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INTEGRATING COGNITIVE LOAD, MULTIMEDIA LEARNING, FLIPPED CLASSROOM, AND SELF-EFFICACY: A SYSTEMATIC LITERATURE REVIEW

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Abstract

This systematic literature review examines the integration of Cognitive Load Theory (CLT), Multimedia Learning (ML), Flipped Classroom (FC) pedagogy, and Self-Efficacy (SE) in technology-mediated education. As digital learning environments become more complex, there is increasing demand for approaches that address both cognitive processes and learner motivation. While CLT and ML have traditionally guided instructional design, the rise of flipped classroom models has shifted attention toward learner autonomy, engagement, and psychological readiness. However, the relationships among these constructs remain insufficiently synthesized. Using a structured review protocol, this study analyzes peer-reviewed research through thematic synthesis and bibliometric mapping to identify conceptual relationships and research trends. The findings indicate that CLT provides the foundational principles for instructional design, while ML applies these principles to digital learning practices. The flipped classroom is mainly viewed as a pedagogical approach that promotes active and flexible learning. Self-efficacy consistently emerges as a key factor influencing learning performance, often functioning as a mediating or moderating variable. This review proposes an integrated cognitive–motivational framework that highlights interactions among instructional design, learner beliefs, and engagement in flipped learning environments.

Keywords: *Cognitive Load Theory; Multimedia Learning; Flipped Classroom; Self-Efficacy; Systematic Review.*

INTRODUCTION

The rapid development of digital technology has significantly transformed educational practices across schools and universities worldwide. Since the expansion of online and blended learning environments, especially after the acceleration of digital education in recent years, educators have increasingly relied on learning management systems, instructional videos, virtual classrooms, and interactive multimedia resources to facilitate teaching and learning processes. These changes have encouraged the implementation of more flexible and student-centered instructional models, one of which is the Flipped Classroom approach. In flipped classroom environments, students are expected to study learning materials independently before attending classroom sessions, while class meetings are used for discussion, collaborative activities, and problem-solving exercises. This model is widely promoted because it allows classroom interaction to become more active and meaningful. However, in practice, many students still experience difficulties adapting to independent learning demands, particularly when they are required to understand complex instructional materials through digital media without continuous teacher guidance. As a result, learning outcomes in flipped environments often vary depending on students' readiness, instructional design quality, and learning support systems.

One of the major issues emerging in technology-enhanced learning environments is the increasing amount of information students must process simultaneously. In many online and flipped learning situations, students are required to watch lengthy instructional videos, read digital texts, interpret graphics, listen to narration, and complete interactive assignments within a limited period of time. Although multimedia technologies are designed to improve learning accessibility and engagement, excessive or poorly structured information may instead create confusion and cognitive overload. This phenomenon can be explained through Cognitive Load Theory (CLT), introduced by Sweller et al. (1988), which emphasizes that human working memory has limited processing capacity. When instructional materials exceed learners' cognitive capacity, students may struggle to process information effectively, resulting in lower comprehension, reduced concentration, and poor learning performance. For example, students in online courses frequently report difficulty understanding instructional videos that contain excessive text, complex explanations, or distracting visual elements. Empirical studies have consistently demonstrated that reducing unnecessary cognitive load through structured instructional design improves students' ability to understand concepts and solve problems more effectively. Therefore, understanding how cognitive load operates within digital learning environments has become increasingly important for educators and instructional designers.

The relevance of CLT in digital education is further strengthened through the development of Multimedia Learning theory proposed by Mayer (2009). Multimedia learning theory explains that meaningful learning occurs when learners can integrate verbal and visual information in ways that support cognitive processing without overloading working memory. In contemporary educational settings, multimedia instruction has become a central component of online and flipped learning environments. Universities and schools commonly use instructional videos, animation-based explanations, digital presentations, and interactive learning applications to

improve learning accessibility and engagement. Nevertheless, the effectiveness of multimedia instruction depends not merely on the use of technology itself, but on how instructional materials are designed. In many cases, digital instructional materials prioritize visual attractiveness rather than cognitive efficiency. Long videos without segmentation, redundant narration, excessive animation, or irrelevant decorative visuals can distract learners and reduce instructional effectiveness. Mayer's multimedia principles, including coherence, signaling, redundancy reduction, and segmenting, therefore provide essential guidelines for developing effective digital learning resources. Previous studies show that students learn more effectively when multimedia materials are concise, well-organized, and cognitively manageable. This suggests that multimedia learning design plays a critical role in supporting successful flipped classroom implementation.

At the pedagogical level, flipped classroom implementation has also shifted greater responsibility for learning from teachers to students. Unlike traditional classrooms where teachers directly explain concepts during class sessions, flipped learning requires students to prepare independently before participating in classroom discussions and collaborative activities. While this approach offers opportunities for deeper learning and active participation, it also creates challenges related to learner motivation, persistence, and confidence. In this context, Self-Efficacy, introduced by Bandura (1997), becomes highly relevant in understanding students' success in digital learning environments. Self-efficacy refers to learners' beliefs in their ability to complete learning tasks successfully and overcome academic difficulties. In online and flipped learning contexts, students with strong self-efficacy are generally more confident in managing independent study activities, engaging with challenging instructional materials, and persisting when encountering difficulties. Conversely, students with low self-efficacy often experience anxiety, disengagement, and frustration when faced with cognitively demanding multimedia tasks. For instance, students who perceive instructional videos as too complicated or difficult to follow may lose confidence in their ability to learn independently, which eventually affects their participation and academic achievement. Several empirical studies further indicate that self-efficacy functions as a mediating factor between instructional design and learning outcomes, highlighting the close relationship between cognitive and motivational dimensions in digital education.

Despite extensive research concerning cognitive load, multimedia learning, flipped classroom pedagogy, and self-efficacy, existing literature remains fragmented and tends to examine these constructs separately. Studies on cognitive load primarily focus on instructional efficiency and mental processing, multimedia learning research emphasizes the optimization of digital instructional materials, flipped classroom studies investigate pedagogical restructuring and student engagement, while self-efficacy research concentrates on learner motivation and psychological readiness. In actual educational practice, however, these dimensions interact continuously within the same learning environment. A poorly designed instructional video in a flipped classroom may simultaneously increase cognitive overload, reduce learner confidence, and decrease classroom participation. On the other hand, well-structured multimedia materials supported by effective instructional strategies may reduce cognitive burden, strengthen self-efficacy, and improve learning engagement simultaneously. The lack of integrative

studies examining these relationships creates an important theoretical and practical gap in educational technology research. Without a comprehensive understanding of how cognitive, pedagogical, and motivational factors interact, educational institutions may continue implementing digital learning innovations without fully addressing the challenges experienced by learners. Therefore, this systematic literature review aims to synthesize previous studies on the integration of Cognitive Load Theory, Multimedia Learning, Flipped Classroom, and Self-Efficacy to develop a more comprehensive understanding of effective technology-enhanced learning. Specifically, this study seeks to examine how these constructs are conceptually connected and how their interaction influences learning effectiveness in digital education contexts.

METHODS

This study employed a systematic and structured methodological approach to examine the relationships among Cognitive Load Theory, Multimedia Learning, Flipped Classroom pedagogy, and Self-Efficacy in technology-enhanced learning environments. Considering that previous studies discussing these constructs are often fragmented and distributed across different educational perspectives, a comprehensive review method was necessary to synthesize conceptual relationships, identify recurring patterns, and evaluate the current direction of research development. This chapter explains the methodological procedures used in the review process, including the research design, review protocol, search strategy, inclusion and exclusion criteria, screening procedures, eligibility assessment, data extraction and coding, quality appraisal, data synthesis techniques, and review process flow. Through a systematic methodological framework, the study aims to ensure that the review process is transparent, rigorous, and replicable while providing a comprehensive understanding of how cognitive, instructional, pedagogical, and motivational dimensions interact in digital learning contexts. According to Tranfield et al. (2003), systematic review methods are particularly valuable for consolidating fragmented evidence and strengthening theoretical integration across interdisciplinary fields of research.

Research Design and Review Protocol

This study employed a systematic literature review (SLR) design to synthesize empirical evidence on the integration of cognitive load, multimedia learning, flipped classroom pedagogy, and self-efficacy in digital learning contexts. The review protocol was developed a priori and structured in accordance with the PRISMA framework to ensure transparency, replicability, and methodological rigor. According to Moher et al. (2009), the PRISMA framework provides standardized procedures for reporting systematic reviews in a transparent and comprehensive manner, thereby improving the reliability and reproducibility of review findings. The review process comprised four sequential stages: identification, screening, eligibility assessment, and inclusion.

The use of the systematic literature review approach in this study was intended to provide a structured and evidence-based synthesis of previous empirical findings related to digital learning effectiveness. Unlike traditional narrative reviews that often rely on selective interpretation, the SLR approach applies explicit procedures for identifying, evaluating, and synthesizing relevant studies systematically. Xiao et al. (2019) emphasize

that systematic reviews improve research credibility because the review process is conducted using predefined criteria that reduce subjectivity and selection bias. The adoption of the PRISMA framework further strengthens the methodological quality of the review by ensuring that article selection procedures are transparent and can be replicated by other researchers. This approach is particularly relevant to the present study because the concepts of cognitive load, multimedia learning, flipped classroom, and self-efficacy originate from different theoretical traditions and are frequently examined independently. Through a systematic review protocol, the study seeks to identify how these constructs are conceptually interconnected, how they influence one another in technology-mediated learning environments, and how previous empirical studies collectively contribute to the development of a more integrated framework for understanding digital learning processes.

Search Strategy

To identify relevant studies systematically, this review employed a structured search strategy using Boolean operators and keyword combinations related to the main constructs of the study, namely Cognitive Load Theory, Multimedia Learning, Flipped Classroom, and Self-Efficacy. The search strategy was designed to capture empirical studies discussing the interaction between cognitive, pedagogical, and motivational aspects in technology-enhanced learning environments.

The following Boolean search string was applied during the identification process: ("cognitive load") AND ("flipped classroom" OR "flipped learning") AND ("self-efficacy") AND ("multimedia learning" OR "multimedia instruction"). The use of alternative terms such as “flipped learning” and “multimedia instruction” was intended to capture variations in terminology commonly used in educational technology research. Searches were conducted through peer-reviewed academic database exports, including journal articles and conference proceedings. Only studies written in English and published in scholarly outlets were included to ensure academic quality and consistency.

No initial restriction was placed on publication year in order to capture the broader development of the constructs examined in this review. The identification phase yielded 200 records related to digital learning, multimedia instruction, flipped classroom implementation, and learner motivation. However, only a limited number of studies explicitly integrated all core constructs within the same research framework, indicating that integrative research in this area remains relatively limited.

Inclusion and Exclusion Criteria

Explicit inclusion and exclusion criteria were defined prior to the screening process to minimize selection bias and ensure that only relevant studies were included in the review.

Inclusion Criteria:

1. Empirical quantitative, qualitative, or mixed-methods research.
2. Explicit examination of at least three of the following constructs: Cognitive Load Theory, Flipped Classroom, Multimedia Learning, and Self-Efficacy.
3. Conducted within digital, blended, or technology-enhanced learning contexts.
4. Published in peer-reviewed journals or conference proceedings.

Exclusion Criteria:

1. Conceptual papers, editorials, or book chapters without empirical data.
2. Studies not situated in instructional or educational contexts.
3. Articles lacking measurable outcomes related to learning performance or psychological constructs.

These criteria were applied to ensure that the selected studies provided empirical evidence relevant to the objectives of this systematic literature review.

Screening Procedure

The screening stage involved automated keyword detection within titles and abstracts followed by manual verification to ensure the relevance of each study to the objectives of the review. During this process, articles were examined based on the presence of the core constructs related to Cognitive Load Theory, Flipped Classroom, Multimedia Learning, and Self-Efficacy within the titles, abstracts, and keywords of the identified records.

Keyword distribution across the 200 identified records revealed:

1. 42 records containing “cognitive load”
2. 71 records containing “flipped classroom” or “flipped learning”
3. 103 records containing “self-efficacy”

Studies that did not explicitly mention or discuss the core constructs were excluded from further analysis. In addition, duplicate records retrieved from multiple database sources were identified and removed to avoid redundancy during the review process. The title and abstract screening stage also revealed that many studies focused only on a single construct, such as self-efficacy or flipped classroom implementation, without examining their integration with cognitive load or multimedia learning perspectives. Consequently, 193 records were excluded due to insufficient construct integration and limited relevance to the objectives of this systematic literature review.

Eligibility Assessment

A full-text eligibility assessment was conducted for all studies that met the initial screening criteria. During this stage, each article was carefully reviewed to determine its relevance and methodological alignment with the objectives of the review. The assessment was guided by predefined inclusion criteria to ensure consistency and rigor in the selection process. Specifically, studies were included only if they fulfilled the following conditions:

1. Cognitive load was explicitly measured or clearly operationalized, including dimensions such as intrinsic, extraneous, or germane cognitive load;
2. A flipped classroom approach was implemented as the primary instructional intervention or learning strategy;
3. Self-efficacy was examined as a psychological construct, either as a mediator, moderator, predictor, or outcome variable related to learning performance or student engagement.

In addition, studies were evaluated for the clarity of their research design, the adequacy of data reporting, and the relevance of their participant population to the context of the review. Articles that did not sufficiently address these variables, lacked empirical data, or used unrelated instructional approaches were excluded from further analysis.

Following the full-text evaluation process, a total of seven studies satisfied all eligibility requirements and were therefore included in the final synthesis. These studies formed the basis for the qualitative analysis and interpretation presented in this review.

Data Extraction and Coding

To ensure a systematic and transparent synthesis process, a structured data extraction matrix was developed and applied to all included studies. The matrix served as a standardized framework for organizing and comparing relevant information across studies, thereby facilitating consistency in analysis and interpretation. Each article was reviewed in detail, and key study characteristics and findings were coded according to predetermined categories.

The following information was extracted from each study:

1. Author(s) and year of publication;
2. Research design (e.g., experimental, quasi-experimental, correlational, or mixed methods);
3. Sample characteristics, including participant demographics, educational level, and sample size;
4. The operationalization and measurement of cognitive load, including whether intrinsic, extraneous, or germane load was assessed;
5. A description of the flipped classroom implementation, such as the use of pre-class videos, in-class collaborative activities, or digital learning platforms;
6. Measurement instruments or indicators used to assess self-efficacy;
7. Reported statistical relationships among cognitive load, flipped classroom practices, and self-efficacy;
8. Key findings and conclusions relevant to the objectives of the review.

In addition to descriptive coding, attention was also given to methodological details such as data collection procedures, analytical techniques, and the context in which the intervention was implemented. This allowed for a more nuanced understanding of how different instructional designs and learner variables influenced outcomes.

To enhance methodological rigor and minimize subjectivity, all coding categories were defined prior to the analysis process. Clear operational definitions were established to maintain consistency in interpreting study variables and findings. In cases where information within a study appeared ambiguous or open to multiple interpretations, cross-verification procedures were conducted by re-examining the original text and comparing interpretations across coding categories. This process helped ensure interpretive consistency, reliability, and accuracy throughout the synthesis stage.

Quality Appraisal

The methodological quality of the included studies was assessed using structured appraisal criteria to ensure the credibility and reliability of the findings. The evaluation focused on:

1. Clarity and appropriateness of the research design,
2. Validity and reliability of measurement instruments,
3. Appropriateness of statistical analyses,
4. Transparency of data analysis and reporting procedures.

Studies were reviewed to determine whether their methods, instruments, and analytical approaches were clearly described and aligned with the research objectives. Particular attention was given to the measurement of cognitive load and self-efficacy, including the use of validated instruments and suitable statistical techniques.

Overall, all included studies demonstrated acceptable methodological quality and were considered appropriate for inclusion in the review. However, some variability was observed in the operationalization of cognitive load and the precision of measurement instruments across studies.

Data Synthesis

A thematic synthesis approach was employed to identify recurring patterns across studies and develop an integrative understanding of the relationships among flipped classroom instruction, cognitive load, and self-efficacy. A qualitative synthesis was considered more appropriate than a meta-analysis due to substantial heterogeneity in:

1. Measurement instruments,
2. Flipped classroom implementation strategies,
3. Statistical models and analytical approaches,
4. Sample characteristics and educational contexts.

The synthesis focused on examining how instructional design influenced cognitive processing and motivational outcomes, particularly the mediating and moderating roles of self-efficacy and cognitive load. Through cross-study comparison, key themes and explanatory mechanisms were identified to provide a comprehensive interpretation of the findings.

Review Process Flow

The review process resulted in the following study selection distribution:

1. Records identified: $n = 200$
2. Records screened: $n = 200$
3. Records excluded after title and abstract screening: $n = 193$
4. Full-text articles assessed for eligibility: $n = 7$
5. Studies included in the qualitative synthesis: $n = 7$

The relatively low inclusion rate (3.5%) indicates that only a limited number of studies simultaneously examined cognitive load, flipped classroom pedagogy, and self-efficacy within a single research framework. This finding highlights the scarcity of

integrative research exploring the interaction between instructional design, cognitive processing, and motivational factors in educational settings.

RESULTS

This section presents the synthesis of findings obtained from the systematic literature review and bibliometric mapping analysis concerning cognitive load, multimedia learning, flipped classroom instruction, and self-efficacy. The results are organized into two major components: empirical findings derived from the selected studies and structural patterns identified through bibliometric visualization using VOSviewer. The integration of these approaches enables a comprehensive understanding of how instructional design, cognitive processes, and motivational factors interact within technology-enhanced learning environments. The discussion further interprets the findings in relation to existing theoretical perspectives and highlights the implications for future educational research and instructional practice.

Study Characteristics

The systematic screening and eligibility process resulted in the inclusion of seven empirical studies that simultaneously examined cognitive load, flipped classroom, multimedia learning, and self-efficacy. From approximately 200 initially identified records, only seven met all inclusion criteria, indicating that integrative investigations combining these variables remain limited despite the rapid growth of research on each construct independently.

Most studies were conducted in higher education contexts and employed quantitative, quasi-experimental, or mixed-method approaches. The dominant learning environments were technology-supported or blended instructional settings, particularly those utilizing multimedia-based flipped classroom models. Across the studies, cognitive load was commonly analyzed through the framework of Cognitive Load Theory (CLT), while self-efficacy was primarily conceptualized using social cognitive perspectives emphasizing learners' beliefs in their ability to complete academic tasks.

The characteristics of the selected studies also indicate a growing interdisciplinary orientation in educational research. The reviewed articles combined perspectives from instructional design, educational psychology, multimedia learning, and technology-enhanced pedagogy to investigate how learners respond cognitively and motivationally within flipped learning environments. Most studies focused on university students as participants, reflecting the widespread implementation of digital and blended learning models in higher education settings. In addition, the frequent use of experimental and quasi-experimental methods suggests that researchers increasingly seek to measure the direct effects of instructional interventions on cognitive load and self-efficacy outcomes. This methodological tendency demonstrates an effort to establish stronger empirical evidence regarding the effectiveness of flipped classroom strategies supported by multimedia learning principles.

The reviewed studies focused on several educational domains, including language learning, digital education, and technology-enhanced instruction. Multimedia components such as instructional videos, segmented content, interactive platforms, and

game-based learning environments were consistently incorporated within flipped classroom settings.

Synthesis of Empirical Findings

Table 1. Summary of Included Studies and Key Findings

No	Title	Findings
1	The Impact of Game-Based Learning on Student Cognitive Load and Self-Efficacy in a Flipped Classroom	Game-based flipped instruction reduced extraneous cognitive load and enhanced self-efficacy. Self-efficacy mediated the relationship between instructional design and academic achievement.
2	Optimizing Language Learning in Blended Environments through Flipped Instruction	Task complexity increased intrinsic load; however, flipped instructional structure facilitated cognitive regulation. Self-efficacy predicted adaptation to cognitively demanding tasks.
3	Examining the Effects of Task Complexity and Technology-Enhanced Flipped Learning	Multimedia scaffolding in flipped settings mitigated cognitive overload. Self-efficacy partially mediated the relationship between cognitive load and learning outcomes.
4	A Decade of Evolution in Flipped Classroom Innovation	Effective multimedia segmentation aligned with Cognitive Load Theory reduced overload and indirectly strengthened students' self-efficacy.
5	Mapping the Scientific Landscape of the Flipped Classroom	Bibliometric trends reveal increasing integration of motivational constructs, including self-efficacy, although direct measurement of cognitive load remains limited.
6	Improving Competence in Nonformal Digital Education Settings	Self-efficacy moderated the negative effects of high cognitive load on performance. High-efficacy learners demonstrated resilience under cognitively demanding conditions.
7	The Impact of Educational Digitalization on Learning Performance	Technology-rich environments increase risk of cognitive overload; digital competence and self-efficacy function as protective psychological mechanisms.

Synthesis of Bibliometric Mapping and Empirical Findings

The integration of bibliometric mapping with the synthesis of seven selected empirical studies strengthens the analytical depth of this review by combining structural and contextual perspectives. The bibliometric visualization (Figure 1 and Figure 2) provides a systematic overview of the intellectual landscape through the identification of dominant themes, keyword relationships, and emerging research trends, while the empirical studies validate and enrich these thematic clusters through contextual and methodological evidence. Together, the findings demonstrate how major research themes are interconnected and applied across different contexts, enabling a more comprehensive understanding of the field by linking macro-level scholarly patterns with practical research insights.

Thematic Structure Based on Co-occurrence Network

The keyword co-occurrence network generated using VOSviewer illustrates the conceptual structure and relationships among the main themes within the reviewed literature.

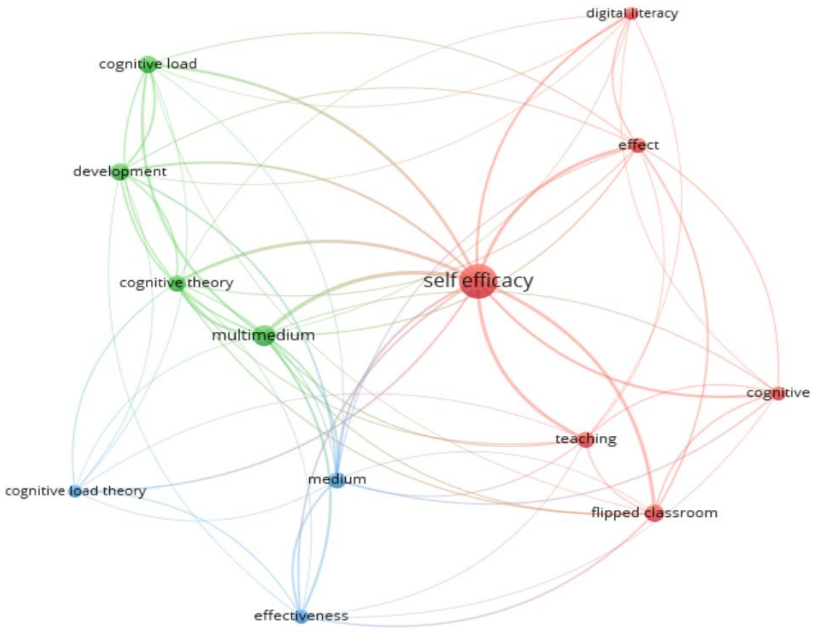

Figure 1. VOSviewer Data

In the visualization, self-efficacy appears as the most central and dominant node, highlighting its strong connection with several important constructs, including cognitive load, flipped classroom, teaching, digital literacy, effectiveness, and multimedium. The prominence of self-efficacy suggests that researchers consistently view it as a key factor influencing students' learning experiences and academic success, particularly in technology-supported and multimedia learning environments. Its central position also indicates that discussions surrounding instructional innovation and cognitive processes are frequently linked to learners' confidence in their ability to perform academic tasks effectively.

The network further reveals three major thematic clusters that shape the current research landscape. The first cluster, the Cognitive and Multimedia Learning Cluster, includes concepts such as cognitive load, cognitive load theory, cognitive theory, multimedium, and development. This cluster reflects the growing emphasis on designing multimedia learning environments that reduce unnecessary cognitive burden and improve students' comprehension. The second cluster, the Instructional Strategy Cluster, consists of themes related to flipped classroom, teaching, and medium, indicating strong scholarly attention toward innovative teaching approaches and the integration of digital media in instruction. Meanwhile, the third cluster, the Outcome and Digital Competency Cluster, includes effect, effectiveness, and digital literacy, highlighting research interests in evaluating learning outcomes and students' ability to adapt to digital learning environments.

The central positioning of self-efficacy across these clusters suggests that it serves as an important bridge connecting instructional strategies, cognitive processes, and educational outcomes. This pattern aligns closely with the findings of the seven empirical studies reviewed in this research, where self-efficacy frequently functions either as a dependent variable influenced by instructional design or as a mediating factor between learning strategies and academic performance. In many studies, students who experienced well-structured multimedia instruction or flipped classroom models reported higher confidence in their ability to understand content, solve problems, and complete learning tasks successfully. Furthermore, the strong relationship between cognitive load and self-efficacy in the network supports empirical evidence showing that reducing extraneous cognitive load through effective multimedia design can positively influence students' confidence and engagement. Overall, the thematic structure demonstrates that successful learning environments are not solely determined by instructional technology itself, but also by how these approaches shape students' cognitive experiences and beliefs about their own capabilities.

Density Visualization and Research Intensity

The density visualization of keyword occurrences provides further insight into the intensity and development of research themes within the dataset.

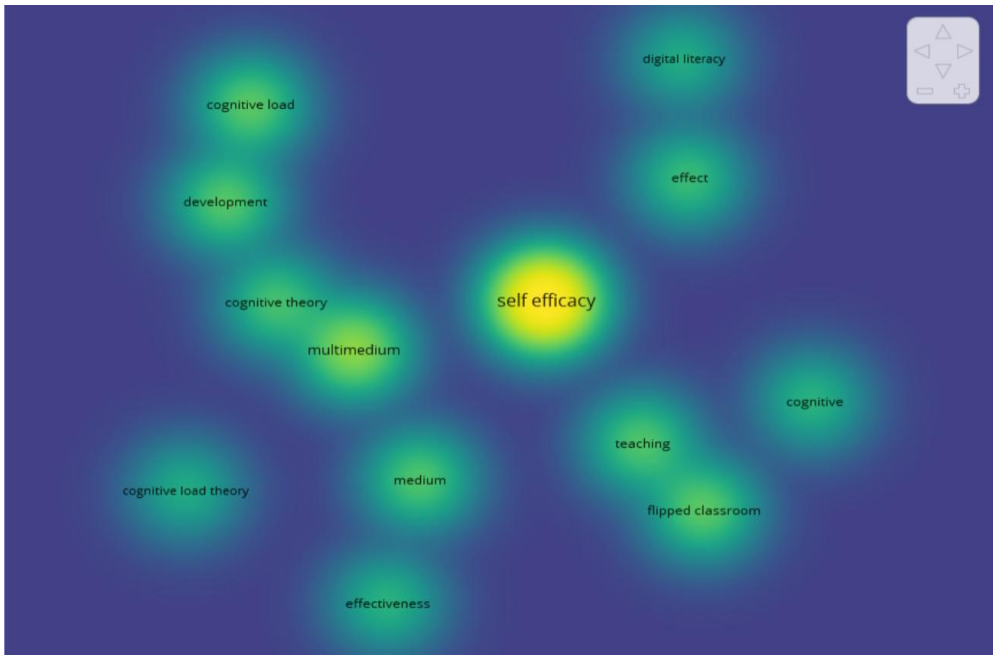

Figure 2. VOSviewer Analysis

In the VOSviewer map, the brightest area shown in the yellow spectrum is concentrated around self-efficacy, indicating that this concept has the highest frequency of occurrence and the strongest citation influence among all identified keywords. This finding suggests that self-efficacy has become a central focus in the scholarly conversation, particularly in studies related to learning effectiveness, instructional strategies, and educational technology. The prominence of this theme

reflects the growing recognition that students' beliefs in their own abilities significantly influence motivation, engagement, and academic performance across various learning environments.

Surrounding the central yellow area are green-colored clusters representing moderately developed themes such as cognitive load, digital literacy, and flipped classroom. These themes appear closely connected to self-efficacy, but they demonstrate a lower research density, indicating that they are still developing and expanding within the literature. The visualization suggests that studies exploring the relationship between self-efficacy and digital learning environments, particularly flipped classroom models and digital literacy, have gained increasing attention in recent years as educational practices become more technology-oriented. Researchers are increasingly interested in understanding how digital competencies and innovative instructional methods influence students' confidence and learning outcomes in both online and blended learning contexts.

The density pattern also highlights the continuing importance of cognitive load theory as a foundational theoretical framework in educational research. Although it appears less dominant than self-efficacy in the visualization, cognitive load remains strongly connected to discussions about instructional design and multimedia learning. This indicates that scholars still rely on cognitive load theory to explain how learners process information and manage mental effort during learning activities. However, compared to self-efficacy research, studies that directly integrate cognitive load theory with digital pedagogy and technology-enhanced learning appear to be less extensive. Overall, the density visualization demonstrates that while self-efficacy research has reached a relatively mature and established stage, related areas such as digital literacy, flipped classroom implementation, and the integration of cognitive theories with digital pedagogy continue to evolve and offer significant opportunities for future investigation.

DISCUSSION

Integrated Thematic Synthesis with Empirical Evidence

The integration of bibliometric findings with empirical evidence provides a deeper understanding of how the identified themes interact within the broader educational research landscape. While the bibliometric mapping highlights the structural relationships among major concepts, the empirical studies offer practical and contextual explanations of how these relationships operate in real learning environments. Together, they reveal a consistent pattern showing that instructional design, cognitive processes, and learner psychology are closely interconnected. In particular, the synthesis demonstrates that self-efficacy does not develop independently, but is strongly influenced by the quality of instructional strategies and the cognitive demands experienced by learners. This integrated perspective therefore serves as a bridge between theoretical mapping and practical educational outcomes, allowing for a more comprehensive interpretation of the thematic clusters identified in the bibliometric analysis.

Instructional Design → Cognitive Load → Self-Efficacy

Several empirical studies reviewed in this research demonstrate that well-structured instructional design, particularly through multimedia environments and flipped classroom models, can significantly reduce students' extraneous cognitive load. This finding closely aligns with the bibliometric cluster connecting cognitive load, multimedium, and development, indicating a strong conceptual relationship between instructional design and learners' cognitive experiences. In practice, instructional approaches that present information in a clear, organized, and interactive manner help students process learning materials more efficiently and avoid unnecessary mental overload. Strategies such as instructional segmentation, guided multimedia presentation, and pre-class learning activities in flipped classrooms enable learners to focus their cognitive resources on understanding concepts rather than struggling with confusing or excessive information.

The empirical evidence further suggests that reducing cognitive overload positively influences students' perceptions of competence and control during learning activities. When students are able to process information more effectively, they tend to feel more confident in completing academic tasks and solving problems independently. This increased sense of competence contributes directly to stronger self-efficacy, which in turn enhances motivation, persistence, and overall academic performance. Therefore, the bibliometric centrality of *self-efficacy* is not merely a reflection of research popularity, but also represents an empirically supported causal relationship within educational practice. The findings collectively indicate that effective instructional design plays a critical role in shaping cognitive experiences that ultimately strengthen learners' confidence and ability to succeed in digital and multimedia-based learning environments.

Flipped Classroom and Teaching Strategy as Self-Efficacy Enhancers

The strong relationship between *flipped classroom*, *teaching*, and *self-efficacy* in the bibliometric network reflects the increasing emphasis on active and student-centered learning environments in educational research. The reviewed empirical studies consistently show that flipped classroom models help students become more prepared and engaged through pre-class video learning and interactive in-class activities. By allowing students to study materials at their own pace before class, these approaches reduce learning anxiety and improve students' readiness to participate in discussions, problem-solving, and collaborative tasks during classroom sessions.

The studies further reveal that repeated participation in successful learning activities strengthens students' mastery experiences, which play a crucial role in developing self-efficacy. As students gain confidence in completing academic tasks and understanding concepts, they become more motivated and persistent in their learning process. The bibliometric density surrounding flipped classroom and self-efficacy therefore suggests that flipped learning is not simply a technological or scheduling innovation, but a student-centered pedagogical approach that systematically builds learner confidence through active engagement and structured learning experiences.

Digital Literacy as a Moderating Variable

Although *digital literacy* is less central than *self-efficacy* in the bibliometric visualization, it remains strongly connected to themes such as multimedia learning and flipped classroom instruction. The empirical findings suggest that digital literacy functions both as a prerequisite skill for effective technology-enhanced learning and as a moderating variable influencing the relationship between instructional strategies and self-efficacy. Students with higher digital literacy are generally more capable of navigating digital platforms, understanding multimedia content, and adapting to online learning environments, which reduces cognitive overload and improves learning engagement.

The studies also show that digitally literate students tend to experience stronger gains in self-efficacy because they can participate more confidently in flipped and multimedia-based learning activities. In contrast, limited digital skills may increase cognitive burden and reduce the effectiveness of instructional interventions. These findings highlight that digital competence should be viewed not merely as an outcome of technology integration, but as a foundational condition for successful learning in digital environments.

Conceptual Integration Model

The conceptual integration model synthesizes the findings from both bibliometric mapping and empirical evidence into a unified explanatory framework. The model suggests that effective instructional design, particularly through flipped classroom approaches and multimedia learning environments, serves as the starting point for improving the learning process. Well-structured instructional materials help reduce unnecessary cognitive burden by organizing information clearly and allowing students to process learning content more efficiently. This cognitive load management becomes essential because students are better able to focus their mental resources on understanding concepts rather than dealing with confusion or information overload.

As cognitive demands become more manageable, students develop stronger self-efficacy through repeated successful learning experiences, improved comprehension, and greater participation in classroom activities. Increased self-efficacy then contributes directly to learning effectiveness by enhancing motivation, persistence, engagement, and academic performance. Within this pathway, digital literacy functions as a contextual moderator influencing every stage of the process. Students with stronger digital competence are more capable of navigating multimedia tools, adapting to flipped learning environments, and managing online learning tasks effectively, which amplifies the positive effects of instructional design on cognitive processing and self-efficacy. Therefore, the model highlights that successful digital learning is not determined by technology alone, but by the alignment between instructional strategies, cognitive processes, learner motivation, and digital competence.

Theoretical and Research Implications

Theoretical Implications

The integration of bibliometric mapping and empirical synthesis highlights *self-efficacy* as a central construct connecting cognitive theory and digital pedagogy. The

findings suggest that self-efficacy functions not only as a motivational factor but also as a mechanism through which instructional quality influences learning outcomes. Empirical evidence further shows that instructional interventions are most effective when they reduce cognitive load and align with learners' digital competencies. This extends *Cognitive Load Theory* by demonstrating that cognitive processing and motivational beliefs are closely interconnected. Consequently, the flipped classroom is reframed not merely as an instructional innovation, but as a pedagogical environment whose success depends on instructional quality, learner readiness, and psychological support.

Research Implications

The convergence between bibliometric mapping and empirical findings suggests several directions for future research. Studies should further examine mediation and moderation relationships among cognitive load, self-efficacy, digital literacy, and learning outcomes using approaches such as structural equation modelling and longitudinal analysis. Future research should also explore the interaction between cognitive load and digital literacy across different disciplines and cultural contexts, while integrating additional constructs such as self-regulated learning to strengthen the explanatory framework.

Practical Implications

The findings emphasize the importance of designing flipped and multimedia learning environments that minimize extraneous cognitive load through principles such as segmentation, signaling, and coherence. Educational institutions should also support students' self-efficacy through structured feedback, scaffolded activities, and mastery experiences. In addition, digital learning policies should address both technological infrastructure and learner readiness, while teacher professional development programs should strengthen competencies in cognitive load management, multimedia instruction, and motivational support strategies.

CONCLUSION

This systematic literature review explored how cognitive load management, multimedia learning design, flipped classroom pedagogy, and self-efficacy interact within digital learning environments. Although educational technology research continues to expand rapidly, the review found that only a limited number of studies comprehensively examined these four constructs together, highlighting a significant gap in integrative research. The findings indicate that the success of flipped classroom approaches is not determined solely by the use of technology or the restructuring of classroom activities. Instead, effective learning depends on how well instructional strategies align with students' cognitive processes and learning needs. Well-designed multimedia materials that minimize unnecessary cognitive load help students process information more efficiently, leading to improved understanding, engagement, and academic performance.

The review also revealed that self-efficacy plays a central role in shaping students' learning experiences within technology-enhanced environments. Across the selected

studies, self-efficacy consistently functioned as an important psychological factor that influenced how students responded to instructional design and managed cognitive demands during learning activities. Students who felt more confident in their abilities were generally more motivated, engaged, and capable of achieving positive learning outcomes. These findings suggest that cognitive and motivational dimensions of learning are deeply interconnected rather than separate processes. Overall, this review contributes to the field by proposing an integrated cognitive–motivational–pedagogical perspective, emphasizing that effective digital learning emerges from the interaction between instructional design principles, pedagogical approaches such as flipped classrooms, and learners' beliefs in their own capabilities.

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