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OPTIMIZATION OF INSTRUCTIONAL TECHNOLOGY FOR ATTENTION SPAN IN THE DIGITAL GENERATION

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Abstract: Exposure to technology has led to a decline in the attention span of the digital generation, which has implications for the learning process. This presents an opportunity for instructional technology, including learning systems, to provide solutions to address this issue. This Systematic Literature Review aims to explore the impact of instructional technology on attention span to optimize learning in the digital generation. The search strategy used the PRISMA method with a qualitative descriptive approach collected from Google Scholar, Scopus, and PubMed databases, resulting in 20 articles for analysis. The results show that the phenomenon of attention span is closely related to cognitive load theory and student engagement. Therefore, most of the approaches described prioritize dividing learning content into small parts and integrating various strategies to make the content more engaging for students. Through active and collaborative learning models, student engagement will also increase, thus affecting the attention span of the digital generation. The practical implication of this study is the need for teachers and educators to design short, varied content and utilize interactive media to maintain student focus. Further research is recommended to empirically test the effectiveness of these strategies at various educational levels and explore new technologies such as artificial intelligence (AI) and immersive reality (VR/AR).

Keywords: Optimization, Instructional Technology, Attention Span

OPTIMALISASI TEKNOLOGI PEMBELAJARAN TERHADAP RENTANG PERHATIAN PADA GENERASI DIGITAL

Abstrak: Paparan teknologi berdampak pada penurunan rentang perhatian generasi digital yang berimplikasi pada proses pembelajaran. Hal ini memberikan peluang pada teknologi pembelajaran yang mencakup sistem pembelajaran untuk memberikan solusi dalam menghadapi hal tersebut. *Systematic Literature Review* ini bertujuan untuk mengeksplorasi teknologi pembelajaran terhadap rentang perhatian untuk mengoptimalkan pembelajaran pada generasi digital. Strategi pencarian menggunakan metode PRISMA dengan pendekatan deskriptif kualitatif yang dikumpulkan dari basis data Google Scholar, Scopus, dan PubMed sehingga menghasilkan 20 artikel untuk dianalisis. Hasil penelitian menunjukan bahwa fenomena rentang perhatian sangat berkaitan erat dengan teori beban kognitif dan keterlibatan siswa. Oleh karena itu sebagian besar pendekatan yang dijabarkan mengutamakan pada pembagian konten pembelajaran menjadi bagian kecil dan diintegrasikan dengan berbagai strategi agar konten lebih menarik perhatian siswa. Melalui model pembelajaran aktif dan kolaboratif juga akan meningkatkan keterlibatan siswa sehingga akan berpengaruh kepada rentang perhatian generasi digital. Implikasi praktis dari kajian ini adalah perlunya guru dan pendidik merancang konten singkat, variatif, serta memanfaatkan media interaktif untuk menjaga fokus siswa. Penelitian selanjutnya disarankan untuk menguji efektivitas strategi ini secara empiris pada berbagai jenjang pendidikan serta mengeksplorasi teknologi baru seperti kecerdasan buatan (AI) dan realitas imersif (VR/AR).

Kata Kunci: Optimalisasi, Teknologi Pembelajaran, Rentang Perhatian

INTRODUCTION

Current advances in digital technology are transforming the way we learn and teach. Learning is no longer confined to the physical classroom. Technology allows accessibility that is not limited by space and time. However, along with its development, concerns have arisen about the negative impacts of technology itself, particularly on focus and attention. Research shows that digital technology tends to impact the brain, from attention and memory to social interaction capacity by triggering distractions such as multitasking and task-switching, which impact concentration and short-term memory (Lodge & Harrison, 2019).

The digital generation grew up in an environment inextricably linked to technology. Characteristics of the digital generation, such as Generation Z, tend to desire instant gratification, have a short attention span, and a low ability to validate information (Hastini et al, 2020). Attention span is the length of time a person can focus or concentrate on information without distraction. The emergence of various short video platforms reinforces this phenomenon because short content is addictive and supported by algorithms that encourage users to continuously watch without realizing it (Kohler, 2023). This gives rise to a phenomenon known as a short attention span, a condition where a person has a shorter focus span.

On the website The Treetop (2024) states that the average human attention span is 8.25 seconds with an attention span that can range from 2 seconds to 20 minutes. The average human attention span decreased by almost 25% from 2000 to 2015. In Simon et al (2023) also states that age differences affect the duration of attention span where in young adults (19-32 years) it is longer with an average of 76 seconds compared to children (7-13 years) which is 29 seconds, then elderly adults (56-85 years) with an average of 67 seconds.

Facing this phenomenon, the role of instructional technology becomes increasingly important. Instructional technology emerges from the problems that arise in the learning process. Instructional technology is not only synonymous with media, but also encompasses learning systems designed to be more effective (Anggraeny et al., 2020). There are three basic principles in the development and utilization of instructional technology: a systems approach, student-oriented, and optimal and varied use of learning resources (Salsabila, U.H., Agustian, 2021). In this regard, attention span needs to be considered in designing learning, especially for the current digital generation, which has grown up and is integrated with the technological environment in everyday life. In the context of the digital generation, attention is crucial for conveying information more meaningfully, thus strengthening comprehension capacity, given the limited capacity of working memory (Lodge & Harrison, 2019).

Strategies that can be implemented to address the characteristics of today's students related to attention span include creating more dynamic, interactive, and short-term content. For example, research by Samala et al (2023) suggests that implementing bite-sized learning, such as microlearning or nanolearning, which divides complex topics into smaller components, can improve retention and engagement, especially when combined with gamification elements, MOOCs, and mobile learning. Social media platforms have also increased the popularity of short videos that align with the principles of bite-sized learning (Khlaif & Salha, 2021). The characteristics of the digital generation, which tends to have a short attention span and low ability to validate information, present opportunities for creating online games to simulate learning related to decision-making and building learning websites to support literacy (Hastini et al, 2020).

Previous studies have examined various approaches to addressing this phenomenon, but

they have focused on only one aspect, such as learning models, digital media, or specific strategies. Research rarely examines the integration of all these components simultaneously to address the attention span phenomenon of the digital generation. This creates a research gap regarding how to optimize instructional technology through a combination of these components to be more adaptive to the challenges of short attention span. This Systematic Literature Review (SLR) aims to explore how optimizing instructional technology addresses this phenomenon to provide a more comprehensive understanding. The increasing reliance on digital technology presents an opportunity for instructional technology to address students' attention issues and create more meaningful learning experiences. This study is expected to contribute to the formulation of innovative methods that suit the needs of the digital generation.

METHODOLOGY

This study uses the Systematic Literature Review (SLR) method which aims to collect various relevant sources related to the optimization of instructional technology towards attention span in the digital generation. The strategy used refers to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method, a qualitative descriptive approach using related variable keywords, namely ("learning technology" OR "educational technology" OR "instructional technology") AND ("attention span" OR focus OR concentration) AND ("digital generation" OR "digital natives" OR "Generation Z") with a publication range of 2019-2024. The databases used are Scopus, Google Scholar, and PubMed with the help of publish or perish software. The formulation of the research questions from this literature review are:

RQ1: How can instructional technology be optimized to address the attention span of the digital generation?

RQ2: What is the potential for future instructional technology?

The article selection process was conducted by a single researcher, so inter-rater reliability testing was not applied. To minimize bias, the researcher used inclusion and exclusion criteria and recorded the entire selection process according to the PRISMA flow, including the stages of identification, screening, and inclusion. The inclusion criteria formulated by the researcher are as follows.

Table 1. Inclusion Exclusion Criteria

Criteria	Inclusion	Exclusion
Literature Type	Article Journal	Book or Book Chapter
Publication Year	2019-2024	Before 2019
Research Subject	Students at K-12 atau or Higher Education	Children, General Public
Accessibility	Overall can be accessed for free	Paid or only contains abstracts
Scope	Optimization of instructional technology (models, strategies, methods, media) to deal with attention span	In addition to optimizing instructional technology (models, strategies, methods, media) to deal with attention span

RESULTS

At the identification stage, 740 articles were found with details of 500 articles in the Google Scholar database, 200 articles in the Scopus database, and 40 articles in the PubMed database. 92 duplicate articles were found resulting in 494 articles. At the screening stage,

selection was carried out based on the title and abstract resulting in 296 relevant articles. Meanwhile, at the inclusion stage, researchers selected the entire content of articles that met the inclusion criteria resulting in 20 articles for analysis.

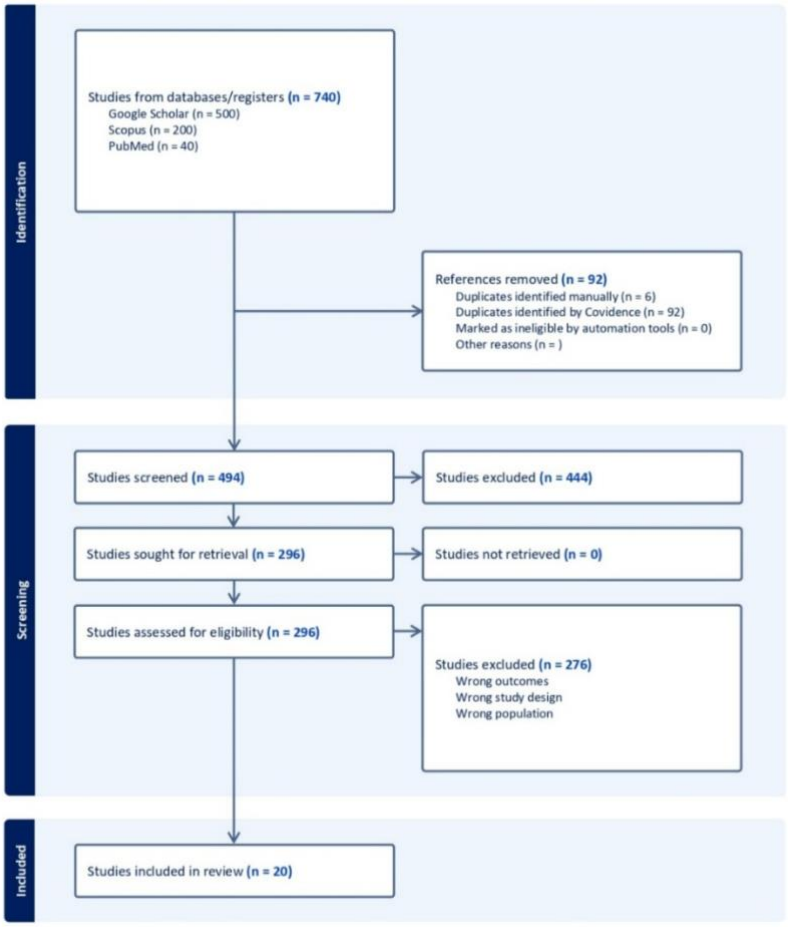

Figure 1. PRISMA Flow Diagram

The research results based on 20 articles that have met the inclusion criteria regarding the optimization of instructional technology for attention span, including models, methods, and strategies that can be applied in learning, are presented in the following table.

Table 2. Research Results

Author (Year)	Type of Technology/Strategy	Results
Garshasbi et al (2021)	Microlearning and CSCL (Computer-Supported Collaborative Learning)	Increase student motivation, engagement, and retention.
Robles et al (2023)	Microlearning	Increases student engagement, as well as improving their reading comprehension skills.
George et al (2021)	Reward-based active learning	Increases student attention span and engagement through cooperative learning.
Hanif & Gálvez-Peralta (2023)	The "1-minute break"	Helps students maintain focus or regain their attention during lectures.
Patterson et al (2020)	10-minute video with animations	Helps in understanding the material than a longer but lower quality lecture recording for their learning.
Seidel (2024)	Segmented videos	Help viewers navigate and understand the

		material more efficiently, thereby increasing the effectiveness and absorption of the material for students.
Fating et al (2024)	Inquiry-based learning	Helps simplify and clarify the concept of the topic, increasing receptivity and questions, increasing attention span
Bincy O G & Rages John (2019)	Tactile learning style (touch-based)	Increases attention span and task engagement in upper elementary school students with impulsive behavior.
Jessica & Santoso (2022)	Clear instructions, repetition by students, relating the material to students' lives, implementing HOTS, and varying the delivery of learning	Increase attention span.
Vivekananth (2022)	Nano learning	Increases productivity and knowledge retention, and reduces screen time required, which has a positive impact on student health.
Bhat et al (2023)	Game-based learning	Helps students understand the material better, improves academic performance, and creates a more dynamic and competitive classroom atmosphere, thus providing a positive and sustainable learning experience.
Istiqomah et al (2019)	The Somatic, Auditory, Visualization, Intellectually (SAVI) approach	Increases student attention and provides results which significantly increases student engagement.
Govindarajan et al (2020)	Team teaching	Improves student attention and comprehension, reduces boredom with a variety of teaching styles and effective use of audiovisual aids.
Mat-jizat et al (2020)	Spaced-learning	Improves academic performance and student motivation in higher education institutions because the breaks between learning sessions help them maintain attention and engagement in the material being taught.
Mosca et al (2019)	The MIOPA (Multiple Inclusions of Pedagogical Approaches) method	Increases student engagement and understanding of the material.
Valenti et al (2020)	Virtual Reality (VR)	Increases the appeal and duration of attention, helping students focus longer.
Arora & Sharma (2019)	The ARCS (Attention, Relevance, Confidence, Satisfaction) model	Increases students' attention span longer and class participation.
Stone et al (2022)	Animations in interactive books and the chunking method	Extend the attention span and increase student engagement in learning.
Bock et al (2021)	Videos with the sandwich principle	Increase student attention and motivation.
Andraszek (2023)	PQBL (Pure Question-Based Learning)	Effective in maintaining concentration in the learning process.

The digital generation is a generation that grew up where technology has become an integral part of everyday life. Digital generations such as Generation Z and Alpha have a strong affinity for technology, tend to be less tolerant of frustration, and want instant results, are more easily involved in active, collaborative, and technology-based activities, while traditional teaching approaches are less effective (Castro et al., 2020). Generation Z has an attention span

of around 8 seconds due to early exposure to technology that allows instant and fast access to information. In the context of learning, this generation prefers interactive learning to help maintain attention longer (Nicholas, 2020).

Attention span is the most common problem found in the classroom (Jessica & Santoso, 2022). Therefore, various approaches need to be considered by instructional technologists to deal with or overcome this phenomenon. Uninteresting learning and teachers who do not provide high-level thinking skills result in a short attention span for students (Jessica & Santoso, 2022). It is necessary to develop learning skills to learn so that students are able to face the challenges of a dynamic and information-rich modern world (Castro et al., 2020).

DISCUSSION

Optimization of Instructional Technology for Attention Span

Instructional technology offers various solutions that can help in dealing with students' attention spans which currently tend to be shorter, especially in the digital generation. The Bite-Sized Learning approach, which is dividing learning materials into small, short, and easy-to-digest pieces, is the most widely used approach. Microlearning and Nano Learning discussed in the article are part of Bite-Sized Learning. Although microlearning is short and simple, the learning content should not be simplified, the learning content can be broken down into small units to reduce cognitive load (Garshasbi et al., 2021). The development of a mobile application based on microlearning was carried out by Robles et al (2023) so that it produces an effective application that not only focuses on students' attention span, but can also increase student engagement and improve their reading skills. In the research, Grashasbi et al (2021) integrated microlearning with Computer-Supported Collaborative Learning (CSCL) to design and implement collaborative learning modules. In addition to micro, nano-learning with a duration of usually under five minutes is also effective in increasing student focus and reducing screen time required (Vivekananth, 2022).

In the learning process, learning media plays an important role in overcoming limitations of the senses, space and time (Rani et al., 2024). Therefore, in this case, the most frequently discussed learning media is the use of video. Short videos is also an example of the application of Bite-Sized Learning. Of the four articles that use learning videos as a medium to deal with attention span in the digital generation, the strategies used are using the principle of segmentation, the sandwich principle, and animation assistance. Learning that is segmented into shorter parts gradually shows better understanding because it can be accessed in a structured and separate manner, thus helping to navigate the material (Seidel, 2024). The sandwich principle, which combines collective and individual learning phases in one learning unit, such as inserting active elements in the middle of the video such as practice questions. Learning videos using the sandwich principle in a study conducted by Bock et al (2021) using two interruptions of activating elements in the form of practice questions in learning videos showed a significant increase in test scores. In the study by Patterson et al (2020), two-minute premium videos assisted by animation were watched more by students than long lecture recordings and this helped them remember. The use of animation can also be applied to interactive textbooks, especially by dividing the content into small pieces showing high student engagement, even students not only watch but repeat the animation (Liberatore & Xu, 2022).

Not only can the distribution of content or learning materials reduce cognitive load and

increase students' attention span, but it can also be done by implementing "pauses" in learning. The "1-minute break" technique every 15 minutes during learning helps to maintain students' focus and attention (Hanif & Gálvez-Peralta, 2023). The space learning method where the material is delivered in three 20-minute sessions and then given a 10-minute break for physical activity is effective in improving academic performance because it is able to maintain attention and involvement in the material (Mat-jizat et al., 2020).

Various learning models can also be applied to maintain or increase students' attention span. In the study, George & Supreetha (2021) implemented cooperative learning with a reward-based active learning approach to increase attention span and student engagement. The reward-based active learning is designed with a point system for groups that actively participate as the main motivation for students. Inquiry-based learning can also be applied to increase students' attention span because this method simplifies and clarifies concepts so as to develop thinking skills (Deshmukh et al., 2024). Other interactive approaches such as Somatic, Auditory, Visualization, Intellectually (SAVI), Attention, Relevance, Confidence, Satisfaction (ARCS), pure Question-Based Learning (pQBL) and team teaching methods can increase students' attention span (Istiqamah et al, 2019; Arora & Sharma, 2019; Andraszek, 2023; Govindarajan et al., 2021).

Technology integration can support students' sustained attention. The application of Virtual Reality (VR) can increase the appeal and duration of attention, and help students focus longer, as in a study conducted by Valenti et al (2020) which showed that almost 60% of students spent more than 25 minutes in the VR experience. Moreover, by integrating technology with a collaborative learning model. In a study by Mosca et al (2019) recommends the Multiple Inclusions of Pedagogical Approaches (MIOPA) method which combines various approaches such as collaboration and hands-on activities to achieve more effective learning outcomes. Other approaches such as game-based learning help students understand the material better, improve academic performance, and create a more dynamic and competitive classroom atmosphere, thus providing a positive and sustainable learning experience (Bhat et al., 2023).

Therefore, the digital generation who tend to have a short attention span need to use interactive and visual learning methods. In a study conducted by Jessica & Santoso (2022), it was concluded that several strategies that can be applied in dealing with this attention span are providing clear instructions and asking students to repeat them, making learning interesting by linking the material to students' lives, applying high-level thinking skills (HOTS), and variations in delivering lessons. So it is necessary to integrate technology and learning models that are tailored to needs in order to maintain or increase students' attention span.

These results align with Cognitive Load Theory (Sweller, 2023), which emphasizes that information needs to be presented in small units to avoid overloading working memory. Segmenting material, microlearning, and study breaks help reduce cognitive load, allowing students to focus better. These strategies reduce intrinsic and extraneous load by managing interactivity, preventing split-attention and redundancy, and mitigating transient information in the audio modality. Furthermore, findings from the use of interactive video, gamification, and collaborative learning support Engagement Theory, as these strategies foster behavioral, emotional, and cognitive engagement (Fredricks et al., 2004), which are essential for increasing attention span. Behavioral engagement is reflected in students' active participation in quizzes or games, emotional engagement from the enthusiasm and interest generated through interactive

media, and cognitive engagement from the effort to deeply understand the material. These three dimensions play a crucial role in maintaining focus and extending the attention span of the digital generation.

Potential in Future Instructional Technology

The increasingly sophisticated development of technology provides enormous potential for the short attention span phenomenon in the digital generation. Bite-sized learning can be further developed by integrating with the principles or various approaches mentioned earlier. Artificial intelligence (AI) which is currently trending also allows for higher personalized learning. Other technologies such as Augmented Reality (AR) and Virtual Reality (VR) have the potential to provide immersive experiences that will attract students' attention in different interactive ways. This will affect the appeal and attention span of students. In addition, gamification can also be integrated with various learning platforms to increase a healthy sense of competitiveness by students.

Through the use of appropriate instructional technology, the digital generation can be encouraged to stay focused in the learning process, even when exposed to various digital distractions around them. Future instructional technology has the potential to be the key to creating a more dynamic learning environment that can accommodate students' attention needs more optimally. This technology also enables a micro-learning approach, which divides material into short, focused sessions, making it easier for students with limited attention spans to absorb. With these innovations, future instructional technology has the potential to not only maintain, but also increase student attention and engagement, creating a more effective and relevant learning experience in the digital age.

Despite the promising prospects, limitations of the existing literature should be noted. There are few longitudinal studies assessing the effects of instructional technologies on students' long-term attention. Furthermore, most studies still focus on popular technologies (short videos, microlearning), while emerging technologies such as AI and VR/AR have rarely been tested in formal educational contexts with large sample sizes. This highlights the need for further research to develop more comprehensive recommendations.

CONCLUSSION

The various approaches described demonstrate that the phenomenon of attention span is closely related to cognitive load theory and student engagement. Cognitive load theory explains that humans have a limited capacity to process information in working memory. When a person's cognitive load increases, their attention span will be affected. This is especially true given the current digital generation's exposure to short-form content, leading to a short attention span. Therefore, most of the approaches described prioritize dividing learning content into smaller chunks and integrating them with various strategies to further engage students.

The implication for teachers and educators is the need to design learning with more structured, concise content and a variety of media, such as interactive videos or gamification, to maintain student attention. Educators also need to regulate the rhythm of learning breaks (spacing and breaks) and integrate collaborative strategies to maintain student behavioral, emotional, and cognitive engagement. Active and collaborative learning models also increase student engagement, thus impacting their attention span. Further research is recommended to

empirically test the effectiveness of these strategies across different educational levels and subject contexts. In addition, longitudinal studies are also important to see the impact of learning technology sustainability on attention span in the long term, including exploring the integration of new technologies such as artificial intelligence (AI) and immersive reality (VR/AR).

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