

Systematic Literature Review: Digital Learning Tools Integrated with the ARCS Motivation Model

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Abstract: This study aims to examine the integration of digital learning tools with the ARCS (Attention, Relevance, Confidence, Satisfaction) motivational model to understand technology-based learning environments that can enhance learners' motivation and performance. The research employed a Systematic Literature Review (SLR) method following the PRISMA framework. The findings indicate that the ARCS model can be implemented through various digital learning tools across different learner contexts, learning materials, and educational levels. Each tool offers distinct strategies to stimulate attention, relate content to real-life contexts, build confidence, and provide satisfaction. These findings affirm that integrating the ARCS model into digital learning tools supports a learner-centered approach and enhances both motivation and performance. This study contributes to the understanding of motivational design in digital learning and serves as a reference for educators and instructional designers in applying ARCS-based strategies within digital education.

Keywords: ARCS model, digital learning tools, instructional design, motivation, technology integration.

Introduction

The development of digital technology has introduced significant changes in the field of education, bringing forth new approaches to the learning process. The introduction and development of digital technology in education have facilitated more effortless transfer of information, leading to significant transformations in teaching and learning methodologies (Djibran et al., 2024; Ghory & Ghafory, 2021). The presence of technology not only facilitates access to learning resources but also has the potential to enhance student engagement through more interactive, flexible, and personalized learning experiences.

Digital learning tools encompass various technology-based devices, applications, or platforms that support, facilitate, and enhance the learning process, including both hardware and software. The use of digital technology in classroom learning involves various forms of software and hardware that not only support students'

accessibility needs but also function as instructional media that integrate technology into learning activities (Haleem et al., 2022). Digital tools serve not only as channels for delivering information but also as interactive environments that stimulate more profound learning experiences. Technology improves learning processes, supports teachers in managing instruction, and contributes to increased academic motivation and improved student learning outcomes (Abdigapbarova et al., 2025; Amin et al., 2025).

Learning experiences serve as an essential foundation for achieving instructional goals. A learning experience encompasses various dimensions and refers to an individual's perception of interactions, activities, or situations that provide opportunities to gain understanding, knowledge, skills, or competencies (Liu et al., 2023). One of the key factors in achieving learning objectives is students' learning motivation.

In the context of learning, motivation refers to the attention and effort students direct toward their

studies, influenced by personal experiences that shape their engagement and reasons for learning. Therefore, learning goals and strategies should be directed toward involving students in activities that foster the motivation needed to acquire the desired knowledge and skills (Brophy, 2004). Motivation relates to an individual's desire, decisions, and commitment, meaning that studies of motivation aim to identify underlying reasons that drive individuals to act in particular ways (Keller, 2010).

The ARCS model, an acronym for Attention, Relevance, Confidence, and Satisfaction, is a motivational framework developed by John M. Keller to examine and enhance students' learning motivation within educational contexts. The model comprises four key components that represent the essential conditions necessary to ensure students remain actively engaged and capable of sustaining long-term motivation. This model functions not only as a framework for motivating students but also for designing instructional strategies through its four core components, which help students remain engaged with the subject matter and the learning process (Afjar et al., 2020; Luo & Li, 2024).

However, research on implementing the ARCS model within digital learning tools remains limited. Most studies only address the role of ARCS as an instructional model in the classroom or as a basis for motivational assessment instruments. Therefore, there is a need for studies that explicitly affirm the comprehensive integration of the ARCS Motivation Model with digital learning tools.

This study aims to explore the integration of digital learning tools with the ARCS model in instructional contexts. Specifically, it discusses the variety of digital tools used, the technology-facilitated implementation strategies for ARCS, and the impact of its application on students. This study aims to provide insights into the relationship between digital learning tools and the ARCS motivation model, while also offering guidance for designing effective digital learning strategies.

Materials and Methods

This study employed a systematic literature review (SLR) approach following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The article search process was conducted using the Scopus electronic database. Keywords were determined using Boolean operator combinations (AND, OR, NOT) to refine and focus the scope of literature retrieval within the database. The Boolean search strategy used the following keyword combinations: ("ARCS motivation model" OR "ARCS Keller") AND ("digital" OR "technology" OR "electronic" OR "online") AND ("learning" OR "classroom" OR "instructional" OR "educational").

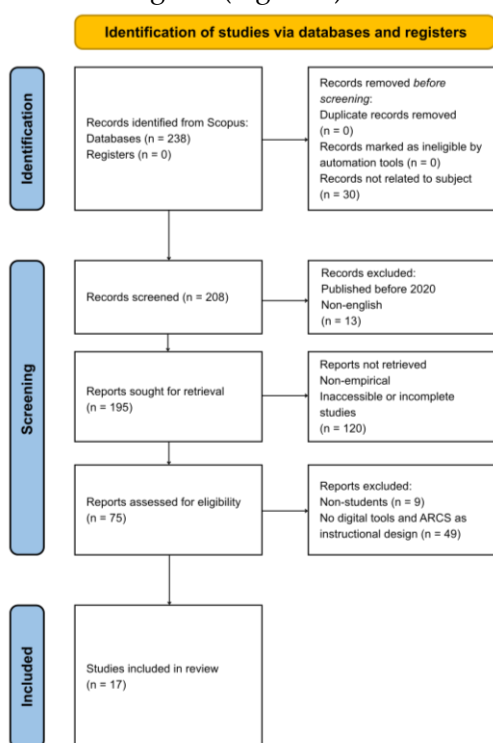
Furthermore, the study established specific inclusion and exclusion criteria to ensure the selected articles were relevant to the research objectives (Table 1).

Table 1. Inclusion and Exclusion Criteria.

Criteria	Inclusion	Exclusion
Publication Year	2020-2025	Published before 2020
Language	English	Non-english
Research Type	Empirical studies (experiment, quasi-experiment, quantitative survey with data)	Non-empirical (conceptual, opinion, editorial, literature review)
Participants	Students	Non-student (Teachers, pre-service teachers, lecturers, or staff)
Focus	Digital learning tools and ARCS as instructional design model	No digital and ARCS
Availability	Full-text accessible	Inaccessible or incomplete studies

The initial search yielded 238 articles from Scopus. After a screening process to remove irrelevant studies, the number of articles was reduced to 208. Subsequently, inclusion and exclusion criteria were applied to narrow down the selection further, resulting in 17 articles that met the eligibility criteria and were included in the final synthesis for further analysis. The entire process followed PRISMA guidelines, with the results presented in the PRISMA flow diagram (Figure 1).

Figure 1. PRISMA flow diagram.



Results and Discussion

Results

This systematic review analyzed 17 articles identified through a comprehensive search of the Scopus database. The main search terms used were "ARCS motivation model," "digital," "technology," and "learning." These terms were selected to ensure coverage of studies relevant to the objectives, discussions, and focus of this literature review. Based on the analyzed articles, the implementation of the ARCS motivation model in digital learning tools demonstrates variation across learner contexts, subject matter, and educational levels (Table 2).

Table 2. Overview of Educational Levels, Subject Matter, and Digital Learning Tools.

Author, Publishing Year	Research Participants	Learning Materials	Type of Digital Learning Tools
(Chen et al., 2025)	Higher Education	Foetal heart rate (Biology and medical)	Electronic Book
(Tu et al., 2025)	Higher Education	Data literacy	Platform online learning or Learning Management System
(Yorganci & Subaşı, 2025)	Higher Education	Mathematics	Electronic Book with GeoGebra applets
(Klada & Papanikolaou, 2025)	Middle School	Language	Augmented Reality (AR)
(Karampa & Paraskeva, 2024)	Higher Education	E-learning design utilizing web technologies	Digital Educational Escape Room (DEER) game

(Nuanmeesri, 2024)	Higher Education	Cultural heritage	Augmented Reality (AR)
(Choi et al., 2024)	Primary Education	Programming	Web-based eClass PowerLesson2
(Cárdenas-Sainz et al., 2023)	Higher Education	Physics	Web-based eXtended reality (XR) application
(Quadir et al., 2023)	Higher Education	Language practice	Programming Teaching Assistant
(Chuang et al., 2023)	Junior High School	Biology	Chatbot and AR
(Rashid & Noor, 2023)	Pre-School	Jawi (Write Malay language using Arabic)	Game-based learning application
(Chaiprasurt et al., 2022)	Higher Education	Information technology	Chatbot
(Hsia et al., 2022)	Higher Education	Educational robot course	Robot
(Yang & Oh, 2022)	Higher Education	Medical	Virtual Reality (VR) gamification
(Riedmann et al., 2022)	Primary Education	Training reading skills	Mobile App
(Hsieh et al., 2020)	Middle School	Basic mathematics	AI-assisted interactive robots
(Y.H. Chang et al., 2020)	Elementary School	English vocabulary	Game-based learning with Kinect Application

The research subjects involved in implementing the ARCS model using digital learning tools demonstrate variation across educational levels. As shown in Table 2, studies integrating digital learning tools with ARCS motivational strategies were conducted at various levels of education, ranging from early childhood to higher education. This variation demonstrates that the ARCS model can be applied to diverse learner groups by adapting to their specific needs and characteristics, highlighting the model's flexibility and adaptability across foundational to advanced educational contexts.

Regarding the subject matter context, the ARCS model can also be applied across different academic disciplines. This diversity confirms that ARCS is not limited to a particular subject area, but can be used as a general motivational framework across disciplines. Additionally, the types of digital tools used in ARCS-integrated learning demonstrate a wide range of media formats. This diversity highlights the model's flexibility, demonstrating that it can be successfully integrated into various types of technology and adapted to suit the characteristics of the subject matter and learning objectives.

Table 3. Application of the ARCS Model in Digital Learning Tools.

Type of Digital Learning Tools	Instructional Strategy				Impact
	Attention	Relevance	Confidence	Satisfaction	
Electronic Book	Sound effects, animations,	Audio-visual content and	Clinical scenarios	Real-time assessment	Enhancing learning

	and interactive games	interaction with digital tools		system with scoring and certificate levels	motivation, self-efficacy, and practical competencies Improving learning achievement through practical application and conceptual understanding, approaches to learning, and quality of self-reflection
Platform online learning or Learning Management System	Learning materials are introduced using problem-based concepts and real-life cases	Story-based contexts and everyday experiences, along with clarification of misconceptions	Tasks and practice activities to build skills and collaborative presentations	Application and presentation of what has been learned with performance-based feedback	
Electronic Book with GeoGebra applets	Surprising elements, showcasing engaging real-life practices, and accompanied by brief explanations	Explaining learning objectives, questions related to students' prior experiences and knowledge, content with examples connected to the professional world, and using language with concrete terms, examples, and concepts aligned with learners' experiences and values	Guidance on how to use the tool and its interactive functions, short-answer tests accompanied by feedback based on results, and exercises provided from easy to challenging levels	Interactive simulations and practice modules, feedback, and the application of consistent standards and consequences for success and assessment	Student learning and motivation were significantly enhanced, resulting in improved academic achievement and providing substantial support for sustained student motivation
Augmented Reality (AR)	An avatar that guides students, feedback messages with text and voice, text	Learning objectives and instructions are explained by the avatar, gamification elements, and	Detailed explanation of task specifications, personalised scaffolding, opportunities for	Positive feedback and motivational messages, visual and auditory praise, and awards	Enhancing learning motivation

	segmentation, the student's role as a detective, a digital environment and interactive worksheets	adaptation of learning styles in the form of optional audio narration alongside reading activities	a second attempt and guided feedback, open-ended questions about the text, and feedback provided gradually and frequently based on student progress		
Digital Educational Escape Room (DEER) game	Profile adjustment with avatars, humour, engaging content, multimedia content, and problem-solving activities	The learning process is closely tied to the interests, goals, and needs of learners, learning objectives are linked to prior knowledge and skills, explaining the value of new knowledge, and connecting examples, concepts, and tasks to relevant experiences	Learning design aligns with the structure and components of the educational process, clear objectives for each material or activity, positive feedback, and navigation tools in the form of buttons	Positive feedback, self-assessment methods, educational games, rewards in the form of badges, leaderboards, points, or certificates, and establishing assessment criteria and rewards	Enhancing learning motivation
Augmented Reality (AR)	Three-dimensional models accessible via QR code on smartphones	Cultural context of craft skills	Instant feedback, easy access via smartphones, and realistic learning experiences in understanding craft concepts and practices	Tangible experiences and learning outcomes are directly visible through AR (3D visualisation of craft results)	Motivated to learn and preserve traditional crafts
Web-based eClass PowerLesson 2	Gamification elements and videos	E-books and videos are linked to tasks relevant to daily life, and they feature	Tasks are scaffolded from basic to advanced levels, group work assignments, self-assessment, and	Self-reflective questions, demonstrations and presentations, and reward points upon	Learning motivation increased

Web-based eXtended reality (XR) application	VR and AR technologies, phenomenon simulations, a two-part learning structure, and application capability to adjust modes (VR, AR, or 3D virtual)	video replay capabilities Learning materials aligned with the official curriculum, employing learn-by-doing and problem-based learning (PBL) methods, with a selection of familiar topics from lessons	the use of avatars with immediate feedback Clear visual guidance and interactive steps, self-regulated adjustment of object properties, repeated experimentation, simulator controls and access to error analysis	completing learning activities Experimentation exploring connections between theoretical concepts and simulation outcomes, with performance results and completion time serving as positive feedback	Enhanced learning outcomes, comprehension, performance, motivation, self-confidence, and learning satisfaction
Programmin g Teaching Assistant	Focus on practice, stimulation of problem-solving skills, user interface display, and the "Problem Set" feature	Exercises taken from books and sources are already familiar to learners, along with step-by-step problem-solving procedures	Programming tasks that allow code to be submitted repeatedly until successfully accepted, programming problem solving, and instant feedback	Automated assessment system with symbols and colour indicators	Enhancing self-confidence, learning motivation, programming and problem-solving skills, as well as encouraging learners to achieve better performance
Chatbot and AR	Animated videos and images, along with an AR chatbot interface that is comprehensible, user-friendly, and logically structured	Content connected to daily life, oriented toward higher education, and aligned with the curriculum	Content with a moderate difficulty level, incorporating time management and self-directed learning	Feedback during activities and application of knowledge in classroom assessments and daily life	Facilitates information comprehension and enhances learning motivation
Game-based learning application	Game concepts, colour combinations, font type and size selection, and the use of animations,	Learning objectives are clearly communicated to help children understand	Each in-game activity provides immediate feedback with support and a total score	Direct and cumulative rewards or recognition at each game level	Enhancing learning motivation in preschool-aged children

	characters, graphics, and audio are tailored to preschool children's developmental level	the benefits of the games they play			
Chatbot	Images, Q&A boards, characters with distinct visual designs, and notifications	Web search functionality, peer discussion forums, and instructions with embedded hyperlinks	Display of completed reading materials, customizable learning starting points, learning prompts through recommendation s, feedback mechanisms, assessment results, and attendance reporting	Leaderboard rankings, offline rewards, educational game simulations, and positive feedback mechanisms	Enhanced academic performance, increased motivation, and improved learning achievement
Robot	Methods and strategies at the beginning of learning, along with robot playability	Variety and reconfiguration capability of the robot that can provide direct experience	repeated trials, responses from the robot according to the received input, and challenges appropriate to the learning	Instant feedback, Feedback during the learning process and inter-class competition	Enhances interest and learning motivation, encourages design skills, and provides a learning experience
Virtual Reality (VR) gamification	Displays real clinical phenomena through VR with audiovisuals, challenges through games and quizzes, and a gamification program with VR	Based on the 8th edition of the American Heart Association guidelines, used in actual NICUs, virtual simulation to role-play as medical professionals, providing preliminary knowledge through online lectures	Provides learning objectives and evaluation standards, online video lectures, explains reasons for failure to allow repeated practice, and offers a VR program that enables self-selection of practice time, and frequency	A gamification program that indirectly facilitates learning, praise messages and rewards, objective compilation of tasks and evaluation results	Enhances competency, knowledge, problem-solving skills, self-confidence, and learning motivation

Mobile App	A splash screen and introductory video featuring the owl character Uli, integration of story elements and characters, changes in the pedagogical agent's facial expressions, and humorous elements in the videos	Games and activities with clear and meaningful learning objectives, friendly characters that play roles in the storyline, and tasks related to syllable and vowel recognition using familiar words in children's reading lessons	Tutorial videos explaining gameplay and sample questions, adjustable difficulty levels (three distinct levels that can increase or decrease based on performance), and game result statistics displaying top achievements	The pedagogical agent and in-game animals express gratitude and acknowledge effort at the end, utilising a reward system that includes praise, positive affirmations, and displays of learning outcomes, along with positive feedback	Enhances competency and provides benefits to learner performance
AI-assisted interactive robots	Robots were used in the classroom, displaying various facial expressions and voices, to introduce themselves and answer student questions	Robots were utilised to play videos and facilitate communication with students	Tests were designed to be moderately challenging and relevant to familiar events or topics, with robots assisting in problem-solving and demonstrating real-life applicability	The assessment framework focused on problem-solving skills, with methodologies previously taught in class	Captured student attention, enhanced learning motivation and effectiveness, improved academic performance, and fostered higher-order thinking skills by guiding students to develop solutions
Game-based learning with Kinect Application	A supermarket environment designed as a familiar visiting place and animation-based quizzes	Real-life supermarket experience with three vocabulary categories: fresh produce, fruits and vegetables, and food departments	Challenges and Interactions with the Kinect Somatosensory System	Quizzes and system feedback mechanisms	Stimulates learning interest, enhances engagement in learning, boosts learning motivation, and improves learning outcomes by

fostering a
better
understanding
of the teaching
materials

The implementation of the ARCS model was carried out through a variety of strategies tailored to the learning tools and subject matter context (Table 3). The strategies employed were highly varied, including problem-based approaches, the utilization of interactive digital media, the use of robots in the classroom, and the design of educational games. These findings suggest that each component of the ARCS model can be effectively integrated through various media and instructional methods to achieve more desirable learning outcomes. The application of these strategies shows variation not only in how learning materials are presented, but also in how interactive, contextual, and practical learning experiences are provided.

Furthermore, the data indicate that the instructional strategies designed based on the ARCS model were able to yield a positive impact on learners. The application of the ARCS model across various learning contexts consistently resulted in enhanced student motivation and improved learning outcomes. Overall, the results show that ARCS-based instructional strategies are effective in capturing learners' attention through elements of novelty, narrative, animation, or real-life experiences; maintaining relevance by connecting learning content to everyday life or professional needs; building confidence through gradually structured tasks, practice, and applied scenarios; and enhancing learning satisfaction through feedback systems, reinforcement, and hands-on application experiences.

Discussion

The analysis reveals that the ARCS model can be applied across various types of digital learning tools, demonstrating varying effectiveness depending on the learner's context, subject matter, and educational level. This finding indicates that digital learning tools function not only as media for delivering instructional content but also as

instruments for implementing the components of ARCS, such as gaining attention, enhancing relevance, building confidence, and providing satisfaction, thereby improving learning effectiveness, including motivation, performance, learning outcomes, and other key aspects. These findings support (Keller, 2010) ARCS theory, which posits that student motivation can be enhanced through the four main components: Attention, Relevance, Confidence, and Satisfaction, delivered via engaging content, contextualization, quizzes, exercises with feedback, rewards, and enjoyable learning experiences.

The application of the ARCS model is found across various educational levels, from primary school to higher education, with the review indicating that the majority of study subjects were at the university level. This aligns with findings by (Fang et al., 2023), who noted that most ARCS research is conducted in higher education, followed by K-12 education. The diversity in the educational levels of the subjects demonstrates the universal nature of ARCS principles, while also highlighting that the use of digital learning tools must be tailored to the characteristics of learners at each stage. This supports Piaget's theory that learning should be tailored to students' cognitive developmental stages. Furthermore, it illustrates that ARCS is not just a framework but also provides an understanding of how learning motivation is formed across various developmental phases. By tailoring ARCS strategies to subject characteristics, learning becomes more effective, simultaneously reinforcing that ARCS can be used in conjunction with other educational theories.

Varied digital tools can support learning in different contexts. This diversity is tailored to the characteristics of the subject matter and learner needs. Findings in higher education indicate that the digital tools used are oriented towards complex, conceptual material that stimulates independent learning. As adult learners, university students

require flexibility, autonomy, and opportunities to reflect on their learning process. The use of digital tools provides space to organize, monitor, and evaluate the learning process. This finding suggests the presence of self-regulatory capabilities and supports (Zimmerman's, 1989) theory of self-regulated learning, which emphasizes the importance of autonomy in the learning process. This theory explains how individuals actively control their learning process by regulating their thoughts, feelings, and actions through planning, monitoring, and reflection. Thus, digital technology acts not only as an assistive medium but also as a facilitator in developing higher-order thinking skills and learning autonomy in students.

Interestingly, one finding highlighted the use of more complex technology in higher education, specifically the use of robots with mechanical engineering students taking elective educational robotics courses. This demonstrates that digital learning tools are selected based on disciplinary requirements and the need for tools that support knowledge construction. The use of robots in higher education contributes to the mastery of technical skills, enhances student engagement and STEM learning, and fosters the development of problem-solving and teamwork competencies (Zamora et al., 2025).

Meanwhile, more interactive and game-based media were used to help primary and secondary school students understand concepts through direct experience. The application of interactive technologies, such as AI robots, motion capture sensor devices (e.g., Kinect), and games, at the basic and secondary education levels aligns with the cognitive developmental characteristics of children, who require visual, kinesthetic stimulation, and enjoyable learning experiences. This finding is consistent with Piaget's theory of cognitive development, which emphasizes that children's cognitive development progresses in stages from concrete to abstract, thus necessitating visual media, kinesthetic activities, and contextual experiences in learning. This confirms that the use of digital learning tools is not merely a technological trend but is also relevant to children's cognitive developmental needs.

Digital learning tools serve as a medium for realizing ARCS strategies in learning. ARCS strategies are implemented through features of digital tools that support each component. The Attention aspect utilizes animation, storytelling, interactive robots, and games to capture student interest. The Relevance aspect connects material to daily experiences, professional contexts, or real-world events, making learning feel personally significant. The Confidence aspect is fostered through scaffolded exercises, simulations, and assessments that help students evaluate their ability and contribute to readiness for more complex material. The Satisfaction aspect is achieved through reward systems, immediate feedback, and practical application to reinforce intrinsic motivation and stimulate the desire to learn. Keller's theory emphasizes the importance of systematic and planned instructional design, enabling the adaptation of teaching materials for participatory learning, providing interactivity that encourages student engagement, and facilitating the development in innovative digital learning technology (Y.-S. Chang et al., 2020).

The differing characteristics of digital tools also show that not all tools contribute equally to all four ARCS components; therefore, media selection must be selective and aligned with learning objectives. In an ever-changing educational landscape, with the rapid development of media and technology offering various features and conveniences, the use of media in learning should still be guided by strong pedagogical foundations (Lee et al., 2023). Digital media can enrich the learning experience and increase student engagement (Aulia et al., 2024). Thus, the integration of ARCS with digital tools plays a role in ensuring that students not only understand the material but also feel interested in learning, confident, and satisfied with their learning experience.

Overall, the positive influences identified from the application of ARCS in digital learning tools include increased motivation, interest, engagement in learning, improved conceptual understanding, and student learning outcomes. These findings suggest that ARCS strategies play a role in addressing the issue of low learning motivation in education. With the elements of attention

and relevance, students are encouraged to focus and understand the benefits of the material, while confidence and satisfaction encourage autonomy and the sustainability of the learning process. Motivational belief strategies play a crucial role in digital learning because strong motivation drives students to hone their skills, complete tasks more effectively, and build a positive mindset that supports constructive behaviour in the digital learning process (Lilian, 2022).

The integration of digital learning into classroom teaching offers benefits not only for students but also for teachers. A digital environment designed with ARCS principles can encourage positive interaction, collaboration, and support among students and with educators. A conducive learning environment and the motivation of both teachers and students can be enhanced through the use of teaching tools integrated with digital technology in the learning process (Ibharim & Shukuri, 2022). The implementation of digital learning also requires the teacher's role as a facilitator who can complement the limitations of technology. The design of learning activities and the use of digital technology must be aligned with instructional strategies and classroom conditions to create a learning environment that encourages students to utilize digital learning effectively (Lin et al., 2017).

In conclusion, the integration of various digital learning tools with ARCS-based instructional strategies expands the understanding of ARCS theory by demonstrating that the effectiveness of these strategies is highly influenced by the suitability of the media to learner characteristics and the learning context. Therefore, this literature review not only confirms the effectiveness of ARCS but also provides a framework for its more contextually applied use in the digital learning era. Consequently, the results of this review are expected to contribute to educators' understanding of how ARCS strategies can be integrated through the use of digital learning tools, while also providing a foundation for researchers to expand investigations into the varied applications of ARCS in different contexts and with different technological approaches, including the potential integration of ARCS with other theories to support meaningful learning.

Conclusions

The integration of digital learning tools with the ARCS motivation model can effectively enhance students' motivation, engagement, and learning performance. The findings indicate that all four components of the ARCS model (Attention, Relevance, Confidence, Satisfaction) can be implemented through various types of learning tools, with each tool contributing differently to facilitating these motivational components through distinct strategies. This integration facilitates the creation of a student-centred digital learning environment, promoting meaningful and sustainable learning experiences. Practically, educators can utilise the ARCS framework as a guiding principle for designing motivation-based digital learning by selecting and adapting digital tools that align with students' cognitive levels and material characteristics to maximise motivation and learning outcomes.

This study is limited by the relatively small number of articles reviewed, which were sourced exclusively from the Scopus database and covered a publication range from 2020 to 2025. Consequently, these findings may not fully represent the comprehensive implementation of the ARCS model in digital learning contexts. Future research is recommended to expand data sources by incorporating multiple databases and extending the publication timeframe. Additionally, further studies could explore the integration of ARCS with other theories and various technologies to provide deeper insights into digital learning environments.

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