Computers & Education 234 (2025) 105330

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Should educators be concerned? The impact of short videos on rational thinking and learning: A comparative analysis

Thorsten Otto

Institute of Educational Psychology Technical University of Braunschweig, Braunschweig, Bienroder Weg 82, Niedersachsen, 38106, Braunschweig, Germany

ARTICLE INFO

Keywords:
Short video use
Social media
Rational thinking
Surface learning
Media comparison

ABSTRACT

Short videos are highly attractive and are becoming increasingly popular among young adults due to their unique properties. However, they also pose a risk of getting used to surface processing and suppressing slow analytic thinking. So far, little is known about the potential impact of short video use (SVU) on learning variables. Therefore, this series of studies aimed to examine the consequences of SVU on rational thinking, academic delay of gratification (ADOG), and a surface learning approach (Study 1) and examine the situational impact of watching a short video collection on those variables except ADOG (Study 2). Further, it was examined whether short video-based learning material is suitable for teaching low-complex material (Study 2). In Study 1, participants ($n = 169$) completed questionnaires regarding SVU, rational thinking, ADOG, and surface learning approach. For Study 2, participants ($n = 123$) took part in an online experiment with a 2 (short video collection; present vs. not present) x 2 (learning material; short video-based vs. text-based) between-subject design, completed questionnaires regarding SVU, rational thinking, surface learning approach and answered a quiz regarding knowledge acquisition. The findings reveal that SVU is negatively associated with rational thinking and positively associated with a surface learning approach. Watching a short video collection led to a higher situational surface learning approach, and participants who learned with short videos scored lower on the quiz than those who learned with text. Limitations, implications, and future directions are discussed.

1. Introduction

Social media such as TikTok, YouTube, and Instagram play an essential role in the lives of teenagers and young adults. One of the prevalent formats in social media is the "short video", which the short video platform (SVP) TikTok first introduced. The short video has helped TikTok with its powerful recommender algorithm to become the social media platform with the highest daily view time within four years (We Are Social & Meltwater, 2024; Zhao, 2021). Short videos (SVs) are characterized by their ephemeral and engaging content, offering instant gratification with minimal cognitive effort (Falgoust et al., 2022; O'Day & Heimberg, 2021; Su et al., 2021). Given social media's influence on students' lives, integrating SVs into higher education could align teaching practices with students' experiences, potentially boosting engagement and motivation (Ding et al., 2023; Otto & Thies, 2024; Schneider et al., 2022; Zhu et al., 2022). Meanwhile, critical voices are raised about the potential negative impact of short video use (SVU) on problematic social media use (PSMU) and academic performance (Marengo et al., 2022; Su et al., 2021; Tian et al., 2023; Xu et al., 2023). Despite

E-mail address: t.otto@tu-braunschweig.de.

https://doi.org/10.1016/j.compedu.2025.105330
Received 8 January 2025; Received in revised form 16 April 2025; Accepted 18 April 2025
Available online 21 April 2025

studies showing associations between general media use and factors like rational thinking, academic delay of gratification (ADOG), and surface learning approach, the specific impact of SVU on these factors remains underexplored (Rozgonjuk et al., 2018; Schutten et al., 2017; Stecula & Pickup, 2021; Wilmer et al., 2017; Xu et al., 2023). Study 1 aims to replicate findings on general media use in the context of SVU, examining its effects on rational thinking, ADOG, and surface learning approach. SVs' fragmented, fast-paced, and highly immersive nature also raises questions about their educational value and situational impact on these learning variables. Media comparisons in knowledge acquisition were examined mainly between video and text (Merkt et al., 2011; Shiu et al., 2020). However, the comparison with SVs in knowledge acquisition has to be investigated. Additionally, recent experimental studies provided initial evidence that watching SVs hurts prospective memory, analytic thinking, and time perception (Chiossi et al., 2023; Jiang & Ma, 2024; Yang et al., 2024). Study 2 will compare learning outcomes from SVs versus traditional texts and compare the situational effects of watching SVs versus watching no SVs on learning variables, addressing a critical gap in understanding SV's impact on learning. This research is vital for educators and short video users to effectively make informed decisions about integrating SVs into educational contexts.

2. Literature review

2.1. Properties of short videos

SVs are user-generated videos, typically 15–60 s long (Kaye et al., 2021). Short video content ranges from dance, education, comedy, infotainment (a combination of learning and entertainment), and more. SVs are available on SVPs like TikTok, which only provides SVs; social networking sites like Facebook; and video-streaming platforms (VSP) like YouTube. Most SVs offer a highly media-rich interface, combining a hypervisual format with unique audio memes condensed into a short length with a fast pace (Violot et al., 2024; Xu et al., 2023). However, despite the dominance of highly dynamic and fast-paced SVs, there is also variety, with some SVs being slow-paced, static, or using neither audio nor subtitles. Generally, SVs are consumed one by one in a personalized loop, so everyday SVU is characterized by watching a short video collection (SVC; a sequence of several short videos). A recommendation algorithm drives the consumption of SVs without any interaction needed except swiping, underlining the passive nature of consuming SVs (Bozdag, 2013; Schellewald, 2022; Zhao et al., 2021). Indeed, two studies showed that passive use is SVP users' central behavior (Bucknell Bossen & Kottasz, 2020; Lee et al., 2022).

Through uses and gratification theory lenses, audiences use media to gratify their needs, like information, entertainment, connection-seeking, and emotional regulation (Bucknell Bossen & Kottasz, 2020; Katz et al., 1973). SVs particularly meet those needs and offer instant gratification by upregulating the dopamine-producing ventral tegmental area in exchange for minimal cognitive effort (Su et al., 2021; Tian et al., 2023). The SVP TikTok is, therefore, sometimes referred to as "digital crack cocaine" in the popular science media (Koetsier, 2020). Hence, in recent years, problematic use has become an object of scrutiny regarding SVU and is also recognized as a possible danger at a global political level in the European Union and Australia (O'Carroll, 2024; Ritchie, 2024; Strauss, 2023). There is also growing literature concerning the association of SVU with important learning variables (e.g. ADOG and attention), suggesting a negative relationship (Chen et al., 2022; Xie et al., 2023; Xu et al., 2023).

2.2. Implications of short video use on rational thinking

Rational thinking is the ability to override heuristic thought and cognitive biases with systematic, analytical thought processes, leading to reasonable decisions (Ceschi et al., 2019; Stanovich, 2016; Teovanović et al., 2015). It is embedded in dual process theories, where two distinct reasoning processes compete against each other for control over decision-making in reasoning tasks (Evans, 2003; Kahneman & Frederick, 2002): System-1 thinking is fast, intuitive, heuristic, and implicit, being more susceptible to cognitive bias (e.g. ignoring base rates). In contrast, system-2 thinking is more effortful, slow, analytical, and conscious. Stanovich (2010) extended the dual process theories in his tripartite model of the mind by subdividing system-2 thinking into two levels: 1) algorithmic level (fluid intelligence) and 2) reflective level (rational thinking). It has been shown that rational thinking added incremental validity beyond intelligence for predicting job and academic performance, making it relevant in higher education (Grimm & Richter, 2024; Salgado et al., 2019; Toplak et al., 2014). Smartphone activities, especially SVs, are primarily passive and non-challenging, relying on quick processing, leading to the exclusive use of system-1 thinking (Bucknell Bossen & Kottasz, 2020; Lepp et al., 2015; Xu et al., 2023). A study by Schutten et al. (2017) showed that heavy media multitaskers, who mainly use media that ensure instant gratification and provide static content (Baumgartner & Wiradhany, 2022), scored lower on rational thinking tasks than light media multitaskers, indicating greater reliance on system-1 thinking. In addition, a study from Stecula and Pickup (2021) found a negative link between YouTube use and rational thinking, attributing it to the passive use of VSPs, as system-2 thinking is undermined. Building on this, the mentioned effect should be identical or even higher for SVU, as SVs are used more passively. However, empirical studies have not addressed the relationship between SVU and rational thinking despite evidence from other digital media (Schutten et al., 2017; Stecula & Pickup, 2021). Potentially, the more one uses SVs, the more one gets used to fast and unreflected system-1 thinking.

2.3. Implications of short video use on academic delay of gratification

ADOG, developed by Bembenutty and Karabenick (1998), is defined as postponing instantly available gratification to pursue academic goals that are distant in time but subjectively more valuable. As an application of delay of gratification (DoG) in educational settings, ADOG shares key traits with the original concept (Mischel, 1996). DoG is vital for self-regulated learning, functioning as a

metacognitive strategy involving planning and monitoring to achieve academic success (Bembenutty & Karabenick, 2004; Pintrich & de Groot, 1990). Research shows that children and students with increased ADOG were more self-efficacious, more intrinsically motivated, and showed higher academic performance, making ADOG a topic of interest for educators (Bembenutty, 2009; Bembenutty & Karabenick, 1998; Corwyn & McGarry, 2020; Herndon & Bembenutty, 2017; Herndon et al., 2015). With the ubiquity of smartphones, media and immediate gratification are constantly accessible, posing a challenge to resisting media temptations while working on academic tasks (Hofmann et al., 2017). This is especially true for SVs, who offer a favorable cost-benefit ratio and immediate gratification (Lee et al., 2022; O'Day & Heimberg, 2021; Su et al., 2021; Tian et al., 2023). As a result, short video users may be less motivated to pursue distant academic rewards, which require more time and complex thought processes. Likewise, constantly experiencing immediate gratification may increase the short video users' expectations for immediate gratification. It may lead them to ignore academic goals, as they require sustained hard work and only offer delayed gratification (Dieterich et al., 2021; Du et al., 2019). Recently, Xu et al. (2023) showed that increased use of SVP is strongly negatively associated with ADOG in adolescents. Hence, it would be interesting to find out if these findings can be replicated for young adults.

2.4. Implications of short video use on surface learning approach

Students use two different learning approaches to prepare for a test: surface and deep learning (Marton & Säljö, 1976). The *surface learning approach* is characterized by accumulating knowledge through memorization rather than understanding, resulting in the acquisition of surface knowledge (Marton & Säljö, 1976). The deep learning approach focuses on genuine understanding through extensive engagement with the learning material. These two approaches can be well described via a surface-to-deep continuum. A surface learning approach is negatively associated with academic performance (Bickerdike et al., 2016; Herrmann et al., 2017; Salamonson et al., 2013), test performance (Vansteenkiste et al., 2004), and academic self-efficacy beliefs (Herrmann et al., 2017) making it an ineffective learning approach in academic contexts. While learning for exams, plenty of attractive social distractions make it difficult for students to maintain concentration during learning (Aru & Rozgonjuk, 2022). In addition, the constant gratification through SVU, driven by algorithmic "compulsion loops", often leads to longer-than-planned usage, reducing study time and impairing sustained concentration due to opportunity costs (Amez & Baert, 2020; Shim et al., 2018; Xu et al., 2023; Zhao, 2021). Deep learning requires more prolonged concentration and time than surface learning (Diseth et al., 2010). Thus, frequent SVU may lead to a greater surface learning approach, as there is insufficient time for deeper engagement.

2.5. Short video use in higher education

Irrespective of the possible negative consequences outlined above for the private use of SVs, integrating SVs into higher education can positively affect student's engagement, motivation, and creativity (Ding et al., 2023; Escamilla-Fajardo et al., 2021; Gao et al., 2023; Zhu et al., 2022). SVs in higher education are largely viewed positively and as helpful, and they stimulate interest in the learning subject (Fleck et al., 2014; Hayes et al., 2020). Conversely, integrating SVs into higher education may also have some downsides. Schools and universities stress developing reflective skills and providing a place where system-2 thinking is required and trained (Ghanizadeh, 2017; Halpern, 2007; Puig et al., 2020). However, SVs in academia could undermine these goals and favor relying on system-1 thinking in the classroom (Evans, 2003; Kahneman & Frederick, 2002). This explanatory approach can be embedded in the "stimulus-organism-response" (S-O-R) model, in which environmental stimuli affect peoples' internal state and lead to a specific behavior (Mehrabian & Russell, 1973). Applied to the present study, the S-O-R model can explain how SVs' surface, fast-paced, and immersive nature (stimuli) may lead to system-1 thinking and surface learning (responses) by stimuli positively affecting the internal state (organism) through dopamine. The response to these stimuli and inner state is passive behavior, reinforced by the recommender algorithm, fostering the reliance on system-1 thinking and preference for surface learning. When this behavior pattern is repeated several times, it will likely be saved in an individual's learning history. Situational consequences on rational thinking and surface learning after watching SVs have not been addressed empirically. In addition, a long-term effect of using SVs is also possible.

2.6. Short videos, videos, and text – comparison of different learning modalities

Research comparing learning from videos (at least 5 min in length) with text for low-complex material shows no differences in important learning outcomes like knowledge acquisition, test performance, transfer, and comprehension, with videos being slightly superior (Merkt et al., 2011; Shiu et al., 2020; Tarchi et al., 2021). This aligns with the multimedia principle, which states that combining text and images enhances learning compared to text alone (Mayer, 2021). Based on the "cognitive theory of multimedia learning" (CTML; Mayer, 2021), learning is more efficient when visual and auditory information is processed through separate channels because it reduces the overall cognitive load. However, when too much information must be processed simultaneously via one or two channels, knowledge acquisition is hindered as the working memory is overloaded. Therefore, the above-mentioned comparative research findings may not be transferable to SVs because of modality differences between video and short video. SVs regularly contain oral text (spoken words) and on-screen text (subtitles), which is why SVs need to be processed in the visual-pictorial channel (the short video itself), auditory-verbal channel (oral text), and visual-verbal channel (subtitles) at the same time. These multiple processes, the fast pace, and the short length of SVs may lead to overloaded cognitive processing. Additionally, the so-called redundancy effect shows that presenting the same information via two channels (here, oral text and subtitles) hampers learning (Mayer, 2021). Therefore, learning from short video-based learning material may result in lower knowledge acquisition than learning from text. To the author's knowledge, no study compared SVs with texts as a learning modality for learning outcomes, underscoring the

urgent need for empirical research.

3. Current series of studies

Study 1 tries to replicate the findings from media research on rational thinking, ADOG, and a surface learning approach for SVU. Short video users may get used to fast and unreflected thinking, resulting in a higher reliance on system-1 thinking. In addition, the constant availability of immediate gratification of SVs may weaken the ability of ADOG in the long run (Tian et al., 2023; Wilmer et al., 2017). Short video users also tend to use SVs longer than planned, leaving less time for learning, so applying a surface learning approach is more likely (Amez & Baert, 2020; Shim et al., 2018). Hence, in Study 1, the following three hypotheses were tested:

H1. Short video use is negatively associated with rational thinking.

H2. Short video use is negatively associated with academic delay of gratification.

H3. Short video use is positively associated with a surface learning approach.

Study 2 examines the situational effects of SVU and compares short video-based and text-based learning material for learning outcomes. When watching SVs, people may be put into a state of passive media use, in which knowledge acquisition and system-2 thinking are inhibited, and a preference for surface processing is raised. Hence, the following three hypotheses were tested:

H4a. Participants who watch a short video collection score lower in the knowledge acquisition quiz than participants who do not watch a short video collection.

H4b. Participants who watch a short video collection score lower on a rational thinking test than participants who do not watch a short video collection.

H4c. Participants who watch a short video collection indicate a higher tendency for a surface learning approach than participants who do not watch a short video collection.

Recent studies showed that learning with videos is slightly superior to learning with texts for low-complex material (Merkt et al., 2011; Shiu et al., 2020; Tarchi et al., 2021). SVs differ from videos in presenting more (redundant) information in a shorter time, which may result in cognitive overload and hinder knowledge acquisition. Hence, the following hypothesis was tested:

H5. Participants learning with short video-based learning material score lower in a knowledge acquisition quiz than those learning with text-based learning material.

As already hypothesized, watching a SVC (H4a) and learning with short video-based learning material (H5) negatively affects knowledge acquisition; a reinforcing relationship appears conclusive for two reasons: 1. This group has the highest watching time of SVs, putting them more likely in a state of everyday passive use than other participants; 2. After watching the non-challenging SVC, they may expect that the short video-based learning material is also non-challenging, resulting in less effort to process. Therefore, the author tested the following hypothesis:

H6. Participants who watch a short video collection and learn with short video-based learning material score lower in the knowledge acquisition quiz than participants of other groups.

3.1. Ethical issues

In both studies, participants were informed that their participation was anonymous and voluntary, that they could terminate the study at any time without facing any disadvantages, and that no personal data within the meaning of the EU General Data Protection Regulation (GDPR) is collected and that their data is treated confidentially. If they did not give consent, the study ended automatically. Transparency was secured as the participants in the online experiment (study 2) were informed of the study's true objectives at the end. The two studies were approved by the Institute of Psychology's Ethics Committee (FV-2024-06 & FV-2024-17).

4. Study 1

4.1. Method

4.1.1. Participants

Prolific (www.prolific.com) was used to recruit survey participants. Participants were paid approximately 2€ for the completion of the study. A total of $N = 177$ individuals from Germany participated in the study. Eight data points were removed due to outliers or failed attention checks, resulting in an analysis sample of $n = 169$ participants (52 female, 111 male, and 6 diverse, $M_{age} = 29$, $SD_{age} = 7.3$, age range: 18–52). Half of the final sample consisted of students (50 %). As no valid assumptions regarding effect sizes could be made due to the lack of previous studies, a sensitivity analysis was employed with G*Power. The result indicated that with a given sample size of $N = 169$, a power of $1\text{-}\beta = .8$, and four predictors, effect sizes of $f = .07$ can be detected using a linear multiple regression fixed model (Faul et al., 2009).

4.2. Measures

4.2.1. Confirmatory Factor Analyses

Confirmatory Factor Analyses (CFAs) were performed with the R package lavaan (Rosseel, 2012) to compute composite reliability (CR) and test the factor structure of the variables studied. Due to the binary and ordinal nature of the variables, the models were estimated using Weighted Least Squares and Variance adjusted over Maximum Likelihood, which assumes continuous variables and performs poorly for scales with less than 5 levels (Flora & Curran, 2004; Muthén & Kaplan, 1985). The $\chi 2$ test statistic, the Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA) were computed. Additionally, to evaluate the $\chi 2$ test statistic, the ratio $\chi 2/df$ was computed as the $\chi 2$ value increases for simpler models. The smaller those ratio values, the better, but a ratio between 2 and 3 accounts for a good fit (Jöreskog & Sörbom, 1993). All models indicate acceptable to good fit indices, except surface learning approach (RMSEA = .09), which still indicated a mediocre fit (Schermelleh-Engel et al., 2003). See supplemental material S1 for all indices.

4.2.2. Social media usage time and general usage of social media

Social media usage time (SMU) was assessed using one item, “How much time do you spend on social media on average per day?" on a 6-point Likert scale from “less than 30 min” to “over 4 h".

4.2.3. Problematic social media use

PSMU was measured with the German version of “The Social Media Disorder Test” (SMDT; Wartberg et al., 2023). An example item is: “I have continued social media use despite the occurrence of negative consequences”. Participants could indicate the occurrence on a 5-point Likert scale from “never” to “very often”, resulting in a maximum score of 20. The SMDT has acceptable reliability and validity for adolescents and young adults from Germany (Wartberg et al., 2023). For the present sample, Cronbach’s α was .86, and CR (Cheung et al., 2024; Fornell & Larcker, 1981) was .89, indicating good reliability (Hair et al., 2009).

4.2.4. Short video usage

SVU was assessed with one item, “How long do you watch short videos on average every day (e.g. TikTok Videos, Instagram Reels, Facebook Reels, and YouTube shorts)?" using a 6-point Likert scale from “less than 30 min” to “over 4 h”. The participants could also indicate that they do not watch SVs at all. Participants were briefed that SVs are between 15 and 60 s long.

4.2.5. Rational thinking

Rational thinking was assessed with the German test battery for rational thinking processes by Grimm and Richter (2024). In consultation with the test battery’s authors, the number of items was slightly reduced, preventing cognitive exhaustion. The test battery consists of four subtests. For each subtest, there were three (resistance to belief bias, resistance to ratio bias) or four (cognitive reflection and disjunctive reasoning) test items, resulting in a maximum score of 14. There were no time limits given to solve the test items. The order of the four subtests and their items were randomized. Grimm and Richter (2024) found one general factor loading on those subtests, showing satisfactory construct and criterion validity (academic success) for students and adults from Germany. For the present sample, Cronbach’s α was .66, and CR was .81. CR does not assume equal factor loadings as Cronbach’s α, making CR a more appropriate reliability measure (Cheung et al., 2024). Therefore, reliability can be assumed as good.

4.2.6. Academic delay of gratification

ADOG was measured with the 10-item “Academic Delay of Gratification Scale” (ADOGS; Bembenutty & Karabenick, 1998). The original English scale was translated into German using a translate-back-translate procedure to ensure the quality of translations (Brislin, 1970). The ADOGS consists of 10 context-based items, in which the participants were asked to choose between two activities, A (immediate gratification) and B (delayed academic gratification), on a 4-point Likert scale ("1 = I would definitely choose A″, to “4 = I would definitely choose B″). In the questionnaire, it was noted that participants who did not attend an academic course should imagine doing so. Bembenutty and Karabenick (1998), Xia et al. (2023), and Xu et al. (2023) could demonstrate that the ADOGS has acceptable reliability and validity for adolescents and students. For the present sample, Cronbach’s α was .74, and CR was .81, indicating good reliability.

4.2.7. Surface learning approach

The surface learning approach was assessed with The Revised Two-Factor Study Process Questionnaire (R-SPQ-2F; Biggs et al., 2001). A translate-back-translate procedure was used to translate the original English scale into German. The author administered only the 10-item surface learning subscale. Participants could indicate their approval on a 5-point Likert scale from “never or rarely true of me” to “always or almost always true of me”. As with the ADOGS, a note was added for participants who did not attend an academic course. The R-SPQ-2F showed good reliability and validity (Biggs et al., 2001; Leiva-Brondo et al., 2020). For the present sample, Cronbach’s α was .86, and CR was .88, indicating good reliability.

4.3. Procedure

After agreeing to the data security conditions, participants participated in an online study designed with the survey tool “LimeSurvey” that took about 15 min to complete. First, participants completed the questionnaires about their SMU, PSMU, and SVU.

Following this, participants completed three questionnaires regarding rational thinking, ADOG, and surface learning approach. The order of the three questionnaires and their items was randomized. Finally, participants were instructed to provide information regarding gender (male, female, or diverse), age, and student status.

4.4. Statistical analysis

First, bivariate correlations were calculated to obtain an overview of the relationships between the variables studied and to detect initial indications of multicollinearity. Hereby following the recommendation of Olsson et al. (1982), polychoric and polyserial correlations were computed using the R package polycor for all variable pairs involving at least one ordinal variable (= measured with a Likert scale). For the expected correlations formulated in H1, H2, and H3, possible confounding variables such as age, gender, and SMU must be considered to obtain more accurate results. ADOG increases from adolescence to age 55 (Göllner et al., 2018; Xu et al., 2023). In addition, women tend to indicate higher scores on ADOG than men, whereas men usually score significantly higher than women in rational thinking tests (Bembenutty, 2007; Pennycook et al., 2016; Primi et al., 2018; Schutten et al., 2017; Silverman, 2003; Stieger & Reips, 2016). A surface learning approach is negatively associated with age (Meeks et al., 2013). Finally, SMU may be associated with the dependent variables for the reasons mentioned for SVU. *In order to account for these confounding variables and test* H1, H2, and H3 *more adequately, multiple linear regressions (MLRs) were employed. This approach enables* a more comprehensive analysis by simultaneously examining the effects of several independent variables. All data were analyzed using SPSS 28.

5. Results

Table 1 shows the descriptive and inferential statistics. Of 169 participants, 11 indicated that they do not use SVs. For SVU, the option "1–2 h" was renamed to "more than 1 h" due to small subsamples for higher values, resulting in a three-point Likert scale. The analysis for H1, H2, and H3 included 152 individuals, as gender was dichotomized, and individuals who did not use SVs were excluded from the analysis. The assumptions of the MLRs (linearity, homoscedasticity, and both normality and independence of errors) were met. Additionally, the variance inflation factor (VIF) values were between 1.038 and 1.204, indicating no multicollinearity. The analysis for H1 showed that the included variables could explain 13 % of the variance ($F = 5.56$, $p = .0003$). Consistent with H1, SVU was negatively associated with rational thinking ($B = -.57$, $\beta = -.18$, $r = .23$, $p = .03$), representing a small effect (Cohen, 1988). Therefore, H1 was supported. Neither for H2 nor for H3 the analysis showed that SVU is significantly associated with ADOG ($B = -.04$, $\beta = -.07$, $r = -.12$, $p = .43$) or a surface learning approach ($B = .04$, $\beta = .08$, $r = .13$, $p = .65$). Therefore, H2 and H3 were rejected.

6. Study 2

For the online experiment in Study 2, a 2 × 2 factorial design was utilized. One factor represents exposition to an SVC (SVC vs. no SVC), and the other represents the modality of the presented learning material with the characteristics (short video-based vs. text-based).

6.1. Participants

The author used Prolific to recruit survey participants. Participants were paid approximately 3€ for study completion. A total of $n = 123$ individuals from Germany participated in the study. As there were no outliers, the analysis sample was $n = 123$ participants (48 female, 72 male, and 3 diverse, $M_{age} = 25$, $SD_{age} = 3.2$, age range: 18–30). A G*Power sensitivity analysis indicated that with a given sample size of $N = 123$, a power of 1-β = .8, four groups, and five covariates, effects of the size $f = .254$ can be detected for using an ANCOVA fixed model.

Table 1
Inferential statiscal analyses and desricptive statistics of the studied variables.

Variables	1	2	3	4	5	6	7	8	*M*	*SD*	*n*
1.SVU	–	polyc.	polyc.	polys.	polyc.	polyc.	polys.	polyc.	1.8[a]	.8	158
2.SMU	.39**	–	polyc.	polys.	polyc.	polyc.	polys.	polyc.	3.6	1.2	169
3.PSMU	.32**	.26**	–	polys.	polyc.	polyc.	polys.	polyc.	2.2	.9	169
4.Rational thinking	−.26**	.00	−.21**	–	polys.	polys.	pearson	pointb.	9.9	2.6	169
5.ADOG	−.13	−.22**	−.19*	−.17*	–	polyc.	polys.	polyc.	2.9	.5	169
6.Surface learning	.11	.27**	.22**	−.09	−.26**	–	polys.	polyc.	2.8	.8	169
7.Age	−.21**	−.18*	−.23**	.01	.24**	−.13	–	pointb.	29	7.4	169
8.Gender	.28**	−.08	.11	−.26**	.13	−.27**	−.02	–	–	–	163

Note. **$p < .01$, *$p < .05$. SVU = short video use. SMU = social media usage time. PSMU = problematic social media use. ADOG = academic delay of gratification. polyc. = polychoric correlation, calculated between two ordinal variables and between ordinal and dichotomous variable. polys. = polyserial correlation, calculated between a ordinal and continuous variable. Perason correlations are calculated between two contionous variables. pointbis. = pointbiseral correlation, calculated between a continous and dichotomous variable. [a] Scores were transformed into a three-point Likert scale (1 = less than 30 min, 2 = 30 min to 1 h and 3 = more than 1 h). Gender (male = 0, female = 1).

6.2. Material

6.2.1. Short video collection

The author created a SVC including eleven SVs with a total length of 3 min to simulate a typical short video usage behavior. The content from the SVs was divergent (dance, comedy, POV, and advertisement). The author and one undergraduate student collected typical SVs individually from TikTok. To further ensure that the SVs differed only in their content, none included names, hashtags, or number of likes to avoid activating pre-existing attitudes. The SVC was edited using the program "Microsoft Clipchamp". The SVs in the SVC were unified to one size (400px width x 550px height) and embedded into a unified frame with typical social media interaction symbols. In addition, the transitions between the SVs were presented as a swipe. All that was done to maximize the typicality of everyday SVU.

6.2.2. Learning material

The learning material consisted of two topics: "language crisis" and "plural of word". The learning material was taken from two SVs on TikTok by the creator "Der Germanist", who consented to use his SVs. The language crisis describes how people have different pictures in mind when they hear a word (e.g. car), which is why people cannot convey a specific image in their mind via the corresponding word. In German, there are two plural forms of "Wort", namely "Worte" and "Wörter", and the correct use of them depends on the context of the sentence. The SVs from "Der Germanist" briefly explain the two learning materials in easy-to-understand language and give examples. The SVs featured no background music, and only the creator and subtitles were visible, keeping a consistent instructional design. Depending on the group, the learning material was presented in one of two ways: 1) two SVs or 2) one text. In the first condition, the original two SVs by "Der Germanist" were used, cut into one video, and were adjusted in the same way as the SVs in the SVC. The two SVs together had a length of 96 s, spoken words, and subtitles. In the second condition, the learning material was text-based (transcription of the two SVs). The text had 256 words in total.

6.3. Measures

Detailed information about the measures used for SMU, PSMU, SVU, rational thinking, and surface learning approach are already shown in Study 1. For rational thinking, a question about test item experience was added to control for participants' test familiarity. For the present sample, Cronbach's α was .87 (PSMU), .68 (rational thinking), .88 (surface learning approach), and CR was .90 (PSMU), .83 (rational thinking) and .91 (surface learning approach), indicating a good to high reliability. CFAs were performed similarly to Study 1. The results showed acceptable to good fit indices for all three variables, except for PSMU (RMSEA = .09), indicating a mediocre fit (see supplemental material S2).

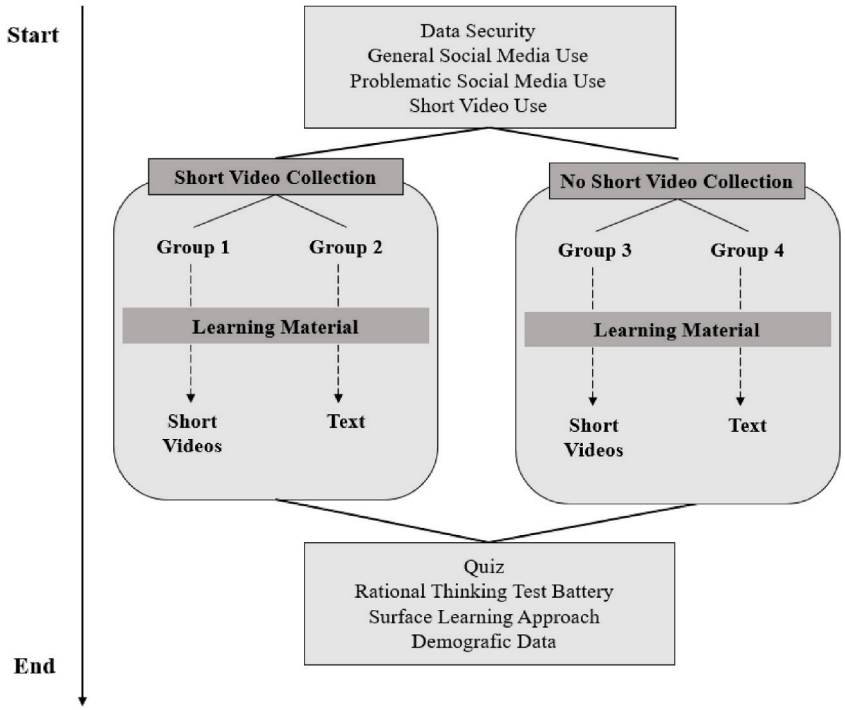


Fig. 1. Overview of the procedure of the online experiment.

6.3.1. Knowledge acquisition

Knowledge acquisition was assessed with a quiz consisting of seven questions. This procedure was adopted by Shiu et al. (2020) and Tarchi et al. (2021), who created a quiz to compare two learning modalities for learning outcomes. For this study, the author created four test items for the topic "language crisis" and three test items for the topic "plural of word". The test featured three formats: single-choice (3x), multiple-choice (3x), and gap text (1x), and was designed to yield a maximum score of 25 points. The quiz produced acceptable variance in a pilot study ($M = 18.5$; $SD = 3$). See Appendix A for the whole quiz.

6.4. Procedure

After agreeing to the data security conditions, participants attended an online experiment designed with "LimeSurvey" which took about 20 min to complete. First, participants completed questionnaires about their SMU, PSMU, and SVU. Participants were then randomly assigned to one of four groups: group one (G1; SVC and SV-based learning material), group two (G2; SVC and text-based learning material), group 3 (G3; no SVC and SV-based learning material), and group 4 (G4; no SVC and text-based learning material). Participants in G1 ($n = 30$) and G2 ($n = 29$) watched a SVC for 3 min and then indicated how pleasant, interesting, funny, typical for their feed, and typical for TikTok the shown SVs were (1 "does not apply at all" to 7 "fully applies"). Participants in G3 ($n = 34$) and G4 ($n = 30$) skipped the SVC and were immediately directed to the next part, where the learning material was shown. The learning material was short video-based for G1 and G3. Participants were automatically directed to the next part after being exposed to the two SVs once. For G2 and G4, the learning material was text-based. The text vanished after 90 s. Next, all participants rated their familiarity with the learning material topics and evaluated the learning experience of the presented learning material (1 "very bad" to 5 "excellent"). A manipulation check followed, asking participants to recall the two topics. Following this, all participants completed the quiz, the test battery for rational thinking, and the R-SPQ-2F. Finally, participants provided information regarding gender, age, and student status. Fig. 1 gives an overview of the online experiment procedure.

6.5. Statistical analysis

For Study 2, group differences in one to three dependent variables (knowledge acquisition, rational thinking, and surface learning approach) were hypothesized for each factor. As mentioned, confounding variables must be considered when examining the surface learning approach and rational thinking. In addition to Study 1's control variables, PSMU was added as a covariate in Study 2 due to its relationship with rational thinking and the surface learning approach in Study 1. Therefore, to address H4-H6, separate one-way ANCOVAs with a between-subjects design were performed to analyze the main effects of each factor on the dependent variable separately while controlling for covariates. Campbell and Stanley (1963) and Gorard (2013) suggested that a posttest-only design should be preferred when group randomization was performed to avoid reactivity, test item familiarity, and error propagation. This argument aligns with Cronbach and Furby's (1970) assertion that a pretest does not reliably control for pre-existing differences. Hence, a posttest-only design was used. Levene's tests were not violated ($p > .05$), and the Kolmogorov-Smirnov tests revealed that residual distribution adhered to normality ($p > .05$). There were no significant interactions between factors and covariates (non-interaction assumption). Therefore, the assumptions for an ANCOVA were met.

7. Results

7.1. Descriptive and inferential statistics

The means and standard deviations are consistent with values from past studies (see Appendix B). Table 2 shows the descriptive statistics of the variables of interest for each group. In accordance with the pilot study, the quiz produced acceptable variance ($M = 16.9$; $SD = 3.15$). The SVs in the SVC were rated as typical SVs for the participant's feed ($M = 4.4$; $SD = 1.8$) and as typical TikTok SVs ($M = 6.0$; $SD = 1.3$), confirming a good simulation of everyday SVU. Participants who were familiar with the topics of the learning material did not score significantly higher on the quiz compared to those who were not ($t\,(121) = .29$, $p = .38$, $d = .05$). The two learning materials' overall evaluations did not differ from each other consistently across conditions ($t\,(121) = .62$, $p = .27$, $d = .11$). Of 123 participants, eight indicated that they do not use SVs. For SVU, the option "2–3 h" was renamed to "more than 2 h", resulting in a four-point Likert scale. SVU showed a medium polyserial correlation with rational thinking ($r = -.37$, $p < .001$, $n = 115$) and a medium polychoric correlation with the surface learning approach ($r = .34$, $p < .001$, $n = 115$).

Table 2
Distribution of means and standard deviations on dependent variables by experimental condition.

Experimental Condition	Quiz[1] *M* (*SD*)	RT[2] *M* (*SD*)	SLA *M* (*SD*)	*n*
1.SVC & LM (Short Videos)	14.8 (3.2)	8.3 (2.7)	3.1 (.8)	30
2.SVC & LM (Text)	18.1 (2.9)	9.2 (2.7)	3.1 (.7)	29
3.No SVC & LM (Short Videos)	17.1 (2.7)	8.8 (3.1)	2.6 (.9)	34
4.No SVC & LM (Text)	17.7 (2.8)	9.6 (2.8)	2.7 (.9)	30

Note. SVC = Short video collection. LM = Learning material. RT = Rational thinking. SLA = Surface Learning Approach. [1] Maximum score = 25. [2] Maximum score = 14.

7.2. Main results

A total of $n = 123$ individuals were included in the analyses. The ANCOVA results for H4.1 and H4.2 showed that participants in the SVC condition did not differ significantly from participants in the non-SVC condition for knowledge acquisition, $F(1,116) = 2.4$, $p = .125$, $f = .14$, and rational thinking, $F(1,116) = .32$, $p = .57$, $f = .05$. Therefore, H4.1 and H4.2 were rejected. The ANCOVA result for H4.3 revealed a main effect for the factor SVC, $F(1,116) = 9.1$, $p = .003$, $f = .28$, showing a higher surface learning approach in the SVC condition ($M = 3.1$, $SD = .73$) compared to the non-SVC condition ($M = 2.6$, $SD = .89$), representing a medium effect size. Therefore, H4.3 is supported. The ANCOVA result for H5 revealed a main effect of learning material, $F(1,116) = 13.7$, $p < .001$, $f = .34$, showing that participants in the short video-based learning material condition ($M = 16.0$; $SD = 3.2$) scored significantly lower on the quiz than participants in the text-based learning material condition ($M = 17.9$; $SD = 2.8$), representing a medium effect size. Hence, H5 is supported. To test H6, three one-way ANCOVAS were conducted to compare G2, G3, and G4, each with G1 (SVC and short video-based learning material). Group comparison was entered as a factor. The results showed that participants in G1 scored significantly lower on knowledge acquisition than participants in G2, $F(1, 52) = 14.7$, $p < .001$, $f = .53$, participants in G3, $F(1, 57) = 8.7$, $p = .005$, $f = .39$, and in G4, $F(1, 53) = 12.2$, $p < .001$, $f = .48$, representing medium to large effect sizes. Hence, H6 is fully supported. Notably, all described results remained significant even when controlled for SVU. Additionally, there were no significant interactions between the two factors on rational thinking ($p = .96$) and surface learning approach ($p = .92$), but on knowledge acquisition, $F(1,114) = 6.4$, $p = .01$, $f = .23$. However, the main effect of learning material on knowledge acquisition remained stable and significant, $F(1,114) = 15.7$, $p < .001$, $f = .37$.

8. Overall discussion

Concerning the widespread popularity of SVs among university students and its unique properties, the current series of studies aimed to examine the potential (situational) consequences of SVU on important learning variables and whether short video-based learning material, compared to text-based learning material, is suitable for teaching. The present series of studies makes three contributions.

Firstly, both studies replicate the findings from general media use with rational thinking (Schutten et al., 2017; Stecula & Pickup, 2021) and partially (only Study 2) with the surface learning approach (Rozgonjuk et al., 2018) for SVU, showing that SVU is negatively associated with rational thinking and positively associated with a surface learning approach. Given the mixed results regarding the relationship between SVU and the surface learning approach, further studies are needed to validate this relationship. There come theoretical implications with these findings. One implication is that the S-O-R model can explain these findings (Mehrabian & Russell, 1973). The short video's attractive, ephemeral, and surface content (stimuli) positively influence the internal state through dopamine release (organism), evoking passive behavior and fostering the reliance on system-1 thinking (response). From a uses and gratifications perspective, one could hypothesize that short video users seek primarily affective gratifications rather than cognitive ones due to short video's properties, reinforcing a habitual, passive behavior and increasing reliance on system-1 thinking. Another theoretical implication is that short video users may develop a positive attitude towards surface processing the more they use SVs, similar to the mechanism of the mere exposure effect (Zajonc, 1968). Additionally, the findings from Study 2, where neither SMU nor PSMU were significant predictors when controlling for SVU (see Appendix C for results), highlight the relevance of distinguishing active from passive media use. Unlike SMU and PSMU, SVU reflects mainly passive behavior, which has been linked to adverse outcomes (Escobar-Viera et al., 2018; Ozimek et al., 2023; Reinecke et al., 2022). As universities stress developing rational thinking, practical implications for educators are that they should create environments where students learn how rather than what to think (Tsui, 2002), promote scientific reasoning via problem-based learning (Anggraeni et al., 2023; Grimm & Richter, 2024; Sternberg, 2018), or, based on the S-O-R model, encourage a more active, reflective engagement with fast-paced SVs in the classroom. This could foster rational thinking strategies and help to break SVU's stimuli-response patterns. On the other hand, frequent short video users should consider using nudge-based interventions (e.g. greyscale or disabling notification) to prevent compulsive SV viewing (Holte et al., 2023; Olson et al., 2023; Wickord & Quaiser-Pohl, 2023).

Second, watching a 3-min SVC leads to a higher preference for a situational surface learning approach, independent of the participants' SVU, indicating a general effect. One possible explanation is that watching the SVC evoked a situational desire for surface processing, which impacted questionnaire responses. It is also possible that participants may have preferred surface processing to mitigate cognitive overload through the overwhelming amount of information presented in the SVs (Hu & Yeo, 2020). As the surface learning approach was measured with a self-report questionnaire, future studies should include process measures, such as concept mapping or think-aloud protocols, to extend the internal validity of the current findings (Cerdán & Vidal-Abarca, 2008; Hay, 2007).

Third, short video-based learning material generated less knowledge acquisition in participants than text-based learning material for low-complex material, independent of the participant's SVU in the given learning context. This can be explained by the CTML (Mayer, 2021). The short video-based learning material may hinder knowledge acquisition by quickly overloading the visual and verbal channels with (redundant) information, exceeding their capacity. Schüler et al. (2013) concluded that boundary conditions such as text length or pacing affect the multimedia effect and principles. Hence, the fast pacing of SVs may be the main driver of hurting the multimedia effect, explaining why the short video-based learning material was inferior to text-based learning material. Additionally, a significant interaction effect was found, indicating that prior exposure to SVs amplified the adverse main effect of SV-based learning material on knowledge acquisition. These findings come with practical implications: While short video-based learning materials led to lower knowledge acquisition than text-based materials, this does not imply, however, that SVs are inherently unsuitable for teaching knowledge. Rather, it suggests that educators who intend to integrate SVs into the classroom should be mindful of pacing, subtitles, and

the additional cognitive load these elements may impose when selecting or designing SVs as learning materials. However, it remains unclear whether SVs with slower pacing and without subtitles would be more effective for knowledge acquisition than traditional learning materials or the short video format used in this study. Another practical implication, based on the significant interaction effect observed, is that short video users should try to avoid watching entertainment-focused SVs before learning sessions with short video-based material, as this may hinder knowledge acquisition. Finally, SVs can also be used in other ways than teaching or learning with them, e.g. as interest or attentional hooks. The effective use of hooks is supported by the findings from McCauley and McHugh (2021), who demonstrated that SV hooks embedded in a science classroom successfully evoke and maintain students' interest.

9. Limitations and conclusion

The presented series of studies has several limitations that must be acknowledged. First, due to the cross-sectional design, no conclusions about cause-and-effect relationships can be made for the correlational results of both studies. It is also likely that people scoring lower on rational thinking tests tend to use SVs more often than those scoring higher on rational thinking tests. Second, even though the author was successful in creating typical SVs, utilizing physiological measures recording emotional and cognitive responses to SVs could have provided deeper insights and strengthened the assumption of a mental state of everyday SVU (Su et al., 2021; Valkenburg & Peter, 2013). Therefore, future studies should extend the experimental design of this study by utilizing physiological measures. Third, SVU and SMU were measured exclusively with retrospective self-report measures, which may be insufficient as a meta-analysis of Parry et al. (2021) showed only a moderate correlation between logged and self-reported media use. The author tried to limit this insufficiency in measuring SVU and SMU with close-ended questions, as they showed higher correlations with logged media use than open-ended questions (Ernala et al., 2020). Nevertheless, future studies should extend their measurements for SVU and SMU to logging services (e.g. weekly usage time report in the TikTok application). Fourth, external validity is limited as participants may act differently when using SVs during lectures. Therefore, future studies should examine short video-based learning material in the field, as Ding et al. (2023) and Pozzo et al. (2024) did.

In conclusion, the present series of studies reveals that SVU is negatively associated with rational thinking and positively associated with a surface learning approach in a young adult sample from Germany. Additionally, Study 2 provides the first experimental evidence that SVs may be less effective than text-based materials for conveying low-complexity content and that watching multiple SVs might be associated with a shift toward a more surface learning approach. However, as this was the first series of studies to examine both the (situational) impact of SVU on rational thinking and surface learning approaches, alongside the first comparative analysis of short video-based learning material, the findings should be interpreted **cautiously**. Further studies are needed to draw firm conclusions about the impact of SVU and the effectiveness of the "short video" format for teaching and learning. The findings of the present studies contribute to the growing literature on SVU and urge the importance of SVU and its consequences for important learning variables.

Ethics approval

This study was approved by the Ethics Committee of the Institute of Psychology at the Technical University of Braunschweig (FV-2024-06 & FV-2024-17).

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for profit sectors.

Declaration of competing interest

I have nothing to declare.

Acknowledgments

The author appreciates Barbara Thies' comments on previous versions of the manuscript and Simon Kuhl's help with the creation of the short video collection.

Appendix A. Knowledge Acquisition quiz

1. **The so-called language crisis refers to the awareness of … (Multiple Choice)**
   a) that everyone understands different things when they hear certain languages.
   b) that, for example, two people dont think of the same dog when they hear the word dog.
   c) that everyone has a different image in their head when they hear certain words.
   d) that everyone has problems understanding certain languages.
   e) that it is impossible for everyone to communicate their own thoughts comprehensively using words.
2. **When did the language crisis reach its peak? (Single Choice)**
   a) ca. 1750

b) ca. 1800
c) ca. 1850
d) ca. 1900
e) ca. 1950

3. **What are the causes of the language crisis? (Multiple choice)**
   a) Concepts cannot be conveyed in the form of images.
   b) The complexity of the environment cannot be represented by linguistic means.
   c) Words are too imprecise in their meaning.
   d) The existence and mixture of different languages prevents the precise sharing of one's own thoughts.
   e) Due to individual experiences, each person links unique associations or images with certain terms (e.g. children's room).
4. **Is the following graphic an example of the language crisis?**

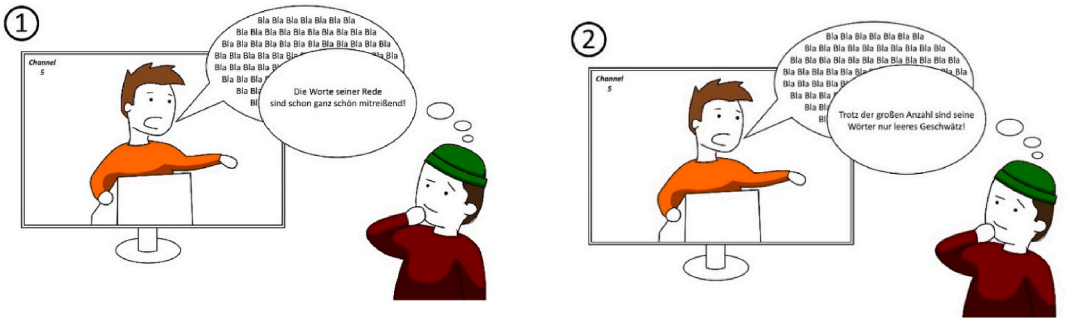
Text in speech bubble: "Hey I have bought a new car. "

a) Yes, this is an example of the language crisis.
b) No, this is not an example of the language crisis.

5. **Fill in the correct plural of "word" in the following matrix.**

In the dictionary you can find the meaning of this ___[1].
I was very touched by his ___[2].
"House", "red" and "road" are ___[3] that often appear in her poems and carry deep meaning as they function as metaphors.
"Emotions"and 'feelings' are ___[4].
I can't believe he misspelled these emotional ___[5] of her speech.
I liked the last three ___[6] he used.
During the speech he forgot some important ___[7].
A matrix with [1] to [7] was displayed, in which participants were able to choose between two alternative words (Wörter) and words (Worte) per gap.

6. **Which sentences use the correct plural of "word"? (multiple choice)**
   a) I know individual words (Wörter) that can be hurtful.
   b) She used a large number of words (Wörter) in the interview.
   c) The words (Worte) of the poem really got to him.
   d) So many memorable words (Wörter) never came out of his mouth.
   e) He understood the content of the words (Worte).
7. **Two graphics "1″ and "2″ are shown below. Which of the following statements regarding the two graphs is correct?**
   a) Graphic 1 and graphic 2 use the correct plural of "word".
   b) Only diagram 1 uses the correct plural of "word", diagram 2 uses the wrong one.
   c) Only Graphic 2 uses the correct plural of "word" Graphic 1 uses the wrong one.
   d) Both Graphic 1 and Graphic 2 use the wrong plural of "word".



Text in speech bubble (1): The words (Worte) of his speech are quite rousing.
Text in speech bubble (2): Despite the large number, his words (Wörter) are just empty chatter.

Appendix B. Means and standard deviations for variables of interest Study 2

Distribution of means and standard deviations of studied variables

Variables	*MW*	*SD*	*n*
1.SMU	3.6	1.3	123
2.SVU	2.3	1.0	115
3.PSMU	2.2	.93	123
4.Quiz[1]	16.9	3.1	123
5.RT[2]	8.9	2.8	123
6.SLA	2.9	.85	123

Note. SMU = social media usage time. SVU = short video use. PSMU = problematic social media use. RT = tational thinking. SLA = surface learning approach. [1] Maximum score = 25. [2] Maximum score = 14.

Appendix C. Multiple Linear Regression analyses

Multiple Regression with dependent variable rational thinking

Variables	B	Std Error	β	T	Sig.
1.SVU	−.90	.29	−.31	−3.1	.003
2.SMU	−.07	.22	−.03	−.30	.76
3.PSMU	−.11	.29	−.03	−.37	.71
4.Age	−.10	.08	−.12	−1.3	.21
5.Gender	−.26	.46	−.05	−.57	.57
6.Student Status	−1.2	.53	−.20	−2.2	.03

Note. n = 114. SVU = short video usage. SMU = social media usage time. PSMU = problematic social media use. Gender (male = 0, female = 1). Student status (no = 0, yes = 1).

Multiple Regression with dependent variable the surface learning approach

Variables	*B*	*Std Error*	*β*	*T*	Sig.
1.SVU	.24	.09	.28	2.6	.01
2.SMU	.01	.07	.00	.02	.98
3.PSMU	.12	.09	.13	1.4	.17
4.Age	.01	.02	.00	.05	.96
5.Gender	−.01	.14	−.01	−.10	.92
6.Student Status	.03	.17	.02	.19	.85

Note. n = 114. SVU = short video usage. SMU = social media usage time. PSMU = problematic social media use. Gender (male = 0, female = 1). Student status (no = 0, yes = 1).

Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.compedu.2025.105330.

Data availability

Data will be made available on request.

References

Amez, S., & Baert, S. (2020). Smartphone use and academic performance: A literature review. *International Journal of Educational Research, 103*, Article 101618. https://doi.org/10.1016/j.ijer.2020.101618

Anggraeni, D. M., Prahani, B. K., Suprapto, N., Shofiyah, N., & Jatmiko, B. (2023). Systematic review of problem based learning research in fostering critical thinking skills. *Thinking Skills and Creativity, 49*, Article 101334. https://doi.org/10.1016/j.tsc.2023.101334

Aru, J., & Rozgonjuk, D. (2022). The effect of smartphone use on mental effort, learning, and creativity. *Trends in Cognitive Sciences, 26*(10), 821–823. https://doi.org/10.1016/j.tics.2022.07.002

Baumgartner, S. E., & Wiradhany, W. (2022). Not all media multitasking is the same: The frequency of media multitasking depends on cognitive and affective characteristics of media combinations. *Psychology of Popular Media, 11*(1), 1–12. https://doi.org/10.1037/ppm0000338

Bembenutty, H. (2007). Self-regulation of learning and academic delay of gratification: Gender and ethnic differences among college students. *Journal of Advanced Academics, 18*(4), 586–616. https://doi.org/10.4219/jaa-2007-553

Bembenutty, H. (2009). Academic delay of gratification, self-efficacy, and time management among academically unprepared college students. *Psychological Reports, 104*(2), 613–623. https://doi.org/10.2466/pr0.104.2.613-623

Bembenutty, H., & Karabenick, S. A. (1998). Academic delay of gratification. *Learning and Individual Differences, 10*(4), 329–346. https://doi.org/10.1016/S1041-6080(99)80126-5

Bembenutty, H., & Karabenick, S. A. (2004). Inherent association between academic delay of gratification, future time perspective, and self-regulated learning. *Educational Psychology Review, 16*(1), 35–57. https://doi.org/10.1023/B:EDPR.0000012344.34008.5c

Bickerdike, A., O'Deasmhunaigh, C., O'Flynn, S., & O'Tuathaigh, C. (2016). Learning strategies, study habits and social networking activity of undergraduate medical students. *International Journal of Medical Education, 7*, 230–236. https://doi.org/10.5116/ijme.576f.d074

Biggs, J., Kember, D., & Leung, D. Y. (2001). The revised two-factor study process questionnaire: R-SPQ-2F. *British Journal of Educational Psychology, 71*(Pt 1), 133–149. https://doi.org/10.1348/000709901158433

Bozdag, E. (2013). Bias in algorithmic filtering and personalization. *Ethics and Information Technology, 15*(3), 209–227. https://doi.org/10.1007/s10676-013-9321-6

Brislin, R. W. (1970). Back-translation for cross-cultural research. *Journal of Cross-Cultural Psychology, 1*(3), 185–216. https://doi.org/10.1177/135910457000100301

Bucknell Bossen, C., & Kottasz, R. (2020). Uses and gratifications sought by pre-adolescent and adolescent TikTok consumers. *Young Consumers, 21*(4), 463–478. https://doi.org/10.1108/YC-07-2020-1186

Campbell, D. T., & Stanley, J. C. (1963). *Experimental and quasi-experimental designs for research*. Houghton, Mifflin and Company.

Cerdán, R., & Vidal-Abarca, E. (2008). The effects of tasks on integrating information from multiple documents. *Journal of Educational Psychology, 100*(1), 209–222. https://doi.org/10.1037/0022-0663.100.1.209

Ceschi, A., Costantini, A., Sartori, R., Weller, J., & Di Fabio, A. (2019). Dimensions of decision-making: An evidence-based classification of heuristics and biases. *Personality and Individual Differences, 146*, 188–200. https://doi.org/10.1016/j.paid.2018.07.033

Chen, Y., Li, M., Guo, F., & Wang, X. (2022). The effect of short-form video addiction on users' attention. *Behaviour & Information Technology, 42*(16), 2893–2910. https://doi.org/10.1080/0144929X.2022.2151512

Cheung, G. W., Cooper-Thomas, H. D., Lau, R. S., & Wang, L. C. (2024). Reporting reliability, convergent and discriminant validity with structural equation modeling: A review and best-practice recommendations. *Asia Pacific Journal of Management, 41*(2), 745–783. https://doi.org/10.1007/s10490-023-09871-y

Chiossi, F., Haliburton, L., Ou, C., Butz, A. M., & Schmidt, A. (2023). Short-form videos degrade our capacity to retain intentions: Effect of context switching on prospective memory. In *Proceedings of the 2023 CHI conference on human factors in computing systems*. https://doi.org/10.1145/3544548.3580778. New York, United States.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Routledge. https://doi.org/10.4324/9780203771587

Corwyn, R. F., & McGarry, P. P. (2020). An expectancy value theory predicts achievement in undergraduate statistics through academid delay of gratification. *Statistics Education Research Journal, 19*(2), 42–56. https://doi.org/10.52041/serj.v19i2.109

Cronbach, L. J., & Furby, L. (1970). How we should measure "change": Or should we? *Psychological Bulletin, 74*(1), 68–80. https://doi.org/10.1037/h0029382

Dieterich, R., Wüllhorst, V., Berghäuser, J., Overmeyer, R., & Endrass, T. (2021). Electrocortical correlates of impaired motor inhibition and outcome processing are related in high binge-watching. *Psychophysiology, 58*(6), Article e13814. https://doi.org/10.1111/psyp.13814

Ding, N., Xu, X., & Lewis, E. (2023). Short instructional videos for the TikTok generation. *The Journal of Education for Business, 98*(4), 175–185. https://doi.org/10.1080/08832323.2022.2103489

Diseth, Å., Pallesen, S., Brunborg, G. S., & Larsen, S. (2010). Academic achievement among first semester undergraduate psychology students: The role of course experience, effort, motives and learning strategies. *Higher Education, 59*(3), 335–352. https://doi.org/10.1007/s10734-009-9251-8

Du, J., Kerkhof, P., & van Koningsbruggen, G. M. (2019). Predictors of social media self-control failure: Immediate gratifications, habitual checking, ubiquity, and notifications. *Cyberpsychology, Behavior, and Social Networking, 22*(7), 477–485. https://doi.org/10.1089/cyber.2018.0730

Ernala, S. K., Burke, M., Leavitt, A., & Ellison, N. B. (2020). How well do people report time spent on Facebook? An evaluation of established survey questions with recommendations. In *Conference on human factors in computing systems*. HI. https://doi.org/10.1145/3313831.3376435. Honolulu, USA.

Escamilla-Fajardo, P., Alguacil, M., & López-Carril, S. (2021). Incorporating TikTok in higher education: Pedagogical perspectives from a corporal expression sport sciences course. *Journal of Hospitality, Leisure, Sports and Tourism Education, 28*, Article 100302. https://doi.org/10.1016/j.jhlste.2021.100302

Escobar-Viera, C. G., Shensa, A., Bowman, N. D., Sidani, J. E., Knight, J., James, A. E., & Primack, B. A. (2018). Passive and active social media use and depressive symptoms among United States adults. *Cyberpsychology, Behavior, and Social Networking, 21*(7), 437–443. https://doi.org/10.1089/cyber.2017.0668

Evans, J. S. B. T. (2003). In two minds: Dual-process accounts of reasoning. *Trends in Cognitive Sciences, 7*(10), 454–459. https://doi.org/10.1016/j.tics.2003.08.012

Falgoust, G., Winterlind, E., Moon, P., Parker, A., Zinzow, H., & Chalil Madathil, K. (2022). Applying the uses and gratifications theory to identify motivational factors behind young adult's participation in viral social media challenges on TikTok. *Human Factors in Healthcare, 2*, Article 100014. https://doi.org/10.1016/j.hfh.2022.100014

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods, 41*(4), 1149–1160. https://doi.org/10.3758/brm.41.4.1149

Fleck, B. K. B., Beckman, L. M., Sterns, J. L., & Hussey, H. D. (2014). Youtube in the classroom: Helpful tips and student perceptions. *Journal of Effective Teaching, 14*(3), 21–37. https://eric.ed.gov/?id=ej1060489.

Flora, D. B., & Curran, P. J. (2004). An empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. *Psychological Methods, 9*(4), 466–491. https://doi.org/10.1037/1082-989X.9.4.466
Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50. https://doi.org/10.1177/002224378101800104
Gao, S.-Y., Tsai, Y.-Y., Huang, J.-H., Ma, Y.-X., & Wu, T.-L. (2023). TikTok for developing learning motivation and oral proficiency in MICE learners. *Journal of Hospitality, Leisure, Sports and Tourism Education, 32*, Article 100415. https://doi.org/10.1016/j.jhlste.2022.100415
Ghanizadeh, A. (2017). The interplay between reflective thinking, critical thinking, self-monitoring, and academic achievement in higher education. *Higher Education, 74*, 101–114. https://doi.org/10.1007/s10734-016-0031-y
Göllner, L. M., Ballhausen, N., Kliegel, M., & Forstmeier, S. (2018). Delay of gratification, delay discounting and their associations with age, episodic future thinking, and future time perspective. *Frontiers in Psychology, 8*, 2304. https://doi.org/10.3389/fpsyg.2017.02304
Gorard, S. (2013). The propagation of errors in experimental data analysis: A comparison of pre- and post-test designs. *International Journal of Research and Method in Education, 36*(4), 372–385. https://doi.org/10.1080/1743727X.2012.741117
Grimm, J., & Richter, T. (2024). Rational thinking as a general cognitive ability: Factorial structure, underlying cognitive processes, and relevance for university academic success. *Learning and Individual Differences, 111*, Article 102428. https://doi.org/10.1016/j.lindif.2024.102428
Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate data analysis* (7th ed.). Prentice-Hall.
Halpern, D. F. (2007). *Halpern critical thinking assessment using everyday situations: Background and scoring standards*. Claremont McKenna College.
Hay, D. B. (2007). Using concept maps to measure deep, surface and non-learning outcomes. *Studies in Higher Education, 32*(1), 39–57. https://doi.org/10.1080/03075070601099432
Hayes, C., Stott, K., Lamb, K. J., & Hurst, G. A. (2020). "Making every second count": Utilizing TikTok and systems thinking to facilitate scientific public engagement and contextualization of chemistry at home. *Journal of Chemical Education, 97*(10), 3858–3866. https://doi.org/10.1021/acs.jchemed.0c00511
Herndon, J. S., & Bembenutty, H. (2017). Self-regulation of learning and performance among students enrolled in a disciplinary alternative school. *Personality and Individual Differences, 104*, 266–271. https://doi.org/10.1016/j.paid.2016.08.027
Herndon, J. S., Bembenutty, H., & Gill, M. G. (2015). The role of delay of gratification, substance abuse, and violent behavior on academic achievement of disciplinary alternative middle school students. *Personality and Individual Differences, 86*, 44–49. https://doi.org/10.1016/j.paid.2015.05.028
Herrmann, K. J., Bager-Elsborg, A., & McCune, V. (2017). Investigating the relationships between approaches to learning, learner identities and academic achievement in higher education. *Higher Education, 74*(3), 385–400. https://doi.org/10.1007/s10734-016-9999-6
Hofmann, W., Reinecke, L., & Meier, A. (2017). Of sweet temptations and bitter aftertaste: Self-control as a moderator of the effects of media use on well-being. In L. Reinecke, & M. B. Oliver (Eds.), *The Routledge handbook of media use and well-being: International perspectives on theory and research on positive media effects* (pp. 211–222). Routledge.
Holte, A. J., Giesen, D. T., & Ferraro, F. R. (2023). Color me calm: Grayscale phone setting reduces anxiety and problematic smartphone use. *Current Psychology, 42*(8), 6778–6790. https://doi.org/10.1007/s12144-021-02020-y
Hu, X., & Yeo, G. B. (2020). Emotional exhaustion and reduced self-efficacy: The mediating role of deep and surface learning strategies. *Motivation and Emotion, 44*(5), 785–795. https://doi.org/10.1007/s11031-020-09846-2
Jiang, Q., & Ma, L. (2024). Swiping more, thinking less: Using TikTok hinders analytic thinking. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace, 18*(3). https://doi.org/10.5817/CP2024-3-1
Jöreskog, K. G., & Sörbom, D. (1993). *Lisrel 8: Structural equation modeling with the SIMPLIS command language*. Chicago: Scientific Software International.
Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. In T. Gilovich, D. W. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgement* (1st ed., pp. 49–81). Cambridge University Press. https://doi.org/10.1017/cbo9780511808098.004.
Katz, E., Blumler, J. G., & Gurevitch, M. (1973). Uses and gratifications research. *Public Opinion Quarterly, 37*(4), 509. https://doi.org/10.1086/268109
Kaye, D. B. V., Chen, X., & Zeng, J. (2021). The co-evolution of two Chinese mobile short video apps: Parallel platformization of Douyin and TikTok. *Mobile Media & Communication, 9*(2), 229–253. https://doi.org/10.1177/2050157920952120
Koetsier, J. (2020). Digital crack cocaine: The science behind TikTok's success. Retrieved from https://www.forbes.com/sites/johnkoetsier/2020/01/18/digital-crack-cocaine-the-science-behind-tiktoks-success/?sh=4c4aa09278be. (Accessed 7 October 2024).
Lee, A. Y., Mieczkowski, H., Ellison, N. B., & Hancock, J. T. (2022). The algorithmic crystal: Conceptualizing the self through algorithmic personalization on TikTok. *Proceedings of the ACM on Human-Computer Interaction, 6*, 1–22. https://doi.org/10.1145/3555601
Leiva-Brondo, M., Cebolla-Cornejo, J., Peiró, R., Andrés-Colás, N., Esteras, C., Ferriol, M., Merle, H., Díez, M. J., & Pérez-de-Castro, A. (2020). Study approaches of life science students using the revised two-factor study process questionnaire (R-SPQ-2F). *Education Sciences, 10*(7), 173. https://doi.org/10.3390/educsci10070173
Lepp, A., Li, J., Barkley, J. E., & Salehi-Esfahani, S. (2015). Exploring the relationships between college students' cell phone use, personality and leisure. *Computers in Human Behavior, 43*, 210–219. https://doi.org/10.1016/j.chb.2014.11.006
Marengo, D., Angelo Fabris, M., Longobardi, C., & Settanni, M. (2022). Smartphone and social media use contributed to individual tendencies towards social media addiction in Italian adolescents during the COVID-19 pandemic. *Addictive Behaviors, 126*, Article 107204. https://doi.org/10.1016/j.addbeh.2021.107204
Marton, F., & Säljö, R. (1976). On qualitative differences in learning: I-outcome and process. *British Journal of Educational Psychology, 46*(1), 4–11. https://doi.org/10.1111/j.2044-8279.1976.tb02980.x
Mayer, R. E. (2021). *Multimedia learning* (3rd ed.). Cambridge University Press.
McCauley, V., & McHugh, M. (2021). An observational narrative of student reaction to video hooks. *Education Sciences, 11*(6), 286. https://doi.org/10.3390/educsci11060286
Meeks, M. D., Williams, F., Knotts, T. L., & James, K. D. (2013). Deep vs surface learning: An empirical test of generational differences. *International Journal of Education and Research, 1*(8), 1–15.
Mehrabian, A., & Russell, J. A. (1973). A measure of arousal seeking tendency. *Environment and Behavior, 5*(3), 315–333. https://doi.org/10.1177/001391657300500303
Merkt, M., Weigand, S., Heier, A., & Schwan, S. (2011). Learning with videos vs. learning with print: The role of interactive features. *Learning and Instruction, 21*(6), 687–704. https://doi.org/10.1016/j.learninstruc.2011.03.004
Mischel, W. (1996). From good intentions to willpower. In P. M. Gollwitzer, & J. A. Bargh (Eds.), *The psychology of action: Linking cognition and motivation to behavior* (pp. 197–218). The Guilford Press.
Muthén, B., & Kaplan, D. (1985). A comparison of some methodologies for the factor analysis of non-normal Likert variables. *British Journal of Mathematical and Statistical Psychology, 38*(2), 171–189. https://doi.org/10.1111/j.2044-8317.1985.tb00832.x
O'Carroll, L. (2024). EU threatens TikTok Lite with ban over reward-to-watch feature. Retrieved from https://www.theguardian.com/technology/2024/apr/22/eu-threatens-to-ban-tiktok-lite-over-reward-to-watch-feature. (Accessed 7 October 2024).
O'Day, E. B., & Heimberg, R. G. (2021). Social media use, social anxiety, and loneliness: A systematic review. *Computers in Human Behavior Reports, 3*, Article 100070. https://doi.org/10.1016/j.chbr.2021.100070
Olson, J. A., Sandra, D. A., Chmoulevitch, D., Raz, A., & Veissière, S. P. L. (2023). A nudge-based intervention to reduce problematic smartphone use: Randomised controlled trial. *International Journal of Mental Health and Addiction, 21*, 3842–3864. https://doi.org/10.1007/s11469-022-00826-w
Olsson, U., Drasgow, F., & Dorans, N. J. (1982). The polyserial correlation coefficient. *Psychometrika, 47*, 337–347. https://doi.org/10.1007/BF02294164
Otto, T., & Thies, B. (2024). Exploring the influence of instagram use on materialism and situational intrinsic learning motivation: An online experimental study. *Education and Information Technologies*, 1–32. https://doi.org/10.1007/s10639-024-12762-4
Ozimek, P., Brailovskaia, J., & Bierhoff, H.-W. (2023). Active and passive behavior in social media: Validating the social media activity questionnaire (SMAQ). *Telematics and Informatics Reports, 10*, Article 100048. https://doi.org/10.1016/j.teler.2023.100048
Parry, D. A., Davidson, B. I., Sewall, C. J. R., Fisher, J. T., Mieczkowski, H., & Quintana, D. S. (2021). A systematic review and meta-analysis of discrepancies between logged and self-reported digital media use. *Nature Human Behaviour, 5*(11), 1535–1547. https://doi.org/10.1038/s41562-021-01117-5

Pennycook, G., Cheyne, J. A., Koehler, D. J., & Fugelsang, J. A. (2016). Is the cognitive reflection test a measure of both reflection and intuition? *Behavior Research Methods, 48*, 341–348. https://doi.org/10.3758/s13428-015-0576-1

Pintrich, P. R., & de Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33–40. https://doi.org/10.1037/0022-0663.82.1.33

Pozzo, D. N., Biegelmeyer, U. H., Gomez Pedroza, F. J., Grados, E. A., Barrera, M. B., Craco, T., & Fermiano Fidelis, A. C. (2024). The impact of TikTok as an educational tool on students' performance: A multi-group comparison of international business classes in Peru and Colombia. *Procedia Computer Science, 238*, 989–994. https://doi.org/10.1016/j.procs.2024.06.124

Primi, C., Donati, M. A., Chiesi, F., & Morsanyi, K. (2018). Are there gender differences in cognitive reflection? Invariance and differences related to mathematics. *Thinking & Reasoning, 24*(2), 258–279. https://doi.org/10.1080/13546783.2017.1387606

Puig, B., Blanco Anaya, P., & Bargiela, I. M. (2020). A systematic review on E-learning environments for promoting critical thinking in higher education. In M. J. Bishop, E. Boling, J. Elen, & V. Svihla (Eds.), *Handbook of research in educational communications and technology* (pp. 345–362). Springer International Publishing. https://doi.org/10.1007/978-3-030-36119-8_15.

Reinecke, L., Gilbert, A., & Eden, A. (2022). Self-regulation as a key boundary condition in the relationship between social media use and well-being. *Current Opinion in Psychology, 45*, Article 101296. https://doi.org/10.1016/j.copsyc.2021.12.008

Ritchie, H. (2024). Australia approves social media ban on under-16s. Retrieved from https://www.bbc.com/news/articles/c89vjj0lxx9o. (Accessed 30 November 2024).

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*(2). https://doi.org/10.18637/jss.v048.i02

Rozgonjuk, D., Saal, K., & Täht, K. (2018). Problematic smartphone use, deep and surface approaches to learning, and social media use in lectures. *International Journal of Environmental Research and Public Health, 15*(1). https://doi.org/10.3390/ijerph15010092

Salamonson, Y., Weaver, R., Chang, S., Koch, J., Bhathal, R., Khoo, C., & Wilson, I. (2013). Learning approaches as predictors of academic performance in first year health and science students. *Nurse Education Today, 33*(7), 729–733. https://doi.org/10.1016/j.nedt.2013.01.013

Salgado, J. F., Otero, I., & Moscoso, S. (2019). Cognitive reflection and general mental ability as predictors of job performance. *Sustainability, 11*(22), 6498. https://doi.org/10.3390/su11226498

Schellewald, A. (2022). Theorizing "stories about algorithms" as a mechanism in the formation and maintenance of algorithmic imaginaries. *Social Media + Society, 8*(1), 1–20. https://doi.org/10.1177/20563051221077025

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research, 8*(2), 23–74. https://doi.org/10.23668/psycharchives.12784

Schneider, S., Beege, M., Nebel, S., Schnaubert, L., & Rey, G. D. (2022). The cognitive-afective-social theory of learning in digital environments (CASTLE). *Educational Psychology Review, 34*(1), 1–38. https://doi.org/10.1007/s10648-021-09626-5

Schüler, A., Scheiter, K., & Gerjets, P. (2013). Is spoken text always better? Investigating the modality and redundancy effect with longer text presentation. *Computers in Human Behavior, 29*(4), 1590–1601. https://doi.org/10.1016/j.chb.2013.01.047

Schutten, D., Stokes, K. A., & Arnell, K. M. (2017). I want to media multitask and I want to do it now: Individual differences in media multitasking predict delay of gratification and system-1 thinking. *Cognitive Research: Principles and Implications, 2*(1), 8. https://doi.org/10.1186/s41235-016-0048-x

Shim, H., Lim, S., Jung, E. E., & Shin, E. (2018). I hate binge-watching but I can't help doing it: The moderating effect of immediate gratification and need for cognition on binge-watching attitude-behavior relation. *Telematics and Informatics, 35*(7), 1971–1979. https://doi.org/10.1016/j.tele.2018.07.001

Shiu, A., Chow, J., & Watson, J. (2020). The effectiveness of animated video and written text resources for learning microeconomics: A laboratory experiment. *Education and Information Technologies, 25*(3), 1999–2022. https://doi.org/10.1007/s10639-019-10025-1

Silverman, I. W. (2003). Gender differences in delay of gratification: A meta-analysis. *Sex Roles, 49*(9–10), 451–463. https://doi.org/10.1023/a:1025872421115

Stanovich, K. E. (2010). Distinguishing the reflective, algorithmic, and autonomous minds: Is it time for a tri-process theory? In J. B. T. S. Evans, & K. Frankish (Eds.), *In two minds: Dual processes and beyond* (pp. 55–88). Oxford Univ. Press. https://doi.org/10.1093/acprof:oso/9780199230167.003.0003.

Stanovich, K. E. (2016). The comprehensive assessment of rational thinking. *Educational Psychologist, 51*(1), 23–34. https://doi.org/10.1080/00461520.2015.1125787

Stecula, D. A., & Pickup, M. (2021). Social media, cognitive reflection, and conspiracy beliefs. *Frontiers in Political Science, 3*, 62. https://doi.org/10.3389/fpos.2021.647957

Sternberg, R. J. (2018). Direct measurement of scientific giftedness. *Roeper Review, 40*(2), 78–85. https://doi.org/10.1080/02783193.2018.1434715

Stieger, S., & Reips, U.-D. (2016). A limitation of the cognitive reflection test: Familiarity. *PeerJ, 4*, Article e2395. https://doi.org/10.7717/peerj.2395

Strauss, M. (2023). French Senate to open commission of inquiry into TikTok. Retrieved from https://www.reuters.com/technology/french-senate-open-commission-inquiry-into-tiktok-2023-02-09/. (Accessed 23 October 2024).

Su, C., Zhou, H., Gong, L., Teng, B., Geng, F., & Hu, Y. (2021). Viewing personalized video clips recommended by TikTok activates default mode network and ventral tegmental area. *NeuroImage, 237*, Article 118136. https://doi.org/10.1016/j.neuroimage.2021.118136

Tarchi, C., Zaccoletti, S., & Mason, L. (2021). Learning from text, video, or subtitles: A comparative analysis. *Computers & Education, 160*, Article 104034. https://doi.org/10.1016/j.compedu.2020.104034

Teovanović, P., Knežević, G., & Stankov, L. (2015). Individual differences in cognitive biases: Evidence against one-factor theory of rationality. *Intelligence, 50*, 75–86. https://doi.org/10.1016/j.intell.2015.02.008

Tian, X., Bi, X., & Chen, H. (2023). How short-form video features influence addiction behavior? Empirical research from the opponent process theory perspective. *Information Technology & People, 36*(1), 387–408. https://doi.org/10.1108/ITP-04-2020-0186

Toplak, M. E., West, R. F., & Stanovich, K. E. (2014). Assessing miserly information processing: An expansion of the Cognitive Reflection Test. *Thinking & Reasoning, 20*(2), 147–168. https://doi.org/10.1080/13546783.2013.844729

Tsui, L. (2002). Fostering critical thinking through effective pedagogy. *The Journal of Higher Education, 73*(6), 740–763. https://doi.org/10.1080/00221546.2002.11777179

Valkenburg, P. M., & Peter, J. (2013). The differential susceptibility to media effects model. *Journal of Communication, 63*(2), 221–243. https://doi.org/10.1111/jcom.12024

Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004). Motivating learning, performance, and persistence: The synergistic effects of intrinsic goal contents and autonomy-supportive contexts. *Journal of Personality and Social Psychology, 87*(2), 246–260. https://doi.org/10.1037/0022-3514.87.2.246

Violot, C., Elmas, T., Bilogrevic, I., & Humbert, M. (2024). Shorts vs. regular videos on YouTube: A comparative analysis of user engagement and content creation trends. In *Proceedings of the 16th ACM web science conference*. https://doi.org/10.1145/3614419.3644023. New York, United States.

Wartberg, L., Spindler, C., Berber, S., Potzel, K., & Kammerl, R. (2023). A four-item questionnaire to measure problematic social media use: The social media disorder test. *Behavioral Sciences, 13*(12), 980. https://doi.org/10.3390/bs13120980

We Are Social & Meltwater. (2024). Digital 2024 global overview report. Retrieved from https://datareportal.com/reports/digital-2024-global-overview-report. (Accessed 19 September 2024).

Wickord, L.-C., & Quaiser-Pohl, C. (2023). Suffering from problematic smartphone use? Why not use grayscale setting as an intervention! – An experimental study. *Computers in Human Behavior Reports, 10*, Article 100294. https://doi.org/10.1016/j.chbr.2023.100294

Wilmer, H. H., Sherman, L. E., & Chein, J. M. (2017). Smartphones and cognition: A review of research exploring the links between mobile technology habits and cognitive functioning. *Frontiers in Psychology, 8*, 605. https://doi.org/10.3389/fpsyg.2017.00605

Xia, L.-L., Li, J.-D., Duan, F., Zhang, J., Mu, L.-L., Wang, L.-J., Jiao, C.-Y., Song, X., Wang, Z., Chen, J.-X., Wang, J.-J., Wang, Y., Zhang, X.-C., & Jiao, D.-L. (2023). Effects of online game and short video behavior on academic delay of gratification - mediating effects of anxiety, depression and retrospective memory. *Psychology Research and Behavior Management, 16*, 4353–4365. https://doi.org/10.2147/PRBM.S432196

Xie, J., Xu, X., Zhang, Y., Tan, Y., Wu, D., Shi, M., & Huang, H. (2023). The effect of short-form video addiction on undergraduates' academic procrastination: A moderated mediation model. *Frontiers in Psychology, 14*, Article 1298361. https://doi.org/10.3389/fpsyg.2023.1298361

Xu, Z., Gao, X., Wei, J., Liu, H., & Zhang, Y. (2023). Adolescent user behaviors on short video application, cognitive functioning and academic performance. *Computers & Education, 203*, Article 104865. https://doi.org/10.1016/j.compedu.2023.104865

Yang, Y., Liu, R.-D., Ding, Y., Lin, J., Ding, Z., & Yang, X. (2024). Time distortion for short-form video users. *Computers in Human Behavior, 151*, Article 108009. https://doi.org/10.1016/j.chb.2023.108009

Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology, 9*, 1–27. https://doi.org/10.1037/h0025848

Zhao, Z. (2021). Analysis on the "douyin (tiktok) mania" phenomenon based on recommendation algorithms. *E3S Web of Conferences, 235*, Article 03029. https://doi.org/10.1051/e3sconf/202123503029

Zhu, J., Yuan, H., Zhang, Q., Huang, P.-H., Wang, Y., Duan, S., Lei, M., Lim, E. G., & Song, P. (2022). The impact of short videos on student performance in an online-flipped college engineering course. *Humanities & Social Sciences Communications, 9*(1), 327. https://doi.org/10.1057/s41599-022-01355-6