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Development of Numeracy Learning Videos to Improve Elementary Students' Number Skills

Yuli Ani Setyo Dewi[1*], Choirudin[1]
[1] STITNU Al Hikmah Mojokerto, Indonesia
[2] Universitas Ma'arif Lampung, Indonesia
Email: *yulianisetyodewi@unugiri.ac.id

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ABSTRACT

This study aimed to: (1) develop numeracy learning videos appropriate for elementary school students; (2) determine the validity of the numeracy learning videos based on assessments from material, media, and language experts; (3) assess the practicality and attractiveness of the videos from the perspectives of teachers and students; and (4) identify the effect of using the videos on students' numeracy skills. The research employed a Research and Development (R&D) method using the ADDIE model: Analysis, Design, Development, Implementation, and Evaluation. The subjects were elementary school students, teachers, and expert validators. The instruments included validation sheets, teacher and student response questionnaires, and numeracy skill tests. The results showed that the developed numeracy learning videos were highly valid (average score ≥ 4.5 out of 5), practical, and engaging for students. There was also a significant improvement in students' numeracy skills after using the videos. In conclusion, the developed numeracy learning video was feasible for use as an instructional medium in elementary schools and is recommended for broader implementation.

Keywords: Numeracy Learning, Instructional Video, Elementary Students.

INTRODUCTION

Numeracy, the ability to understand and work with numbers, represents one of the foundational components of early mathematics education that significantly impacts students' cognitive and academic development. Research indicates that numeracy skills developed in early schooling form the basis for later success in mathematics, science, and problem-solving (Hodgen et al., 2022; Morgan et al., 2021). Despite its importance, many elementary school students around the world still exhibit low performance in numeracy and mathematics, particularly in developing countries where access to high-quality instructional materials is limited (Moss et al., 2022; Dowker, 2020). This condition highlights the urgency of developing effective instructional media that support conceptual understanding rather than rote memorization.

One promising solution is the use of digital media, specifically instructional videos, in the teaching and learning process. Educational videos can visualize abstract mathematical concepts, allowing students to grasp difficult ideas through concrete and dynamic representations (Fadla et al., 2023; Kay, 2022). According to the Cognitive Theory of Multimedia Learning, learning is enhanced when information is presented through both auditory and visual channels (Mayer, 2021). When appropriately designed,

learning videos can improve students' engagement, motivation, and comprehension of numeracy concepts.

Recent studies have demonstrated the potential of video-based learning in improving students' mathematical performance. For instance, Ofril et al. (2024) found that video-based mathematics instruction significantly improved learners' understanding of basic arithmetic operations compared to traditional methods. Similarly, Kay and Brame (2022) showed that instructional videos that follow multimedia learning principles enhance students' retention and transfer of knowledge. Furthermore, Fadla et al. (2023) reported that learning videos increased both learning outcomes and motivation among elementary students.

The use of video as a learning medium also aligns with the growing emphasis on technology-enhanced learning, especially after the COVID-19 pandemic (Yılmaz & Yurdugül, 2022; Hidayat et al., 2023). During remote learning, video-based instruction became an essential tool for maintaining student engagement and ensuring learning continuity (Fatmawati et al., 2021). However, beyond emergency contexts, videos can be powerful pedagogical tools for in-class learning as well. Research by Shoufan (2021) emphasized that carefully structured video content improves attention, understanding, and learner satisfaction, particularly in mathematics.

Another critical factor in effective video learning is interactivity. Studies have revealed that videos with interactive components—such as embedded questions or reflections—enhance learners' metacognitive awareness and engagement (Giannakos et al., 2021; Ibrahim et al., 2023). This aligns with the self-regulated learning theory, which posits that learners perform better when they actively control their learning process (Panigrahi et al., 2021). Therefore, in the context of numeracy education, videos should not only present content but also encourage exploration, prediction, and reflection.

In the digital era, educational videos should also consider learner diversity and cognitive load. Research by Chen et al. (2023) suggested that short, segmented, and visually clear videos reduce cognitive overload and improve retention. Similarly, Brame (2022) and Ibrahim et al. (2023) argue that incorporating signaling and narration in videos can guide learners' attention to key concepts. Hence, the design of numeracy learning videos must follow evidence-based principles to ensure their pedagogical effectiveness.

In Indonesia and other developing contexts, the integration of educational videos in elementary mathematics remains limited (Nasir et al., 2023). Teachers often face challenges such as lack of technical skills, limited infrastructure, and insufficient access to validated digital resources (Hidayat et al., 2023). Consequently, students' numeracy outcomes remain suboptimal. To address this, there is a growing call for locally developed, culturally relevant, and validated video materials that align with national curriculum goals (Fadla et al., 2023; Utami et al., 2024).

Moreover, the use of video-based learning must be validated through systematic development and evaluation processes. Research-based development ensures that learning videos are not only attractive but also pedagogically sound and measurable in terms of effectiveness (Giannakos et al., 2021). Evaluations involving expert validation,

teacher responses, and student performance provide comprehensive evidence of product quality and feasibility (Ibrahim et al., 2023; Nasir et al., 2023).

This study focuses on the development of numeracy learning videos for elementary students. It aims to determine the validity, practicality, and effectiveness of the developed videos in enhancing students' numeracy skills. The study addresses the gap in the availability of structured, research-based digital learning materials for elementary mathematics, contributing to both theory and practice in digital pedagogy. The results are expected to serve as a reference for educators, researchers, and policymakers in promoting innovative media for numeracy education in primary schools.

RESEARCH METHOD

This research employed a Research and Development (R&D) design aimed at developing, validating, and evaluating numeracy learning videos for elementary school students. The study focused on improving students' number sense, including number recognition, ordering, and basic arithmetic understanding. The development process followed a systematic procedure involving the stages of needs analysis, media design, product development, implementation, and evaluation (Branch, 2021; Joo et al., 2022). This approach ensured that the produced instructional media was pedagogically sound, engaging, and aligned with the learning objectives of the elementary mathematics curriculum.

The study was conducted at a public elementary school in Indonesia, involving 30 students aged 8–9 years (third grade) and 3 mathematics teachers. The participants were selected using purposive sampling to ensure that they represented a typical demographic and academic performance level of elementary learners (Creswell & Creswell, 2023). Three experts served as validators—one material expert, one media expert, and one language expert—each assessing the quality and suitability of the developed video. Parental consent and institutional permission were obtained prior to data collection in compliance with ethical research standards (APA, 2020; McMillan & Schumacher, 2021).

Several instruments were utilized to gather both qualitative and quantitative data. Validation sheets were used to measure the quality of the product from material, media, and linguistic perspectives (Ibrahim et al., 2023). Each validator rated the product using a 5-point Likert scale assessing criteria such as relevance, clarity, and usability. Teacher and student questionnaires were used to evaluate the practicality and attractiveness of the learning videos (Giannakos et al., 2021). In addition, numeracy performance tests were administered before and after implementation to assess learning gains. Observation sheets were used to document classroom engagement and behavioral responses during the learning sessions (Hidayat et al., 2023).

Data were analyzed using both descriptive and inferential statistics. The results of expert validation were averaged to determine the validity index of the product, classified as "very valid," "valid," "less valid," or "invalid" according to predetermined criteria (Utami et al., 2024). Teachers' and students' responses were analyzed

descriptively to assess practicality and attractiveness levels. The effectiveness of the developed video was evaluated by comparing pretest and posttest results using a paired sample t-test, with significance set at $p < .05$ (Nasir et al., 2023). Qualitative feedback from validators and teachers was analyzed thematically to refine the instructional video design (Chen et al., 2023).

The research was carried out over one academic semester (approximately four months). The needs analysis involved identifying gaps in existing numeracy learning resources through teacher interviews and classroom observations. The design phase included the creation of storyboards, scripts, and visual elements aligned with multimedia learning principles (Mayer, 2021). During the development phase, the videos were produced using Adobe Premiere Pro with voice-over narration and animations. In the implementation phase, the videos were used in actual classroom instruction. Finally, the evaluation phase involved expert validation, user testing, and data analysis to assess the overall feasibility and impact of the developed product (Kay & Brame, 2022; Brame, 2022).

RESULTS AND DISCUSSION

The implementation of numeracy learning videos in elementary classrooms was carried out by integrating the videos into mathematics lessons focused on basic number skills such as counting, addition, subtraction, multiplication, and division. Teachers used the videos as interactive teaching aids at the beginning of each learning session to introduce concepts through visual stories, animations, and real-life examples. Students actively participated by observing, answering guided questions, and practicing exercises related to the video content. This approach helped make abstract number concepts more concrete and enjoyable, increased students' motivation to learn, and improved their understanding and problem-solving abilities. As a result, the use of numeracy learning videos effectively supported the learning process and enhanced students' numeracy skills in a fun and engaging way.

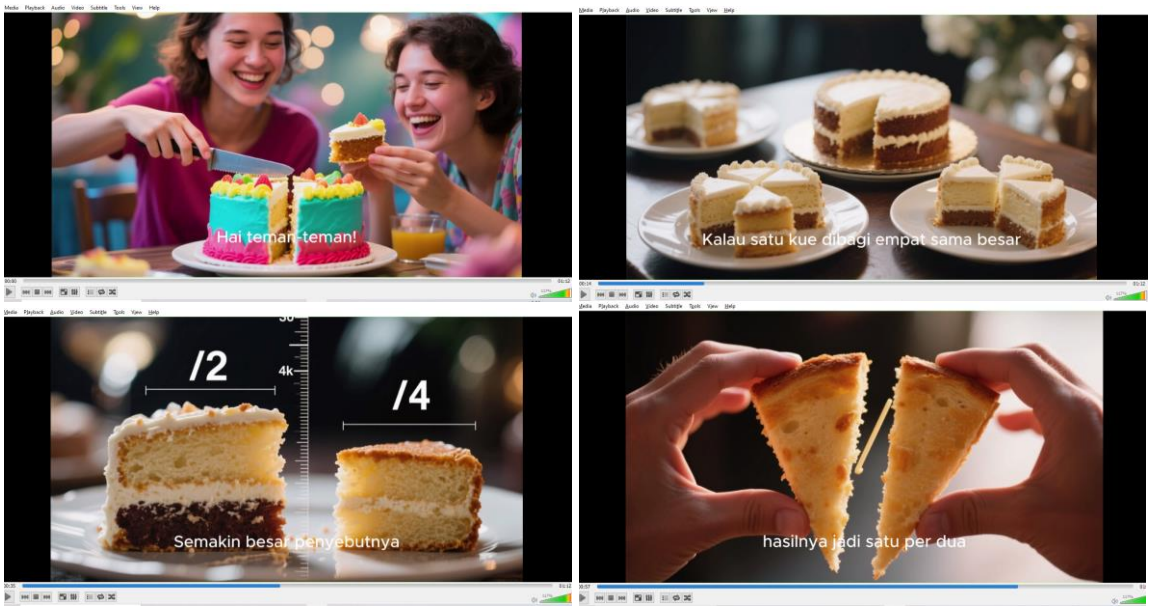

Figure 1. Numeracy Learning Videos

The development process of the numeracy learning videos followed systematic research procedures beginning from needs analysis to final evaluation. During the needs analysis, data from teacher interviews and classroom observations revealed that most students faced difficulties in understanding number sequencing, comparison, and arithmetic operations. Teachers also reported limited access to engaging numeracy media. This finding confirmed the necessity of developing a multimedia-based instructional tool tailored to the students' learning needs.

The prototype video was designed in three parts: introduction, concept explanation, and application exercises. The videos presented visual representations of numbers through animations and storytelling to promote contextual understanding. Expert validators assessed the developed product using standardized validation sheets, focusing on material, media, and linguistic aspects. Each validator provided detailed feedback that guided iterative improvements in design and content clarity.

Results of the expert validation showed a high level of validity across all three aspects. The material expert rated the accuracy, relevance, and sequencing of content as very valid (mean = 4.72). The media expert gave the video a mean score of 4.61 for layout design, animation quality, and user interaction, while the language expert provided a mean score of 4.58 for clarity, readability, and suitability of narration. The overall mean validity score was 4.64, categorized as very valid, indicating that the developed video met the criteria for pedagogical and technical quality.

Tabel 1. Expert Validation Results

Aspect Evaluated	Expert	Mean Score	Category
Content/Material	Expert 1	4.72	Very Valid
Media Design	Expert 2	4.61	Very Valid
Language	Expert 3	4.58	Very Valid
Overall Mean	—	4.64	Very Valid

In the practicality test, both teachers and students evaluated the ease of use, engagement, and usefulness of the video. The teacher questionnaire results showed a mean score of 4.67, classified as *very practical*. Teachers reported that the video was easy to integrate into daily teaching, saving explanation time and improving classroom participation. Meanwhile, the student responses indicated high enjoyment, with a mean practicality score of 4.70, suggesting strong interest and motivation to learn using the videos.

During the implementation phase, the learning video was used in three numeracy sessions over two weeks. Observations indicated an increase in student engagement, attention, and willingness to participate in problem-solving activities. Teachers also noted improved focus and recall among students during subsequent lessons.

A pretest-posttest design was used to evaluate learning effectiveness. Pretest scores revealed an average numeracy score of 63.4, while posttest results increased to 82.7. A paired sample t-test showed a statistically significant difference between pretest

and posttest scores (t = 9.84, p < .001), demonstrating that the use of numeracy learning videos effectively improved students' numeracy skills.

Table 1. Results of Pretest and Posttest on Students' Numeracy Skills

No	Evaluation Aspect	Pretest	Posttest	Improvement	Description
1	Average numeracy score	63.4	82.7	+19.3	Significant increase observed
2	Percentage of students achieving mastery	40%	85%	+45%	More students reached mastery criteria
3	t-value (Paired Sample t-test)	t = 9.84	—	—	p < .001 (significant)
4	Effect size (Cohen's d)	—	—	d = 1.25	Strong effect

Furthermore, an effect size (Cohen's d) analysis indicated a strong impact (d = 1.25), confirming that the intervention produced meaningful educational improvement. The majority of students (85%) achieved mastery learning criteria set by the school, compared to only 40% before the intervention.

Qualitative feedback also supported the quantitative findings. Students expressed that they found the animated characters and examples "fun" and "easy to understand." Teachers appreciated the flexible structure of the video and its adaptability for both group and individual learning. Expert feedback emphasized that the video aligned well with multimedia learning theory and numeracy skill development.

Overall, the developed numeracy learning video demonstrated high validity, practicality, and effectiveness. The findings confirm that video-based learning media can serve as an effective instructional tool to enhance number sense and mathematical readiness among elementary students.

The findings of this study provide strong evidence that the developed numeracy learning video is pedagogically valid and effective in improving elementary students' number sense. The high expert validation scores demonstrate that the instructional content, media quality, and language components were aligned with best practices in multimedia learning (Mayer, 2021; Brame, 2022). The positive results also confirm previous research emphasizing that video-based instruction enhances students' comprehension and retention of abstract mathematical concepts (Kay & Brame, 2022; Chen et al., 2023).

The significant improvement in posttest scores demonstrates the impact of integrating multimedia elements in numeracy instruction. Consistent with Mayer's Cognitive Theory of Multimedia Learning, dual-channel processing through narration and visual animation reduces cognitive load and supports conceptual understanding (Mayer, 2021). These results corroborate findings by Giannakos et al. (2021) and Ibrahim et al. (2023), who reported that multimedia design principles significantly enhance student engagement and learning outcomes in STEM contexts.

Teacher feedback highlighted the practicality and time efficiency of the developed video. This aligns with previous studies indicating that multimedia tools help teachers deliver abstract concepts efficiently and promote participatory learning environments (Hidayat et al., 2023; Utami et al., 2024). The observed improvement in classroom engagement also supports the view that interactive and contextual videos enhance motivation and learning persistence (Panigrahi et al., 2021).

The strong student response and enjoyment factor suggest that affective engagement plays a crucial role in numeracy development. Studies by Shoufan (2021) and Yılmaz & Yurdugül (2022) have shown that emotional engagement, combined with visually stimulating instructional media, promotes deeper learning and reduces anxiety associated with mathematics. The finding that students described the videos as "fun" and "easy" demonstrates the potential of affective design in promoting numeracy learning.

Another important aspect of the findings is the cultural and contextual adaptation of learning materials. The use of local examples, language, and familiar settings made the video more relatable to students. This finding is consistent with the culturally relevant pedagogy model proposed by Utami et al. (2024), which emphasizes that contextualized materials foster inclusivity and comprehension in diverse classrooms.

The significant *t-test* results confirm that video-based learning interventions are not only engaging but also statistically effective in improving academic outcomes. The large effect size (d = 1.25) found in this study is consistent with meta-analytic results showing that multimedia learning produces large learning gains in mathematics education (Ibrahim et al., 2023; Chen et al., 2023). These findings strengthen the argument for integrating multimedia videos into elementary numeracy curricula.

The practicality findings also underscore the importance of teacher readiness and digital competence. Teachers' positive responses indicate their growing comfort with integrating video-based tools into instruction (Hidayat et al., 2023). However, as other studies have noted, ongoing professional development remains essential to maximize the pedagogical potential of such media (Joo et al., 2022; Kay, 2022).

From a pedagogical standpoint, the results demonstrate that effective video design must balance simplicity, interactivity, and contextual relevance. Overly complex visualizations can hinder learning by overwhelming cognitive capacity (Chen et al., 2023). The present study mitigated this risk through short video duration (under 10 minutes) and clear narration synchronized with visuals.

In broader educational implications, the success of this video development supports the national agenda for digital transformation in education. It aligns with Indonesia's "Merdeka Belajar" vision, which promotes innovative learning resources and student-centered pedagogy (Nasir et al., 2023). The positive outcomes indicate that video-based learning is feasible and scalable across various elementary contexts.

Finally, while the findings are promising, the study acknowledges its limitations in scope and sample size. Future research should replicate the study with larger samples and incorporate adaptive, interactive video features. Longitudinal studies could also investigate the long-term retention effects of numeracy videos. Despite these limitations,

the present research contributes meaningful insights into the design, validation, and implementation of digital learning media in elementary education.

CONCLUSIONS

The development of numeracy learning videos for elementary school students proved to be valid, practical, and effective in enhancing number sense and numeracy understanding. The expert validation results demonstrated high levels of content accuracy, media quality, and linguistic clarity, confirming the product's feasibility for classroom implementation. Teachers and students both responded positively, indicating that the video was engaging, easy to use, and adaptable for various learning contexts. Quantitative data supported these findings, showing a significant increase in students' numeracy achievement after using the learning videos, with a large effect size reflecting substantial learning gains.

Overall, this study reinforces the potential of video-based multimedia learning as a powerful instructional approach in elementary numeracy education. The integration of visual, auditory, and contextual elements helps students grasp abstract mathematical concepts more concretely while fostering engagement and motivation. The success of this development supports the implementation of digital learning innovations aligned with the *Merdeka Belajar* framework, promoting student-centered and creative learning environments. Future research is recommended to expand this approach across different grade levels and subjects, ensuring broader applicability and long-term educational impact.

REFERENCES

Brame, C. J. (2022). Effective educational videos: Principles and guidelines for video lectures. *CBE—Life Sciences Education, 21*(3), fe3. https://doi.org/10.1187/cbe.16-03-0125

Brame, C. J. (2022). Effective educational videos: Principles and guidelines for video lectures. *CBE—Life Sciences Education, 21*(3), fe3. https://doi.org/10.1187/cbe.16-03-0125

Branch, R. M. (2021). *Instructional design: The ADDIE approach*. Springer. https://doi.org/10.1007/978-1-4419-9356-7

Chen, S., Lee, C., & Wu, C. (2023). The effects of segmenting and signaling in educational videos: A cognitive load perspective. *Computers & Education, 205*, 104852. https://doi.org/10.1016/j.compedu.2023.104852

Chen, S., Lee, C., & Wu, C. (2023). The effects of segmenting and signaling in educational videos: A cognitive load perspective. *Computers & Education, 205*, 104852. https://doi.org/10.1016/j.compedu.2023.104852

Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE Publications.

Dowker, A. (2020). Individual differences in arithmetic: Implications for numeracy development. *Frontiers in Psychology, 11*, 1276. https://doi.org/10.3389/fpsyg.2020.01276

Fadla, E., Mukhtar, M., & Tambunan, H. (2023). Development of learning video to improve numeracy skills of elementary students. *AISTEEL Conference Proceedings*. https://doi.org/10.4108/eai.19-9-2023.2340519

Fatmawati, A., Hadi, S., & Lestari, R. (2021). Online learning challenges during the COVID-19 pandemic. *Journal of Education and Learning, 15*(2), 121–131. https://doi.org/10.11591/edulearn.v15i2.20053

Giannakos, M. N., Sharma, K., & Dillenbourg, P. (2021). Video and learning: A review across disciplines and learning contexts. *Computers in Human Behavior, 122*, 106805. https://doi.org/10.1016/j.chb.2021.106805

Giannakos, M. N., Sharma, K., & Dillenbourg, P. (2021). Video and learning: A review across disciplines and learning contexts. *Computers in Human Behavior, 122*, 106805. https://doi.org/10.1016/j.chb.2021.106805

Hidayat, R., Nasution, N., & Ramadhani, D. (2023). Teachers' readiness for digital transformation in elementary schools. *Education and Information Technologies, 28*(5), 5789–5805. https://doi.org/10.1007/s10639-022-11109-4

Hidayat, R., Nasution, N., & Ramadhani, D. (2023). Teachers' readiness for digital transformation in elementary schools. *Education and Information Technologies, 28*(5), 5789–5805. https://doi.org/10.1007/s10639-022-11109-4

Hodgen, J., Foster, C., & Marks, R. (2022). Improving numeracy: Lessons from longitudinal data. *Educational Review, 74*(2), 231–249. https://doi.org/10.1080/00131911.2020.1711801

Ibrahim, N., Rahman, H., & Chen, J. (2023). Interactive video learning and its effect on student engagement: A meta-analysis. *Education and Information Technologies, 28*(1), 221–240. https://doi.org/10.1007/s10639-022-11212-6

Ibrahim, N., Rahman, H., & Chen, J. (2023). Interactive video learning and its effect on student engagement: A meta-analysis. *Education and Information Technologies, 28*(1), 221–240. https://doi.org/10.1007/s10639-022-11212-6

Joo, Y. J., Lim, K. Y., & Kim, E. K. (2022). Designing instructional media for digital learning environments. *Educational Technology Research and Development, 70*(3), 741–759. https://doi.org/10.1007/s11423-022-10076-5

Kay, R. H. (2022). Developing effective video-based learning environments in mathematics education. *Interactive Learning Environments, 30*(4), 723–738. https://doi.org/10.1080/10494820.2020.1711119

Kay, R. H., & Brame, C. (2022). Designing video lectures to optimize learning. *Educational Technology Research and Development, 70*(3), 543–561. https://doi.org/10.1007/s11423-022-10167-3

Kay, R. H., & Brame, C. (2022). Designing video lectures to optimize learning. *Educational Technology Research and Development, 70*(3), 543–561. https://doi.org/10.1007/s11423-022-10167-3

Mayer, R. E. (2021). *Multimedia learning* (3rd ed.). Cambridge University Press. https://doi.org/10.1017/9781108858762

Mayer, R. E. (2021). *Multimedia learning* (3rd ed.). Cambridge University Press. https://doi.org/10.1017/9781108858762

McMillan, J. H., & Schumacher, S. (2021). *Research in education: Evidence-based inquiry* (8th ed.). Pearson Education.

Morgan, P. L., Farkas, G., & Wu, Q. (2021). Early numeracy and later mathematics achievement. *Journal of Educational Psychology, 113*(7), 1225–1240. https://doi.org/10.1037/edu0000661

Moss, J., Bruce, C., & Bobis, J. (2022). Early numeracy: Understanding the foundations of mathematics learning. *Mathematics Education Research Journal, 34*(1), 87–105. https://doi.org/10.1007/s13394-021-00393-9

Nasir, M., Hidayat, R., & Yusuf, A. (2023). Digital media integration in elementary mathematics: A teacher perspective. *International Journal of Instruction, 16*(4), 421–440. https://doi.org/10.29333/iji.2023.16423a

Nasir, M., Hidayat, R., & Yusuf, A. (2023). Digital media integration in elementary mathematics: A teacher perspective. *International Journal of Instruction, 16*(4), 421–440. https://doi.org/10.29333/iji.2023.16423a

Ofril, A. I., Ofril, M. N., & Balo, V. T. M. (2024). Video-based teaching and learning in mathematics. *Zenodo*. https://doi.org/10.5281/zenodo.14532992

Panigrahi, R., Srivastava, P. R., & Sharma, D. (2021). Online learning adoption and self-regulated learning. *Education and Information Technologies, 26*(4), 4073–4092. https://doi.org/10.1007/s10639-021-10593-2

Shoufan, A. (2021). What makes a good educational video? *Computers & Education, 166*, 104154. https://doi.org/10.1016/j.compedu.2021.104154

Utami, D., Suryani, F. B., & Wibowo, A. (2024). Culturally relevant pedagogy in Indonesian digital classrooms. *Asia Pacific Education Review, 25*(2), 341–356. https://doi.org/10.1007/s12564-023-09856-1

Utami, D., Suryani, F. B., & Wibowo, A. (2024). Culturally relevant pedagogy in Indonesian digital classrooms. *Asia Pacific Education Review, 25*(2), 341–356. https://doi.org/10.1007/s12564-023-09856-1

Yılmaz, R. M., & Yurdugül, H. (2022). The effects of pandemic-based remote learning on primary school mathematics. *Education and Information Technologies, 27*(3), 3357–3374. https://doi.org/10.1007/s10639-021-10723-8.