



The Effectiveness of the Mindful, Meaningful, Joyful Learning Approach Based on Cognitive Science in the Digital Learning Framework

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Info Article

Received: 4 Sept 2025

Revised: 10 Oct 2025

Accepted: 25 Oct 2025

Online Version: 30 Oct 2025

Abstract

This study aims to analyze the effectiveness of a cognitive science–based instructional strategy through the integration of mindful, meaningful, and joyful learning within the framework of digital learning. Employing a mixed method approach with an explanatory sequential design, the study first applied a quasi-experimental method involving two groups of students 30 in a control group and 30 in an experimental group to examine differences in conceptual understanding and learning motivation. Quantitative data were collected using conceptual understanding tests and learning motivation questionnaires, followed by qualitative data obtained through teacher and student interviews as well as digital classroom observations to explain and deepen the quantitative findings. The results show a significant improvement in conceptual understanding in the experimental group (mean gain = 14.23) compared to the control group (mean gain = 3.12; $p < 0.05$), as well as higher learning motivation (mean gain = 13.12 vs. 3.05; $p < 0.05$). Qualitative findings reveal that teachers experienced greater ease in designing interactive activities, students perceived learning as more meaningful and enjoyable, and classroom dynamics reflected increased engagement and reflective awareness. Theoretically, this study contributes empirical evidence supporting the integration of cognitive science principles with holistic pedagogy in digital learning. Empirically, it demonstrates that mindful, meaningful, and joyful learning can simultaneously enhance cognitive and affective outcomes, offering a humanistic and sustainable model for digital pedagogy development

Keywords: Deep Learning; Digital Learning; Joyful; Meaningful; Mindful

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INTRODUCTION

As technology and education digitalization accelerate, many institutions and schools are turning to digital-based learning. However, the implementation of digital learning in the field is often stuck in the use of media as a tool to deliver material such as presentations, videos, or online platforms without paying attention to how the learning process occurs cognitively and affectively (Feri et al., 2025). This situation causes learning to tend to be monotonous, memorization-oriented, and has little

room for reflection or an exciting and meaningful learning experience (Widiastuti et al., 2025). Similar concerns have been raised by international studies indicating that technology-driven instruction often prioritizes efficiency and content delivery over students' cognitive engagement and emotional involvement, resulting in surface-level learning rather than deep understanding (Entwistle & Ramsden, 2015; Biggs & Tang, 2011). Several studies emphasize that digital learning should not be understood merely as the use of digital platforms, but as a transformation of teaching–learning processes that prioritize pedagogical coherence, learner engagement, and contextualized learning experiences (Rumi et al., 2023). In many cases, digital learning is better understood as a media transformation, not a transformation of the learning process (Noviani et al., 2025; Rosardi & Widiastuti, 2025). This condition shows that the availability of technology alone is not enough to guarantee the quality of learning.

OECD (2021) further emphasizes that effective digital learning environments must support student agency, reflective thinking, and meaningful engagement to enable deep learning and long-term competence development. Within the framework of modern learning theory, instructional strategies are required not merely to transfer content into digital formats, but to intentionally design learning experiences that are deep, meaningful, and holistic. Such strategies should respect the limitations of human cognition while simultaneously supporting students' conceptual understanding and learning motivation (Rahmandani et al.). In digital learning environments particularly those utilizing multimedia elements such as text, images, and video poorly designed instruction can overload students' working memory, leading to excessive cognitive load that hinders information processing, conceptual understanding, and long-term retention rather than enhancing learning outcomes (Damayanti, 2019). Beyond its cognitive consequences, excessive cognitive load may also negatively affect students' motivation, engagement, and emotional involvement in learning activities.

Research in cognitive science consistently demonstrates that unmanaged cognitive load disrupts working memory processes, limits schema construction, and reduces learners' capacity to engage in higher-order thinking and conceptual integration (Sweller et al., 2019; Mayer, 2020). Therefore, effective digital learning design must not only manage cognitive load to support deep conceptual understanding, but also foster motivational and affective conditions that encourage sustained engagement and meaningful learning. This view aligns with the argument that digital learning becomes effective only when instructional design moves beyond technology use toward pedagogically driven, reflective, and learner-centered learning experiences (Rumi et al., 2023). Studies on student engagement indicate that learning designs integrating cognitive challenge with emotional and motivational support lead to higher persistence, deeper understanding, and more positive learning experiences (Fredricks, Filsecker, & Lawson, 2016; D'Mello & Graesser, 2014).

In addition to the cognitive aspect, the educational literature highlights the importance of conscious, meaningful, and enjoyable learning as part of a holistic approach. Mindful Learning Approach in Research conducted by Hasanah (2025) encourage students to be fully present mentally paying attention to the learning process consciously, reflectively, and with focus. The Meaningful Learning approach ensures that the material learned is relevant and contextualized so that students can relate new knowledge to their real experiences (Sorring et al., 2024). Meanwhile, Joyful Learning creates a positive, fun, and motivating learning atmosphere, so that students are more enthusiastic, engaged, and have the emotional energy to learn (Jannah et al., 2025; Rosardi & Widiastuti, 2025). Empirical studies show that emotional engagement and positive learning experiences play a critical role in sustaining students' intrinsic motivation and supporting long-term learning outcomes in digital environments (Pekrun, 2018; Vo & Ho, 2024).

Approaches that integrate these three elements within the framework of Deep Learning in education have received attention. Deep Learning here does not refer to machine learning algorithms, but to human learning, namely the process of deep thinking, reflection, conceptual understanding, internalization, and application in a real context (Wibowo et al., 2025). The integration of mindful, meaningful, and joyful learning is believed to be able to create a holistic learning experience that strengthens students' cognition and affection (Feriyanto & Anjariyah, 2024; Nafi'ah & Faruq, 2025a). From a constructivist perspective, deep learning occurs when learners actively construct meaning through reflection, contextualization, and emotionally supportive learning environments (Entwistle &

Ramsden, 2015; Biggs & Tang, 2011).

A number of literature reviews confirm the positive potential of deep learning, for example, the integration of mindful, meaningful, joyful learning in deep learning can increase active student engagement, deepen conceptual understanding, and increase motivation and enthusiasm for learning (Diputera & Eza, 2024; Marfu'ah & Dewi, 2025; Salong & Ansiska, 2025). However, most of these studies are conceptual or literature reviews, and not many have tested empirically, especially in the context of digital learning and with comprehensive quantitative & qualitative measurements. Recent international reviews highlight the need for empirical studies that combine cognitive outcomes and affective outcomes to better understand how deep learning processes unfold in digital learning contexts (OECD, 2021; Mayer, 2020).

A review of the empirical literature in the context of digital learning, particularly related to students' cognitive load, shows that without proper instructional design, digital learning can cause excessive cognitive load and interfere with information processing and memory retention (Skulmowski & Xu, 2022). On the other hand, if the learning design follows the principles of Cognitive Science, information can be processed more effectively, unnecessary cognitive burdens can be reduced, and students can more easily achieve deep understanding (Putra et al., 2025). This evidence suggests that instructional designs grounded in cognitive science principles are essential for enabling deep conceptual learning rather than surface-level memorization (Sweller et al., 2019; Oberauer, 2019).

Thus, there is a research gap, namely there are many writings on deep learning and the integration of mindful, meaningful, joyful learning, but few evaluate the effectiveness empirically, with quantitative and qualitative design, in the context of digital learning in schools. This is especially relevant in the era of digital education and massive online learning, especially given the challenges of cognitive load, motivation, and emotional engagement of students. Furthermore, limited studies have examined how mindful, meaningful, and joyful learning simultaneously support cognitive processing, emotional engagement, and learning motivation within a single empirical framework (Fredricks et al., 2016; D'Mello & Graesser, 2014).

This research is here to answer this through a mixed method approach with Explanatory Sequential Design. The preliminary study involved teachers, students, and digital education experts, which showed the need to implement cognitive science-based digital learning strategies, especially the integration of mindful, meaningful, and joyful learning in improving students' understanding of concepts and learning motivation.

Thus, this study offers a contribution that provides quantitative and qualitative empirical evidence on the effectiveness of the integration of mindful, meaningful, joyful learning in digital deep learning, in addition to expanding the theoretical framework by combining cognitive science and holistic pedagogy in a digital context, as well as providing practical implications for teachers, and education policymakers, that digital transformation must be accompanied by strategic transformation learning, not just media transformation.

Despite the growing body of literature on deep learning and the integration of mindful, meaningful, and joyful learning, most existing studies remain conceptual or descriptive, with limited empirical validation particularly in the context of digital learning grounded in cognitive science. Moreover, few studies simultaneously examine cognitive outcomes (conceptual understanding) and affective outcomes (learning motivation) using an integrated quantitative and qualitative approach. This study addresses this gap by providing empirical evidence on the effectiveness of a cognitive science based digital learning strategy through a mixed methods explanatory sequential design.

Based on this framework, the purpose of this study is to test the effectiveness of digital learning strategies based on mindful, meaningful, and joyful learning in improving students' conceptual understanding and learning motivation, as well as to describe how students and teachers experience the learning process qualitatively. This research is expected to provide theoretical benefits, strengthen the literature on deep learning in digital education, as well as practical benefits: help schools and educators design digital learning that is more human, effective, and meaningful for students in the modern era.

RESEARCH METHODS

Research Design

This study employed a mixed methods approach using an Explanatory Sequential Design, which involves a two-phase research process. The study began with the collection and analysis of quantitative data, followed by qualitative data collection and analysis aimed at explaining and deepening the quantitative findings. This approach enabled a more comprehensive understanding of the effectiveness of cognitive-science-based digital learning strategies through the integration of mindful, meaningful, and joyful learning. The overall structure of the explanatory sequential mixed methods design, including the quantitative phase, qualitative phase, and data integration process, is illustrated in Figure 1.

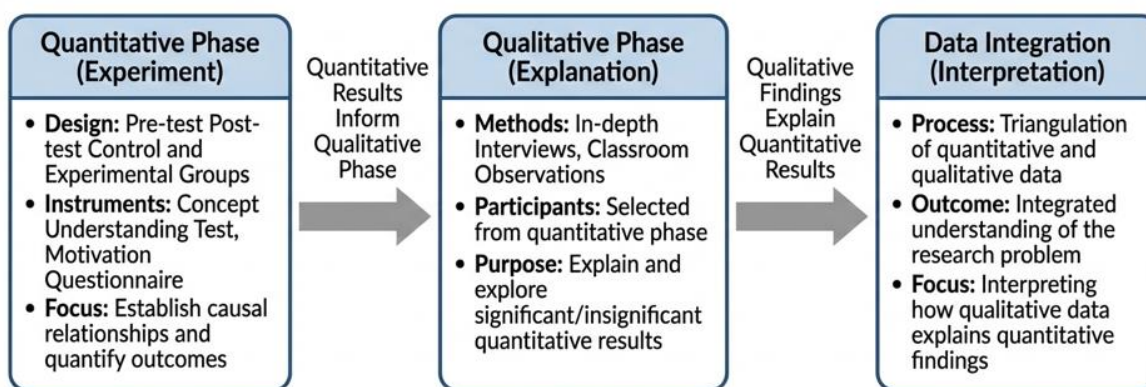


Figure 1. Explanatory Sequential Mixed Methods Design

Research Subject

The participants of this study were 60 fourth-grade elementary school students in Majene Regency, consisting of 30 students in the experimental group and 30 students in the control group. The sampling technique used was cluster random sampling, in which intact classes were randomly selected and assigned as either the experimental or control group. This technique was considered appropriate for educational research conducted in school settings that utilize intact classroom groups.

Experimental Design

This study adopted a quasi-experimental design using a pretest–posttest control group design. Both groups were administered a pretest to measure students' conceptual understanding and learning motivation prior to the intervention. The experimental group then received instruction through digital learning integrated with mindful, meaningful, and joyful learning approaches, while the control group participated in conventional digital learning. After the intervention, both groups were given a posttest to assess changes in students' conceptual understanding and learning motivation.

The learning intervention was conducted over four weeks (eight sessions), which was considered an adequate duration to observe the effects of digital learning on students' cognitive and affective outcomes.

Learning Intervention

The learning intervention implemented in the experimental group was designed based on cognitive science principles within a deep learning framework, integrating three main approaches:

a. Mindful Learning

Students were encouraged to engage in conscious learning through initial focusing activities, short reflective moments, and awareness of their thinking processes. Mindful practices were implemented through reflective questions, thinking pauses, and end of lesson reflections supported by interactive video media.

b. Meaningful Learning

Learning materials were contextualized by linking concepts to students' real-life experiences. Students were guided to connect new concepts with everyday situations through contextual discussions and visual exploration using the Assemblr EDU platform.

c. Joyful Learning

Learning activities were designed to be interactive and enjoyable through the use of interactive videos, digital quizzes, collaborative discussions, and 3D visual activities using Assemblr EDU. These activities aimed to create a positive and motivating learning environment.

The control group followed conventional digital learning, which focused primarily on content delivery through presentation slides and instructional videos without systematic integration of mindful, meaningful, and joyful learning strategies.

Instruments and Data Collection Techniques

- Quantitative data were collected using a conceptual understanding test, consisting of multiple-choice and short-answer questions. A learning motivation questionnaire, using a Likert scale.
- Qualitative data were collected through Semi-structured interviews with teachers and students. Digital classroom observations, aimed at examining students' engagement, interaction, and reflective activities.

Data Analysis Techniques

Quantitative data were analyzed using inferential statistics, specifically an independent samples t-test, to determine differences in gains in conceptual understanding and learning motivation between the experimental and control groups. Qualitative data were analyzed using thematic analysis to identify patterns in students' and teachers' learning experiences. Finally, quantitative and qualitative findings were integrated through triangulation to produce more comprehensive and robust conclusions.

RESULTS AND DISCUSSION

Conceptual Understanding

Experiments conducted on two groups of students the control group and the experimental group, each consisting of 30 participants revealed significant differences in the improvement of conceptual understanding. The experimental group, which received the digital learning intervention based on mindful, meaningful, and joyful learning, demonstrated a substantially higher increase in mean conceptual understanding scores compared to the control group, which experienced conventional digital instruction. This finding provides initial empirical evidence that instructional strategies grounded in cognitive science principles can meaningfully enhance students' learning outcomes.

Table 1. Independent samples t-test results of students' conceptual understanding gain scores

Group	N	Mean Gain	Std. Deviation	Std. Error Mean	Sig.(2-tailed)
Control	30	3.12	2.95	0.54	
Experiment	30	14.23	3.87	0.71	0.000 (<0.05)

Prior to conducting the Independent Samples t-test, data were examined for statistical assumptions. The results of the normality test (Kolmogorov-Smirnov) indicated that the data were normally distributed ($p > 0.05$), while the homogeneity of variance test (Levene's test) confirmed equal variances between groups ($p > 0.05$). These results validate the use of parametric t-test analysis.

The t-test results revealed a statistically significant difference between the two groups ($p < 0.05$). The experimental group achieved a mean gain of 14.23, far exceeding the control group's gain of 3.12. These findings indicate that the integration of mindful, meaningful, and joyful learning not only diversifies instructional practices but also strengthens students' conceptual internalization processes. This result aligns with cognitive science perspectives emphasizing the critical roles of attention, working memory activation, and reflective awareness in supporting deep learning processes (Oberauer, 2019). These findings are consistent with Mayer's Cognitive Theory of Multimedia Learning, which posits that meaningful learning occurs when learners actively select, organize, and integrate information within their working memory (Mayer, 2020). By integrating mindful reflection and meaningful contextualization, the instructional design in this study supported generative cognitive processing, thereby enhancing conceptual understanding.

Furthermore, Sweller et al. (2019) argue that instructional designs that reduce extraneous cognitive load and promote germane processing facilitate deeper conceptual learning. The present findings suggest that mindful, meaningful, and joyful learning helped optimize cognitive load by directing students' attention toward essential information and reflective processing. Recent studies in educational psychology indicate that learning designs which integrate reflection, contextualization, and active cognitive engagement significantly enhance conceptual understanding by facilitating deeper schema construction and knowledge transfer (Chi & Wylie, 2014; Hattie & Donoghue, 2016).

Research on generative learning further supports that students achieve stronger conceptual understanding when instructional activities require them to actively organize, elaborate, and reflect on information rather than passively receive content (Fiorella & Mayer, 2015). Empirical evidence from digital learning contexts also demonstrates that reflective and cognitively demanding learning tasks promote deeper conceptual change and reduce reliance on surface memorization strategies (Kalyuga, 2020).

Learning Motivation

In addition to cognitive outcomes, this study examined the effects of the instructional strategy on students' affective outcomes, particularly learning motivation. Motivation is a key determinant of learning success, as it directly influences student engagement, participation, and learning persistence.

Table 2. Independent samples t-test results of students' learning motivation gain scores

Group	N	Mean Gain	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Control	30	3.05	2.80	0.51	
Experiment	30	13.12	3.65	0.67	0.000 (<0.05)

The Independent Samples t-test indicated a significant difference in learning motivation gains between the two groups ($p < 0.05$). The experimental group demonstrated a substantially higher increase in motivation (mean gain = 13.12) compared to the control group (mean gain = 3.05). These findings suggest that learning strategies emphasizing meaningful engagement and joyful experiences effectively foster students' intrinsic motivation, as learners feel more involved, valued, and encouraged to express themselves (Vo & Ho, 2024). Moreover, the results support the argument that humanistically designed digital learning environments promote a more positive and sustainable learning atmosphere (Wirth et al., 2020).

These findings are strongly supported by Self-Determination Theory, which emphasizes that intrinsic motivation develops when learners experience autonomy, competence, and relatedness in learning environments (Ryan & Deci, 2020). The mindful, meaningful, and joyful learning activities in this study provided opportunities for student choice, competence development, and positive social interaction.

Moreover, prior research has shown that emotionally supportive and enjoyable learning environments foster students' emotional engagement, which in turn enhances learning persistence and motivation (Fredricks et al., 2016; D'Mello & Graesser, 2014). The joyful and interactive digital activities implemented in this study appear to have contributed to such positive emotional

engagement. Studies on motivation in digital learning environments show that instructional designs supporting autonomy, relevance, and positive emotional experiences significantly strengthen students' intrinsic motivation and sustained engagement (Ryan & Deci, 2020; Schindler et al., 2017).

Research in affective learning science highlights that emotionally supportive learning environments increase students' willingness to invest effort, persist in challenging tasks, and engage more deeply with learning activities (Immordino-Yang et al., 2019).

To enrich and explain the quantitative results, qualitative data were collected through classroom observations and in-depth interviews with teachers and students. The analysis identified three main themes.

Table 3. Main themes and representative qualitative findings

Theme	Description	Representative Statement
Reflective Awareness	Students demonstrated increased awareness of their thinking processes through guided reflection activities.	<i>"When we stop and think about what we learned, it helps me understand the lesson better."</i> (Student)
Meaningful Learning Experiences	Learning content was perceived as more relevant because it was connected to real-life contexts.	<i>"The lesson feels closer to my daily life, so it's easier to understand."</i> (Student)
Positive Emotional Engagement	Interactive digital activities created an enjoyable and motivating learning environment.	<i>"Students were more active and enthusiastic during discussions."</i> (Teacher)

These qualitative findings indicate that teachers perceived the instructional strategy as facilitating more structured and interactive learning activities. Students reported that learning became more enjoyable and meaningful because concepts were connected to authentic experiences rather than rote memorization. Classroom observations further revealed increased student interaction, active participation, and emotional engagement facilitated by mindful reflection. Thus, qualitative data reinforce the quantitative results that show that this strategy is effective in both the cognitive and affective domains (Nafi'ah & Faruq, 2025). Qualitative studies in digital pedagogy suggest that reflective awareness activities enable learners to monitor their understanding, regulate cognitive effort, and develop metacognitive control over learning processes (Zimmerman, 2013; Azevedo et al., 2019).

Research on contextual learning further confirms that linking instructional content to learners' real-life experiences enhances meaning-making and supports durable learning outcomes (Herrington et al., 2014).

Integration of Quantitative and Qualitative Findings

The integration of quantitative and qualitative data through triangulation revealed strong consistency between statistical outcomes and participants' lived learning experiences. Quantitatively, students in the experimental group demonstrated significantly higher gains in both conceptual understanding and learning motivation ($p < 0.05$). Qualitatively, these gains were explained by increased reflective awareness, meaningful knowledge transfer, and higher-level cognitive engagement during learning activities.

These results reinforce cognitive science perspectives that deep learning emerges when instructional designs actively support attention regulation, working memory engagement, reflective processes, and meaning-making (Oberauer, 2019; Chen & Singh, 2024). In this context, deep learning was not merely reflected in higher test scores but also in students' ability to connect concepts with authentic experiences and engage cognitively and emotionally with the learning process.

From a deep learning perspective, these findings suggest that meaningful learning occurs when students are cognitively engaged in reflection, actively construct understanding, and transfer knowledge to authentic contexts (Entwistle & Ramsden, 2015; Biggs & Tang, 2011). The integration of mindful reflection, contextual meaning-making, and joyful engagement facilitated higher-order cognitive processing rather than surface-level memorization. This aligns with OECD (2021), which emphasizes that deep learning in digital environments is characterized by student agency, reflective thinking, and emotionally supportive learning contexts. The convergence of quantitative learning gains and qualitative experiential data aligns with contemporary models of deep learning, which emphasize the interaction between cognitive processing, emotional engagement, and reflective meaning-making (Fullan et al., 2018). Evidence from interdisciplinary learning research indicates that deep learning environments emerge when instructional designs intentionally integrate cognitive challenge with emotional safety and reflective practices (Darling-Hammond et al., 2020).

Overall, the findings confirm that digital learning strategies grounded in cognitive science and implemented through mindful, meaningful, and joyful learning effectively enhance both cognitive and affective learning outcomes. These results affirm that deep learning in digital environments is achieved when instructional designs intentionally support reflection, meaning-making, and higher-level cognitive engagement, rather than focusing solely on content delivery or technological features.

CONCLUSION

This study contributes to the literature on digital learning by providing empirical evidence that integrating mindful, meaningful, and joyful learning within a cognitive science framework effectively supports deep learning processes. Specifically, the findings demonstrate that deep learning in digital environments emerges when instructional designs intentionally foster reflective awareness, meaning-making, and higher-order cognitive engagement, rather than focusing solely on content delivery or technological features.

The results indicate that digital learning strategies grounded in mindful, meaningful, and joyful learning are effective in enhancing both students' conceptual understanding and learning motivation. The integration of conscious reflection, contextualized learning experiences, and emotionally positive interactions enables students to actively process information, internalize concepts, and sustain engagement throughout the learning process. These findings confirm that learning effectiveness in digital environments is closely linked to how instructional designs align with human cognitive and affective processes.

Furthermore, the findings affirm that deep learning is achieved when learners are encouraged to reflect consciously on their thinking, connect new knowledge with prior experiences, and engage in higher-order cognitive activities. Mindful learning supports focused attention and metacognitive awareness, meaningful learning facilitates the transfer of concepts to real-life contexts, and joyful learning nurtures intrinsic motivation and emotional engagement. Together, these elements form a holistic learning experience that strengthens both cognitive and affective outcomes.

This study emphasizes that digital transformation in education should be accompanied by pedagogical transformation. Designing digital learning environments based on cognitive science and holistic pedagogy is essential to ensure that learning is not only technologically advanced but also meaningful, motivating, and sustainable for students. These findings provide practical implications for educators and policymakers in developing human-centered digital learning practices that genuinely promote deep learning.

ACKNOWLEDGMENTS

The researcher expressed his appreciation and gratitude to all parties who have provided support in the implementation of this research. Special thanks are extended to the teachers and students who participated as respondents, as well as the digital education experts who have provided valuable input at the preliminary study stage. The researcher also thanked the school and related institutions who facilitated the data collection process, as well as fellow academics who provided feedback during

the preparation of the research instrument and analysis. Without the support and cooperation of all parties, this research could not be carried out properly.

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