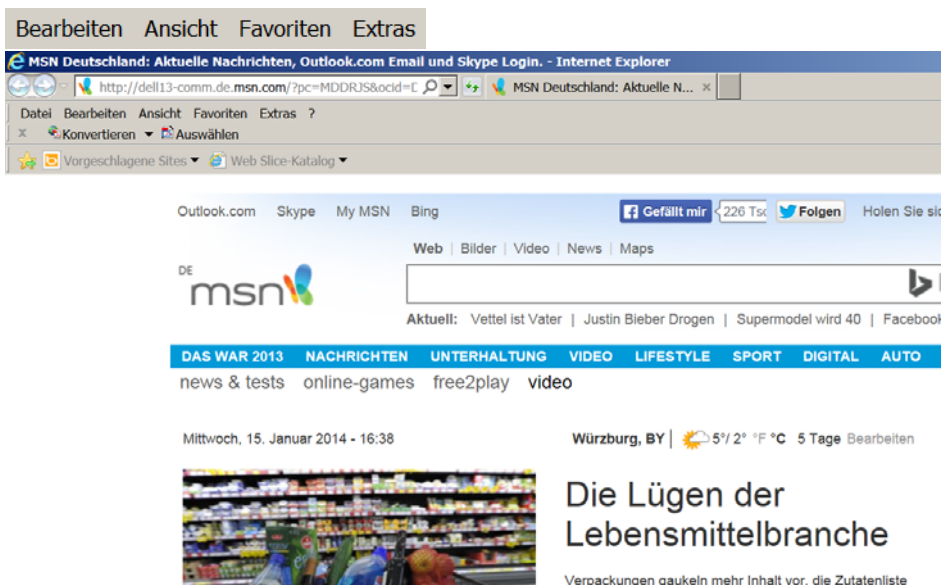


Distractor 2



Distractor 3
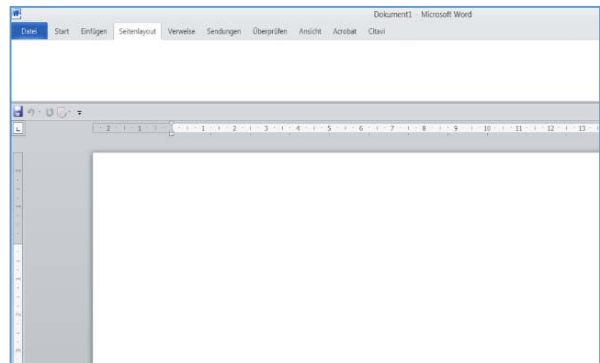


2. Welche Menüoption des vorgegeben Browsers stellt den ersten Schritt des kürzesten Wegs dar, um ein Lesezeichen anzulegen?

3. Bitte gib den Ordner "Rohmaterial" an "mimi@gmx.de" frei. Erlaubt ist nur die linke Maustaste, zum Eingeben der Adresse auch die Tastatur!
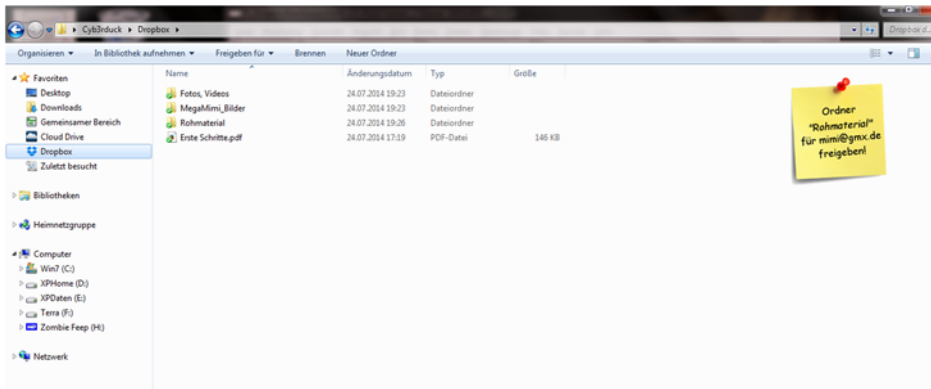


4.1. Von der aktuellen Internetseite soll ein Lesezeichen erstellt werden. Erlaubt ist nur die linke Maustaste!

4.2. Lösche bitte auf der folgenden Internetseite den Verlauf der Chronik von HEUTE. Erlaubt ist nur die linke Maustaste!



5.

# 6. Tasks for PowerPoint

## Starting position
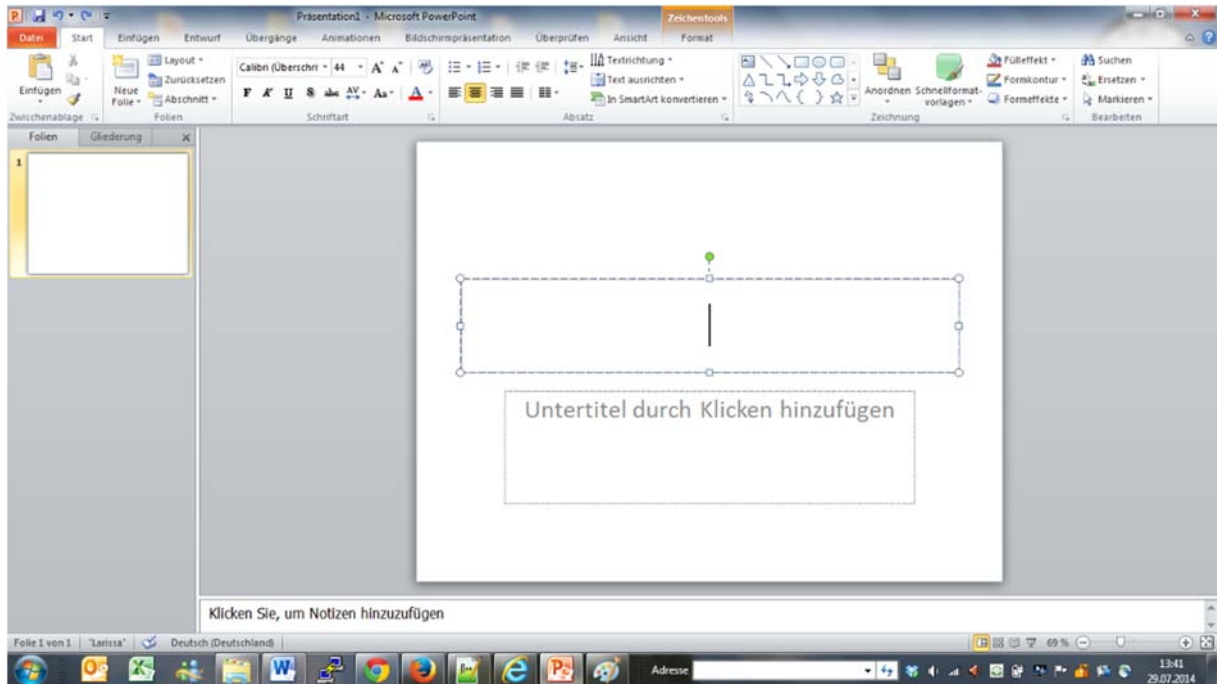


## 6.1.



Im Folgenden soll der Anfang einer Power-
Point-Präsentation gestaltet werden.
Zuerst muss das Deckblatt beschriftet und
dann eine Animation eingefügt werden.
Dabei soll in die vorgesehenen Kästchen für
die Überschrift „Eisbär" und für den
Untertitel „Nordpol" eingegeben werden.
Danach gilt es eine beliebige Animation so
auszuwählen, dass zuerst die Überschrift und
dann der Untertitel erscheinen.
Klicken um weiter zu kommen

## 6.2.



Nun soll auf der zweiten Folie der
Präsentation ein Video eingebettet
werden. Aus den vorgegebenen
Videos ist dabei das Video „Natur"
auszuwählen.

Klicken um weiter zu kommen

7. Der Status in Skype soll von *online* auf *offline* umgestellt werden.



8. Items in Word:

8.1. Einen Text mit einen Kommentar versehen
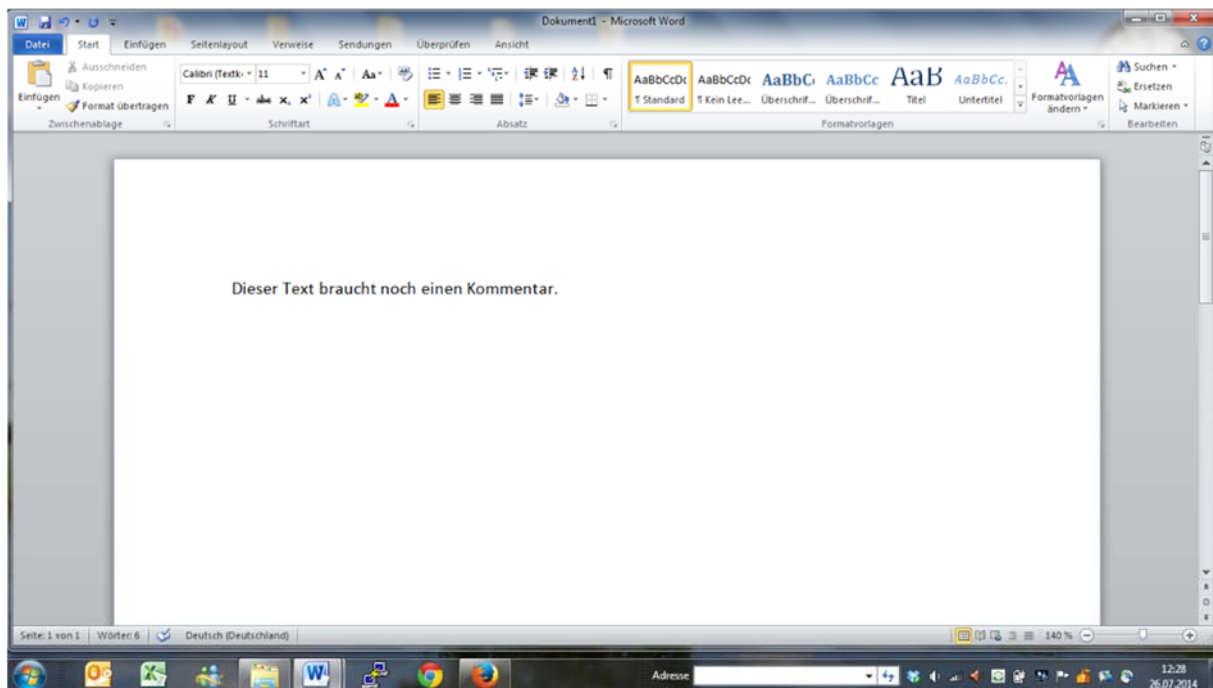


8.2. Bitte fügen Sie/füge in die Datei (oben) noch eine Kopfzeile ein.

8.3. Bitte erstellen Sie/erstelle ein Tabelle.

**Items for Macintosh**

**1. Was ist/sind Möglichkeit/en, um ein Laufwerk auszuwerfen?**

☐   Symbol auf den Papierkorb ziehen

☐   Fenster im Finder öffnen und dann auf „Auswerfen" klicken

☐   Rechte Maustaste → „Auswerfen"

☐   Tastenkombination [cmd ⌘] + Q
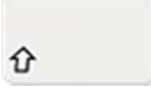
**2. Was ist die einfachste Methode um einen Screenshot bei einem Macintosh zu erstellen?**

☐   Ich wähle die Tastenkombination

☐   [cmd ⌘] + [⇧] + [§ 3]

☐   Ich gehe über PhotoBooth, wähle „interne Aufnahme", „Bildschirmfoto erstellen"

☐   Ich gehe über Vorschau, wähle dort „Bildschirmfoto aufnehmen" , „gesamter Bildschirm"

☐   Ich wähle die Tastenkombination [cmd ⌘] + [alt ⌥] + C

**5.   Tastenkombinationen**
Welche Kombinationen stehen für folgende Befehle:

5.1.  Computer in Ruhezustand versetzten

☐   [cmd ⌘] + [alt ⌥] + [⇧]

☐   [cmd ⌘] + [alt ⌥] + [⏏]

☐   [cmd ⌘] + [ctrl] + [⏏]

☐   [cmd ⌘] + [alt ⌥] + [ctrl] + **8**

5.2.  Dashboard aufrufen

☐   F4

☐   Apple-Symbol

☐   [cmd ⌘] + F

☐   Esc

6. **Wie synchronisiert man das Fotoalbum seines iPhone mit dem seines Macintosh-Computers?** Nachdem man sein iPhone mittels USB-Kabel an den Computer angeschlossen hat…

☐ Wählt man „Systemeinstellungen", klickt mit der rechten Maustaste auf „Synchronisieren" und wählt aus der Liste „Hardware sychronisieren" und dann „Bilder"

☐ Wählt man „iTunes", klickt dann auf das Symbol des iPhones und wählt dann unter „sychronisieren" „Bilder" aus

☐ Öffnet man das Programm „SychroAll" und wählt „Hardware wählen", dort klickt man auf sein iPhone und geht auf „Bilder synchronisieren"

☐ Öffnet man das Programm „KeyNotes", klickt auf das Symbol des iPhones und wählt „Bilder sychronisieren"

7. **Zuordnung: Welche Windows- und Apple-Programme entsprechen einander?**

| Windows Office | Numbers |
|---|---|
| Excel | KeyNote |
| Powerpoint | Quicktime |
| Word | Pages |
| Systemwiederherstellung | iWork |
| Windows Media Player | TimeMachine |

8. **iPhoto**

8.1. Farbqualität verbessern

Dein Foto sieht leider ganz anders aus als deine Erinnerung an den Urlaub. Die Farben sind viel trüber. Was kannst du einfaches unternehmen, um die Farbqualität zu verbessern?
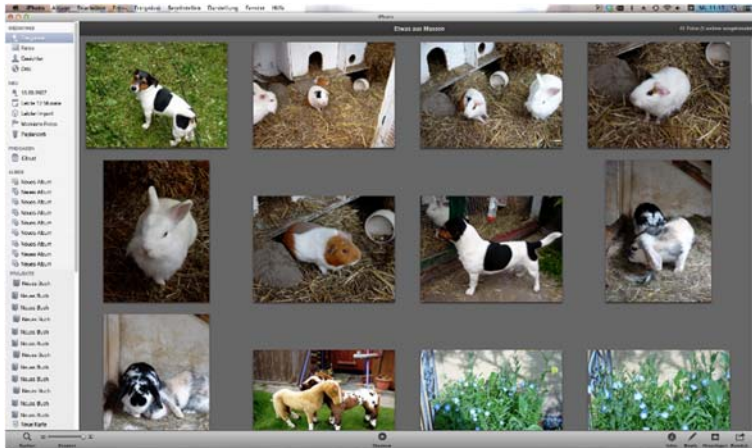
Ausgangslage

## 8.2. Foto verstecken

Du möchtest nicht, dass jemand das Bild von deinem Meerschweinchen (rechts oben) sieht. Wie kannst du das Bild verstecken?



## 9. Montageverständnis

Im Folgenden wird Dir ein kurzer Ausschnitt aus der Scripted-Reality-Sendung „Die Abschlussklasse" gezeigt. Während der Szene passiert ein Fehler, der sich in der Filmmontage bemerkbar macht.

Welches der hier vorgegebenen Bilder macht diesen Fehler deutlich? / Bitte markiere während dem Sehen der Szene den entsprechenden Zeitpunkt.



A video clip of a German scripted-reality-show was shown, which presented the interaction of students in the classroom. They are learning for their final exams. Supposedly, the scene really took place and was filmed by the students themselves. At one point, a mistake in the montage took place, filming from an angle where no student (or the alleged camera in the shelf) could have filmed the scene.

# B Materials Study III

## 1. Socio-demographic questions

Geburtsdatum     __.__.____

Geschlecht      w ☐    m ☐

**Was für eine Schule besuchst du bzw. welche Schulart hast du abgeschlossen?**

    a)   Ohne Abschluss

    b)   Hauptschule / (qualifizierter) Hauptschulabschluss

    c)   Realschule / Mittlere Reife

    d)   Fachoberschule / Fachabitur

    e)   Gymnasium / Abitur

**Welche Noten hattest du im letzten Zeugnis in**

Mathematik: ___

Deutsch: ___

1. Fremdsprache: ___

2. Fremdsprache: ___

Physik: ___

Chemie: ___

**Bitte kreuzen Sie das zutreffende an:**

Höchster Bildungsabschluss

    a)   Ohne Abschluss
    b)   Hauptschulabschluss
    c)   Qualifizierter Hauptschulabschluss
    d)   Mittlere Reife
    e)   Fachhochschulreife (Fachabitur)
    f)   Hochschulreife (Abitur)

Welche Abschlussnote hatten Sie? _____

Berufe der Eltern: Vater _____ Mutter: _____

# Thorium – Atomkraft ohne Risiko?

Løvøya – Dies ist der Name der norwegischen Insel, auf der das Mineral „Thorium" in den 20er Jahren des 19. Jahrhunderts entdeckt wurde. Heute ist von dem Fundort nur noch eine kleine Grube übriggeblieben. Ein dort ansässiger Vikar und Hobby-Mineraloge ging eines Tages auf Entenjagd. Aber statt Enten fand er etwas ganz anderes: Er entdeckte ein neues Mineral. Dieses Mineral schickte er daraufhin dem berühmten schwedischen Chemiker Jakob Berzelius, der heute als Vater der modernen Chemie gilt. Berzelius stellte fest, dass es sich bei der bräunlich-schwarzen Substanz nicht nur um ein neues Mineral handelte, sondern dieses auch aus einem neuen Element bestand, welches er nach dem nordischen Donnergott „Thor" benannte: „Thorium".

Entstanden ist Thorium vermutlich in einer oder mehreren Supernovas vor sechs Milliarden Jahren - zur gleichen Zeit, als das Sonnensystem und die Erde entstanden sind. Aufgrund dessen ist Thorium noch heute überall in unterschiedlichen Konzentrationen in die Erdkruste eingebettet.

Thorium ist wie Uran ein potentieller nuklearer Brennstoff, wobei Thorium ein etwas leichteres Element als Uran ist. Dies wird unter anderem anhand der Ordnungszahlen im Periodensystem deutlich: Aufgrund seiner zwei Protonen weniger, hat Thorium die Ordnungszahl 90 und Uran die Ordnungszahl 92. Thorium ist darüber hinaus ein sogenanntes „brütbares" Material. Das bedeutet, dass Thorium nicht direkt gespalten werden kann, Uran dagegen schon. Thorium hingegen kann in einem Reaktor Neutronen einfangen und ein Uran-Isotop werden, das sich im Folgenden spalten und Energie freisetzen kann.

Bei einer Spaltung absorbiert ein Zellkern ein Neutron, woraufhin er in Spaltfragmente zerfallen kann. Ein Zellkern kann das Neutron aber auch speichern und dann durch radioaktiven Zerfall ein anderes Element werden, wie das bei „brütbaren" Materialien der Fall ist.

Beispielsweise kann Thorium-232 ein Neutron absorbieren und sich in Uran-233 als Spaltstoff verwandeln. Dieser kommt in der Natur nicht vor, kann aber im Kernreaktor erzeugt werden. Somit könnte Uran-233 theoretisch für Bomben verwendet werden. Jedoch besteht das Problem, dass es im Gegensatz zu einer Bombe mit natürlichem Uran zu früh explodieren würde.

Vermutlich aufgrund dieser Tatsache, dass Uran zum Bau von Bomben verwendet werden kann, fiel auch die Entscheidung, Uran anstelle von Thorium für die Nutzung in Atomkraftwerken weiter zu erforschen. Insofern ist die Kernkraft aus einer „Erbsünde" entstanden, denn das Ziel des Manhattan-
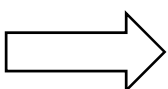
Projektes war, eine Bombe zu bauen. Daher wird die Verbindung zu Atomwaffen und Hiroshima immer zum Image der Kernkraft gehören.

Dennoch sollte gewürdigt werden, dass in Oak Ridge auch Beiträge zur zivilen Kernenergie geleistet wurden. Zur damaligen Zeit hatte die Industrie bereits angefangen, Reaktoren auf der Basis von Rickovers Leichtwasserreaktortechnologie zu konstruieren. In Oak Ridge wurde dann ein bestimmter partieller Prototyp eines Flüssigreaktors entwickelt: Der erste wässrig-homogene Reaktor, AHR. In einem Leichtwasserreaktor hingegen besteht der Kern aus festen Brennstoffelementen. Hierbei wird Uranoxid verarbeitet und zu Pellets gedrückt. Im Anschluss werden fast 70.000 solcher Pellets in den Reaktorkern geladen, die dann unter dem Neutronen-Beschuss leiden.

Im Inneren des Reaktors werden die Pellets, die zunächst regelmäßig und zylindrisch geformt sind, als Kernbrennstoff in Metallstäbe geschichtet. Während ihres Lebenszyklus im Reaktor erleben die Brennelemente zahlreiche Spaltungen. Einige Zellkerne der Brennelemente werden gespalten und wandeln sich in andere Elemente um. Die Ansammlung von Spaltprodukten, sowie die starke Erhitzung, erzeugen eine Reihe an Verformungen und Rissen. Dies hat einige Auswirkungen auf die Leistung des Brennelements. So ändern sich einige der wichtigsten Eigenschaften, wie zum Beispiel die Verschlechterung der Wärmeleitfähigkeit. Diese befähigt das Material, Wärme aus den Pellets in das Kühlmittel abzuleiten.

Somit müssen die Brennstoffelemente regelmäßig ausgetauscht werden, wenn ca. 10% des Brennstoffes gespalten wurde. Um also 100% des Brennstoffes zu verbrennen, müssen die Brennstoffelemente neun Mal recycelt werden. In Oak Ridge wurde versucht, diesen teuren Recyclingprozess zu umgehen. Statt der Verwendung fester Brennstoffe wurde Uran in schwerem Wasser gelöst, wodurch Uranbrennstäbe überflüssig wurden. Bei diesen Flüssigbrennstoffreaktoren entfällt zusätzlich das Problem, eine Ummantelung zu finden, welche den Brennstoff und die Spaltprodukte sicher verwahrt.

Bei Reaktoren mit Festbrennstoff, bei denen man die Spaltprodukte nicht entfernen kann, ist zusätzlich die Nachzerfallswärme ein Problem, sobald der Reaktor abgeschaltet werden soll. Dies sind zwar nur wenige Prozent der Gesamtleistung, bei einem großen Reaktor kann es sich aber auf viele Megawatt belaufen, welche heruntergekühlt werden müssen. Es muss also beachtet werden, dass der Reaktor nicht überhitzt. Ein Beispiel für ein überhitztes System ist der Reaktor in Fukushima. Dort wurde die Ummantelung der Brennelemente so heiß, dass sie mit Wasserdampf reagierte und so Wasserstoff bildete, der zu der Explosion und weiteren Reaktionen führte, was als Zirkon/Wasser-Reaktionen oder Zirkoniumbrand bezeichnet wird.

### 3. Text-based questions

1. Wonach ist Thorium benannt?
A. Nach dem Vikar, der Thorium erstmals entdeckt hat.
B. Nach der Insel, auf der es erstmals gefunden wurde.
C. Nach dem Chemiker, der es erstmals untersucht und beschrieben hat.
D. Nach dem nordischen Donnergott.

2. Welche Eigenschaft von Brennelementen ändert sich im Laufe ihres „Lebenszyklus"?
A. Aggregatzustand.
B. Elektrischer Widerstand.
C. Wärmeleitfähigkeit.
D. Säure-Basen-Haushalt.

3. Wo wurde Thorium entdeckt?
A. In Schweden.
B. In Finnland.
C. In Norwegen.
D. In Dänemark.

4. Die entstehende Hitze durch Spaltprodukte in Festbrennstoffreaktoren beträgt mehrere…
A. Megawatt.
B. Gigawatt.
C. Terawatt.
D. Petawatt.

5. „Zirkoniumbrand" beschreibt den Prozess, dass es durch Überhitzung zu Explosionen kommen kann, da…
A. das im Kühlwasser gelöste Zirkonium mit dem Uranoxid im Kern der Brennstoffelemente reagiert. Durch die freigesetzte Energie kann sich das Kühlwasser in Wasserstoff und Sauerstoff aufspalten.
B. Uran-233 mit schwerem Wasser reagiert. Hierdurch wird Energie freigesetzt und Wasserstoff gebildet.
C. das Zirkonoxid aus den Ummantelungen der Brennstoffelemente durch Protonenbeschuss zerfällt, wodurch Spaltprodukte mit hoher Nachzerfallswärme entstehen, welche den Reaktor überhitzen und Sauerstoff bilden.
D. die Nachzerfallswärme der Uranoxid-Brennstoffelemente den Reaktor überhitzt, wodurch die Ummantelung der Brennstäbe mit dem Wasserdampf reagiert und Wasserstoff bildet.

6. Ein Vorteil von Flüssigbrennstoffen ist, dass…
A. kleinere Brennstoffelemente hergestellt werden können, was sowohl Herstellungskosten, als auch Kosten für die Lagerung spart.
B. das Problem, ob die Ummantelung des Reaktors den Brennstoff sowie anfallende Spaltprodukte sicher verwahren kann, wegfällt.
C. der Brennstoff günstiger zu recyceln ist, da alle Stoffe in einem Flüssigmedium gelöst sind und somit weniger Energiekosten für die Re-Ionisierung anfallen.
D. das Kühlwasser weniger mit bedenklichen Spaltprodukten belastet ist, wodurch geringere Kosten für den Rückbau anfallen und geringere Auswirkungen auf Mensch und Umwelt zu erwarten sind.

7. Wie sieht der Kernbrennstoff in Leichtwasserreaktoren nach dem Neutronen-Beschuss aus?

A. Er ist von Rissen durchzogen.

B. Er ist transparent.

C. Er ist zu einer Masse zerschmolzen.

D. Er ist zu Pulver zerfallen.

8. Flüssigbrennstoffe bestehen aus…(T8)

A. Uran, welches in schwerem Wasser gelöst wurde.

B. Thorium, welches in schwerem Wasser gelöst wurde.

C. Uranoxid, welches in schwerem Wasser gelöst wurde.

D. Thoriumoxid, welches in schwerem Wasser gelöst wurde.

9. Um 100% des Brennstoffs aus Uranoxid-Pellets zu verbrennen, müssen diese…(T9)

A. In mehreren Stufen mit Protonen beschossen werden.

B. Neun Mal recycelt werden.

C. In schwerem Wasser gelöst werden.

D. Zuerst in Uran-233 verwandelt werden.

10. Was ist mit „brütbarem Material" gemeint? (T10)

A. Das Material kann keine Neutronen absorbieren.

B. Der Zellkern des Materials kann keine Protonen speichern.

C. Das Material kommt in der Natur nicht vor.

D. Das Material kann nicht direkt gespalten werden.

11. Seit wann gibt es Thorium? (T11)

A. Seit etwa sechs Millionen Jahren.

B. Seit etwa sechs Milliarden Jahren.

C. Seit etwa einer Million Jahre.

D. Seit etwa einer Milliarde Jahre.

4. Inference questions

1. Was trifft auf Reaktoren mit festen Brennstoffelementen zu?

A. Es muss bei Stromausfall keine Energie für die Kühlung des Systems
zur Verfügung stehen.

B. Durch den Austausch der Brennstäbe entstehen nur geringe Kosten.

C. Sie sind gut erprobt.

D. Die Ummantelung der Brennstäbe besteht aus keinen chemisch reaktiven Stoffen.

2. Welche historische Begebenheit führte dazu, dass sich das Manhattan-Projekt auf ein bestimmtes Ziel ausrichtete?

A. Die Dekolonisation.

B. Der Zweite Weltkrieg.

C. Der Beginn des Kalten Krieges.

D. Die Gründung des Staates Israel.

3. Zu welcher Klasse von Mineralien gehört Thorium? (I3)

A. Zu den organischen Materialien.

B. Zu den Elementen.

C. Zu den Carbonaten.

D. Zu den Oxiden.

4. Problematisch für die Entstehung des Zirkoniumbrandes ist das Entstehen eines explosiven Knallgasgemisches, welches u.a folgendes Element beinhaltet:

A. Wasserstoff.

B. Uran-255.

C. Zirkon-Ionen.

D. Sauerstoff.

5. Welche Reaktortypen sind die Verbreitetsten?

A. Flüssigsalzreaktoren.

B. Schnelle Brutreaktoren.

C. Schwerwasser-Druckreaktoren.

D. Leichtwasserreaktoren.

6. Wann wurde das Manhattan-Projekt durchgeführt?

A. In den 1930er Jahren.

B. In den 1940er Jahren.

C. In den 1950er Jahren.

D. In den 1960er Jahren.

7. Warum ist von dem Ort, wo Thorium entdeckt wurde, nur noch eine kleine Grube übrig?

A. Weil es nach dem Fund in großen Mengen abgebaut wurde.

B. Weil die Insel überschwemmt wurde und das Thorium sich dabei auflöste.

C. Weil es bei den Untersuchungen zu einer Explosion kam.

D. Nach Abtragen der schützenden aufliegenden Gesteinsschicht schmolz das restliche Thorium durch die Sonneneinstrahlung.

8. Was ist eine Supernova?

A. Die Explosion eines Sterns.

B. Die Explosion eines Atomreaktors.

C. Eine Eiszeit.

D. Ein Vulkanausbruch.

9. Was meint die „Erbsünde" (bei der Entstehung) der Kernkraft?

A. Den radioaktiven Müll.

B. Die Verbindung zu atomaren Waffen.

C. Die Verwendung von Uran anstelle von Thorium.

D. Die Verwendung von Thorium anstelle von Uran.

10. Eine Lösung für die Verhinderung des Zirkoniumbrandes wäre…

A. der Verzicht auf Uran-233 in den Brennstäben.

B. der Verzicht auf Uranoxid in den Brennstäben.

C. ein Ersatz für Wasser als Kühlungsmittel.

D. ein Ersatz für den Neutronenbeschuss.

11. Ein Vorteil von Flüssigreaktoren ist, dass… (I11)

   A. keine chemischen Reaktionen auftreten können, welche eine Explosionsgefahr beinhalten.

   B. das Kühlwasser direkt der Reaktionsflüssigkeit zugegeben werden kann.

   C. die Brennstoffflüssigkeit nach der Reaktion keine radioaktiven Elemente mehr enthält, was den Rückbau und das Recycling vergünstigt.

   D. sie durch ihre weite Verbreitung gut erprobt sind.