THE AI-EDUCATION NEXUS: CONSTRUCTING A BLUEPRINT FOR TOMORROW'S LEARNING

Buchaputara Pansri*, Vivat Thongchotchat, Kazuhiko Sato

Graduate School of Engineering, Muroran Institute of Technology, Muroran, Hokkaido, Japan

Abstract

This study introduces a novel framework to enhance research in the intersecting areas of education and Information and Communication Technologies (ICT), focusing on the evolving field of Artificial Intelligence (AI). With AI becoming an integral part of ICT in educational research, there is a clear need for a comprehensive framework that effectively unifies these two domains. The absence of such a framework in current literature has prompted the development of this structured approach, designed to guide researchers in the complexities of integrating AI within educational settings. Our framework offers a methodological synergy between educational and technological aspects, providing a clear, understandable guide for researchers. It responds to the increasing demand for integrative methods in these fields, proposing new ways to blend AI's technological advancements with educational insights. For researchers interested in employing this framework, it will facilitate a deeper understanding of both domains, allowing for a more holistic view of how AI can be effectively utilized in educational research and practice.

Keywords: *Artificial Intelligence (AI), Educational Technology, ICT in Education, AI Integration, Pedagogical Innovation*

1. INTRODUCTION

The intersection of education and ICT, especially AI, demands a new approach. Recognizing the lack of a unified framework in existing literature, this article introduces a novel method to integrate AI within educational research. Our framework provides a synergistic methodology, merging educational theories with AI technology, addressing the urgent need for integrative methods in these fields. A framework aims to guide researchers in effectively utilizing AI, fostering a comprehensive understanding of its role in advancing education.

This research paper is motivated by the recognition of the critical importance of understanding and utilizing the potential of integrating ICT (AI) in education. It seeks to provide a comprehensive perspective on this integration by exploring various aspects of the topic. The paper begins with a detailed literature review, describing the current state of ICT integration in educational settings. This review emphasize the complex nature of this integration and its profound impacts on various educational aspects. In addition to the literature review, this research paper introduces a framework designed to facilitate the application of ICT in education. This framework outlines methodologies, strategies, and potential outcomes, offering a structured approach for researchers and educators. It serves as a practical guide for implementing ICT integration, particularly AI, in educational contexts, with the aim of optimizing the learning experience. Furthermore, the paper concludes with a critical analysis of existing research within the proposed framework, providing solid examples of effective implementation and analysis of ICT integration. It explores the role of AI in education and the potential benefits it brings to both learners and educators. Ultimately, this research paper offers a comprehensive understanding of the fusion of ICT (AI) and education, setting the stage for further exploration and research in this dynamic field. It seeks to inspire researchers, educators, and policymakers to embrace the transformative potential of ICT integration in education and use it to shape the future of learning and teaching.

2. LITERATURE REVIEW

The integration of ICT into education has collect significant attention, with various studies examining its strategic implementation, impact on pedagogical processes, and implications for digital literacy.

The study by Sosa-Díaz et al [1]. provides insights into the integration of Information and Communication Technology (ICT) in primary and secondary education. It highlights the complexity of this process, involving teachers, schools, and policies. The research emphasizes that successful ICT integration requires not just technology deployment but also a deep understanding of the educational ecosystem and strategic planning. It advocates for a holistic approach that takes into account various interdependent factors.

Stein and Sim's [2] study in the International Journal of Educational Technology in Higher Education highlights the vital role of ICT in improving doctoral research processes. Their work demonstrates how ICT aids in data collection, analysis, and dissemination, arguing that it not only makes research methods more efficient but also enhances the quality and global accessibility of research outcomes. This underlines the transformative potential of ICT in academic research.

The impact of ICT in education is significant, encompassing aspects like digital literacy. Tinmaz et al.'s [3] study in Smart Learning Environments emphasizes the importance of digital literacy in the digital education realm. Their review underlines the crucial role of digital literacy skills in modern education, advocating for educational institutions to prepare students to effectively use digital tools for learning.

The role of ICT in addressing gender dynamics [4] within educational settings is also critically examined. Research in this area suggests a strength-based approach to reduce the gender gap in education, proposing that ICT can be a key tool in promoting gender equality and inclusivity. This perspective adds an important dimension to the discussion of ICT in education. Additionally, the impact of ICT on academic performance is explored [5], with findings indicating a positive correlation between ICT usage and improved student academic outcomes. This research contributes an evident dimension to understanding the impact of ICT integration, showing its potential to enhance student learning experiences and academic achievements.

In summary, these studies collectively provide a comprehensive view of the complex nature of ICT integration in education. They highlight the transformative potential of ICT in enhancing educational practices, addressing societal challenges, and improving academic performance, offering valuable insights for further exploration and research in this dynamic field.

3. METHODOLOGY

From a review of the literature on past topics, the researcher has analyzed the principles and structure of the framework used in educational research. This analysis was combined with processes in AI, leading to the development of a framework that serves as a foundation for advancing research. This research integrates knowledge from both the field of education and AI technology. The framework mentioned has a structure as shown in Fig 1, and the details of each part of the framework are as follows.

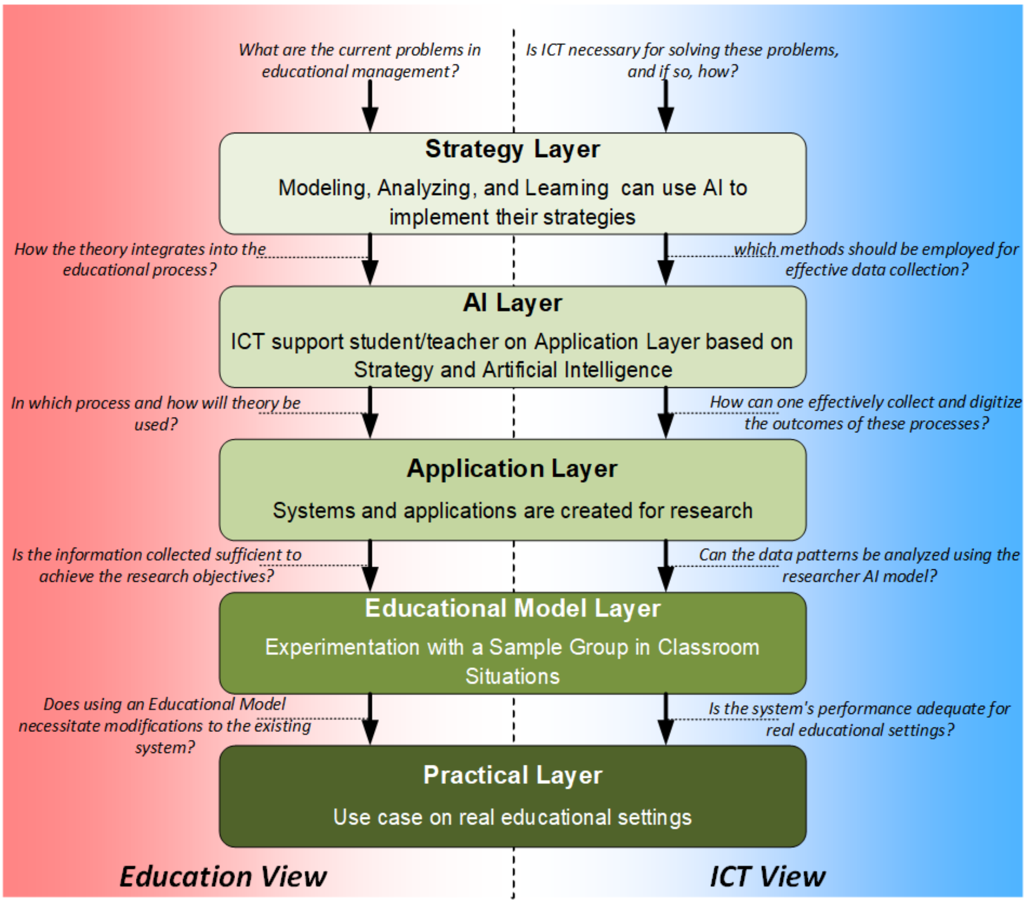

Fig. 1. Framework Education and ICT structure

In this framework, the workflow can be divided into five stages: Strategy Layer, AI Layer, Application Layer, Educational Model Layer, and Practical Layer. These are always arranged in a top-down sequence. Each layer has its own Input, Process, and Output. The Output of each layer automatically becomes the Input for the layer below it. The details of each layer are as follows:

3.1. Strategy Layer

3.1.1. Input of Strategy Layer

The current situation highlights issues in managing teaching and learning within specific courses or curriculums. These problems serve as research objectives, aiming to resolve, clarify, or enhance system efficiency. Objectives are derived from observations, experiences, or data, indicating real system issues requiring research attention. It's also important to ascertain whether ICT plays a role in addressing these problems, as discussed in Tulowitzki, Gerick, and Eickelmann's study on ICT in school leadership and management [6]. This distinction is vital, as some issues may find more effective solutions through physical methods or alternative approaches, rather than relying solely on ICT systems.

3.1.2. Process of Strategy Layer

Analyzing educational data and reviewing relevant literature often reveals that existing frameworks address many challenges. Researchers play a vital role in resolving ambiguities within these frameworks and selecting the most suitable theories for specific educational contexts. Factors such as teaching methods, subjects, sample group size and characteristics, and learner profiles should guide these decisions. The primary goal should be improving teaching methods to benefit students, rather than focusing solely on academic outcomes. For example, L.R. Gay et al. [7] stress the importance of adjusting teaching approaches to accommodate diverse learning styles, aligning with this perspective.

3.2. AI Layer

3.2.1. Input of AI Layer

Once the theory for problem-solving is understood, researchers must determine how to integrate it into the educational process [8], identifying relevant components and formats. The outcomes of this integration are crucial as they form a significant part of the input. Additionally, it's essential to assess whether the ICT systems in use or under development can effectively collect the necessary information [9]. If not, alternative data collection methods should be identified. These details guide the research direction and ensure accurate representation of the actual process results.

3.2.2. Process of AI Layer

The researcher's chosen theoretical process in their research has inherent limitations, influenced by both the theory's nature and environmental constraints. Defining the research scope and testing hypotheses is crucial in educational research. Making sweeping changes, such as altering the entire curriculum or experimenting with all students, can have adverse effects on the educational structure and essential knowledge acquisition for subsequent levels or subjects. Therefore, establishing a framework for testing hypotheses and compensating students in case of adverse research outcomes is necessary, as analyzed by A. Karpov [10]. This raises an ICT-related question: which tools will be employed for data collection in this process? It's imperative to evaluate these tools based on initial data collection methods and research recommendations [11] since this data is critical for analysis within the applied theoretical framework.

3.3. Application Layer

3.3.1. Input of Application Layer

Adapting theoretical processes for classroom use is challenging for researchers, especially when these theories originate from contexts differing significantly from the classroom. Despite similarities in the backgrounds of sample groups, the nature of the processes employed varies based on the researcher's unique characteristics and application context, as noted in PL Roth et al.'s research [12]. Such adaptation is crucial due to the constraints of teaching and learning, including content, time, and assessment. When selecting research topics focusing on specific content areas, researchers must consider these educational limitations. This raises a key ICT-related question: How can one effectively collect and digitize the outcomes of these processes? Common data collection tools like observation, worksheets, tests, and questionnaires, which are primarily physical, present the challenge of converting physical data into a digital format for comprehensive analysis and application in educational research [13].

3.3.2. Process of Application Layer

The researcher's chosen process or activity should align with research objectives, which are derived from issues within teaching and learning management. The resulting adaptations must be data-driven and analyzable using established research performance measurement tools. This process may involve phased outcome measurements to test hypotheses related to improvements. Such adjustments are common when working with humans due to changes in environmental conditions. For example, in a systematic review of Self-Regulated Learning (SRL) measurement tools by E. Araka et al[14], segmenting and assessing results verify the accuracy of researchers' work. Data collection raises an ICT-related question: can physical data collection processes be transformed into digital ones? For tracking student movements, video cameras may be necessary, while E-Learning platforms can be used for worksheet responses. For emotions or feelings, researchers may rely on physiological indicators like ECG or body temperature [15]. The choice of data collection tools is crucial, as inappropriate tools can complicate data formatting and analysis. Researchers must also understand the objectives of data analysis in Machine Learning, whether it involves Supervised, Unsupervised, or Reinforcement Learning.

3.4. Educational Model Layer

3.4.1. Input of Educational Model Layer

By testing hypotheses aligned with the research objectives, the collected data from the sample group can reveal its utility in analyzing problem-solving effectiveness. For example, in the study ``Practical Modeling and Hypothesis Testing" by E. Parkinson [16], data volume per individual and the necessary data analysis processes are considered. Furthermore, the alignment of data interpretation with research indicators is examined. This mirrors inquiries within the ICT domain, initiating the AI process, particularly in data mining for machine learning model creation [17], which extends to advanced concepts such as Neural Networks.

3.4.2. Process of Educational Model Layer

Once the framework for testing research hypotheses reaches this stage, assuming that data collection, analysis, and interpretation tools are properly prepared, the next step for the researcher is to test it with the designated sample group. This group should either be a random sample or one in a controlled research-specific environment [18]. It will determine the characteristics and variations in outcomes and observations, which may align with or deviate from the applied theoretical framework. The conditions of the sample group, particularly in terms of ICT, need analysis. In this context, it involves analyzing real-world data. One challenge researcher encounters when processing real-world data is dealing with unwanted information collected during data collection. Unlike a controlled experimental setup, real-world scenarios, such as those in a classroom, do not always proceed as planned. Some data, irrelevant or not initially hypothesized, such as unintended behaviors or activities, may require filtering to reduce data volume and enhance the efficiency of the researcher's AI-driven models [19].

3.5. Practical Layer

3.5.1. Input of Practical Layer

The feasibility of proposed designs in controlling real educational system issues is crucial. It involves considering necessary modifications to the existing system and evaluating their impact on users, as per the framework by Tai et al [20]. This assessment is vital for ensuring the changes' suitability. From an ICT perspective, success can be observed when testing the prototype with a sample group. However, the real challenge lies in applying the system to a more diverse group with varying characteristics, quantities, and environmental conditions. For example, in China, as per research by Zhang et al [21], questions arise about its practical applicability and potential scalability in a real-world setting.

3.5.2. Process of Practical Layer

Researchers often summarize their research or projects based on initial objectives, but these works are often confined to controlled settings. To truly address educational system issues and drive improvement, the focus should shift from sample groups to creating practical, implementable systems. Unfortunately, this aspect is often overlooked in real-world applications. Unlike fields like engineering or science, education's value lies in how these systems offer insights for educators to develop and implement effectively [22]. In the context of ICT, educators frequently neglect personal data management. To ensure scalability, smarter models and system enhancements are crucial. Researchers often limit themselves to current equipment, but a more advantageous approach involves designing systems that can adapt and scale incrementally, avoiding the need for complete system replacements [23].

4. EXAMPLE MODEL FRAMEWORK

To demonstrate the practical application of the framework presented in the previous section, the researcher utilized a research sample derived from their previously published articles [24]. The research incorporates DISC personality principles to assess learners' characteristics and adaptability within group dynamics. Additionally, gamification, specifically through the use of the game Don't Starve Together, enriches the learning experience, making it engaging and reflective. This article not only highlights the challenges associated with effectively managing learning environments but also emphasize the significance of understanding learner personalities for guiding, managing, and evaluating student outcomes in group activities. The integration of game-based teaching tools alongside DISC personality assessments facilitates the categorization of student behavior and the promotion of collaborative skills.

This example serves to elucidate each step of the process. The chosen research approach amalgamates principles from educational psychology with ICT systems, leveraging machine learning for clustering purposes. This represents a promising direction for future research, with details aligned with the provided framework as:

4.1. Strategy Layer

4.1.1. Input of Strategy Layer

The researcher's concern in the article is about group learning management and assessing students' collaborative work. Teachers often lack the chance to understand their students' characteristic. Hence, it's vital to find a theory that helps teachers comprehend these characteristics, enabling effective analysis, educational management, and assessment of learning outcomes. In terms of ICT, because collaboration can be challenging, monitoring students' behavior during tasks is crucial. A real-time system for observing student behavior would serve as an effective tool for data collection and classroom assessment.

4.1.2. Process of Strategy Layer

In this research, a literature review focused on the DISC personality model by psychologist William Moulton Marston, which outlines crucial persona for effective teamwork. Teachers can apply these personal to assess students' group behavior, often finding alignment with specific DISC personality profiles that reveal predominant tendencies. Recognizing survey limitations, the researchers explored alternative methods for more accurate and comprehensive data collection. In this regard, ICT emerges as a promising means to collect and analyze student behavioral data, potentially surpassing traditional surveys.

4.2. AI Layer

4.2.1. Input of AI Layer

Collaboration is integral to group learning, so researchers strive to cultivate teamwork skills in extracurricular subjects. This objective guides the selection of curriculum activities that can apply theoretical principles to help students attain corresponding outcomes. The specifics of these activities, used as data for analysis and the development of tools to transform physical information into digital format, are essential. This digital conversion is a facet of AI processing, which is a component of the ICT system designed to facilitate this procedure.

4.2.2. Process of Strategy Layer

In the research example provided, researchers opted to utilize the final class period of the day, dedicated to extracurricular subjects and club activities that align closely with the goal of enhancing skills beyond the standard curriculum. These activities resemble general education subjects. The chosen activity involved computer games, a popular medium in current teaching methodologies. The researchers found that these games accurately reflect student behavior, offer safety benefits, and require fewer teachers for supervision. Moreover, using computers allows for the collection of various data types for the ICT system, including voice recording, mouse control, keyboard typing, visual and bodily movements via webcam, and video recordings of screen activities during tasks. Therefore, selecting computer-based activities addresses the challenge of converting physical data into digital format.

4.3. Application Layer

4.3.1. Input of Application Layer

When selecting computer games as a tool for data gathering and behavior pattern analysis aligned with theoretical indicators, it's crucial to define operational procedures, scope, and objectives. Achieving desired outcomes requires understanding task execution, including controlling conditions and limitations. From an ICT perspective, the focus should balance data quantity with collection system efficiency. Collecting data from various sources enhances analysis precision but implies varying data collection tool complexity, AI model intricacy, and system management budget. Choosing data collection methods involves considering devices that gather the most data with minimal complexity for efficient and effective research outcomes.

4.3.2. Process of Application Layer

In educational research, key factors for achieving research goals include defining the student sample group, task objectives, duration, activity-based sanctions, and the teacher's role. The research example involves conditions for changing groups and creating an environment aligned with the research hypothesis to unveil primary and secondary personality traits during group transitions. These elements guide the established system within the research framework and enable process tracking to verify operational accuracy at each stage. From an ICT perspective, the research explores future developments, such as using video data for behavior analysis by teachers. This involves applying image processing to analyze student behavior, including mouse movements and keyboard inputs, providing comprehensive data for AI-driven analysis and creating clustering models in machine learning.

4.4. Educational Model Layer

4.4.1. Input of Educational Model Layer

After implementing the model to test the established research framework for gathering data on student behavior in a controlled environment, questions arise: Does the collected data align with pre-established indicators? Is the percentage of observed behaviors sufficient for analysis? To what extent can the designed activities and conditions elicit various student responses? These questions relate to the ICT aspect of the research, where video-based data collection must be evaluated for direct analytical possibility. If direct analysis isn't possible, what data filtration process is necessary? Additionally, it's crucial to determine whether the data aligns with the intended model for analysis. In real educational settings, student behavior doesn't always align with initial hypotheses because students focus on learning from assigned tasks, while researchers seek to gain insights from students' actions within the designed activities.

4.4.2. Process of Educational Model Layer

The activity designed for data collection within a game, such as surviving a game's winter season, mandatory meetings following a game over, or dividing responsibilities for resource searching, highlights individual roles. This is supported by rotating group members to assess how a student's personality changes when collaborating and whether these changes align with hypotheses. This process mirrors research progress, where initial tests reveal if the group's behavior aligns with the research hypothesis, allowing for adjustments in behavioral assumptions and analytical models. In the context of ICT, video data is used for AI. Analyzing behavior based on hypotheses involves converting in-game activities into numerical data, such as object positions or types, through Object Detection and Object Classification, like YOLOv5. This data is then mathematically analyzed to create models representing character movements, symbolizing student behaviors. However, without specific data collection conditions, like pausing recording during breaks or excluding inattentive gameplay, the accuracy of the designed model in distinguishing student personalities may decrease.

4.5. Practical Layer

4.5.1. Input of Practical Layer

Confirming the hypothesis of a research project and establishing credibility in the results derived from research data necessitates an appropriate sample size. Once data collection from the sample group is complete, integrating this data into real-life scenarios to verify its accuracy becomes essential. These steps enable researchers to identify opportunities for future research development based on real-world applications and provide insights for improvements in their own work, distinguishing whether the research design is theoretical or practical. This also presents open-ended problems in the knowledge domain, potentially contributing to future work. In terms of ICT, for creating theoretical models, researchers might use a sample size of about 5-10 individuals for initial modelling and test it with a sample of approximately 15-30 individuals. However, in the context of managing a classroom study, a single classroom typically contains about 30-45 students, and there are at least four such classrooms in a grade. In practice, increasing the data volume by approximately two to four times renders the system, which needs to analyze and create profiles of learners, incompatible with the prototype system. Moreover, for real-world system operations, accessing student data may not be in the form of researcher database access, necessitating consideration of the data usage by teachers within the system as well.

4.5.2. Process of Practical Layer

One critical aspect that researchers must understand about research in educational curricula is the application of these activities in real educational settings. Creating a conducive learning environment relies on teachers' understanding of the curriculum and explaining the benefits of using games in education. Utilizing profile data that reflects learners' personality traits for group formation, assessment, maintaining privacy of information, and sharing the effectiveness of student profiles are indicators of practical success and credibility. These factors contribute to learners' development in various systems and enhance the learning environment, especially in ICT contexts. Although successful in a sample group, using and representing learner's personality traits is the researcher's prerogative. Setting access controls for teachers and ensuring cybersecurity are crucial in real-world applications. Larger data processing requires specialized units and systematic data storage. Researchers must develop skills or collaborate with others interested in system development to ensure effectiveness and optimal performance in real settings, as shown in Fig 2.

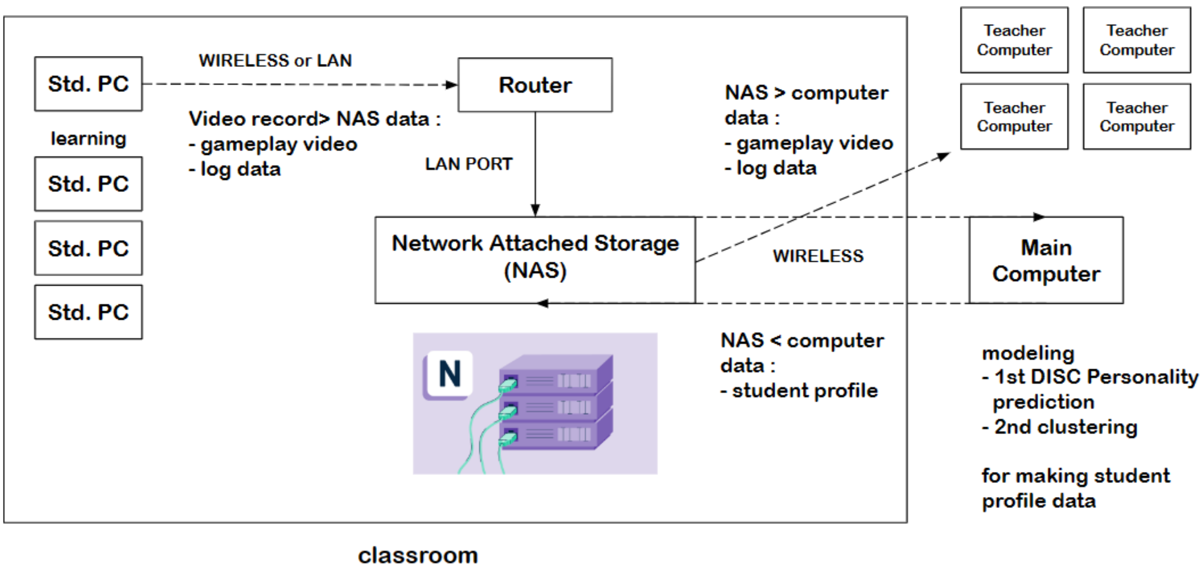

Fig. 2. Example Practical Layer System Structure.

5. CONCLUSION

The integration of ICT, especially AI, in education marks a significant shift with transformative potential for teaching and learning. This research includes a literature review, framework development, and critical analysis, highlighting ICT's varied impacts on educational paradigms. AI enhances learning experiences, streamlines administration, and provides insights into student behavior, fostering personalized and inclusive educational environments.

This framework for ICT integration in education highlights the importance of understanding how research that combines both ICT and educational elements must be closely linked with the collaboration of internal school staff, including teachers, technologists, and the active participation of students. It demonstrates how ICT, particularly AI, can boost learning experiences and student engagement, while also acknowledging challenges like data privacy and the digital divide. The study emphasizes the need for ongoing research and careful ethical considerations in the application of ICT in education. In essence, the successful integration of ICT, especially AI, in education not only promises significant advancements but also necessitates a deep and ethical understanding of how to effectively combine these technologies within educational frameworks.

6. DISCUSSION

Research necessitates embracing diverse knowledge fields. This study fuses AI from science and technology with educational psychology from social sciences. Integrating these domains requires dual-domain experts. However, such scholars often lack recognition. This research models merging science and social science to benefit students, crucial in shaping societies. It highlights interdisciplinary research's potential in enhancing student education and capabilities. This research aims to exemplify how combining scientific and social scientific methods can optimize education and contribute to societal development.

6.1. Future work

For future work, the research team aims to demonstrate the comprehensive application of this framework rather than treating it as an add-on. This will involve presenting the application in an academic article that offers clarity and insights to readers. The article will feature detailed visual representations at each stage of the research design, providing a deeper understanding of how the framework can be applied systematically. The goal is to provide a holistic perspective on the framework's usefulness, showcasing its potential across various aspects of the system and highlighting its adaptability in different contexts. This approach not only validates the framework's effectiveness but also encourages further exploration and adaptation in diverse research settings.

REFERENCES

1. Sosa-Díaz, María José, et al 2022, “EdTech Integration Framework in Schools : Systematic Review of the Literature”, *Frontiers in Education*, vol. 7, Frontiers Media SA,
2. Stein, Sarah J., and Kwong Nui Sim 2020, “Enhancing the roles of information and communication technologies in doctoral research processes”, *International Journal of Educational Technology in Higher Education*, vol.17, pp. 1-15.
3. Tinmaz, Hasan, et al 2022, “A systematic review on digital literacy”, *Smart Learning Environments*, vol 9.1, pp. 1-18.
4. Määttä, Kaarina, and Satu Uusiautti 2020, “Nine Contradictory Observations About Girls’ and Boys’ Upbringing and Education–The Strength-Based Approach as the Way to Eliminate the Gender Gap", *Frontiers in education*, Vol. 5, Frontiers Media SA.
5. Basri, Wael Sh, Jehan A. Alandejani, and Feras M. Almadani 2018, “ICT adoption impact on students’ academic performance: Evidence from Saudi universities”, *Education Research International*, pp.1-9.
6. Tulowitzki, Pierre, Julia Gerick, and Birgit Eickelmann 2022, “The role of ICT for school leadership and management activities: an international comparison”, *International Journal of Educational Management*, vol 36.2, pp. 133-151.
7. Gay, Lorraine R., Geoffrey E. Mills, and Peter W. Airasian 2012, Educational research: Competencies for analysis and applications, Pearson.
8. Sternberg, Robert 2008, “Applying psychological theories to educational practice.”, pp.150-165.
9. Eteokleous, Nikleia 2008, “Evaluating computer technology integration in a centralized school system.”, *Computers & Education*, vol 51.2, pp.669-686.

10. Karpov, Alexander 2018, “Fundamentals of education in knowledge society: Theoretical forecast”, *Revista Românească pentru Educaţie Multidimensională*, vol 10.1 , pp. 171-182.
11. Schulz, Renée, Ghislain Maurice Isabwe, and Frank Reichert 2015, “Investigating teachers motivation to use ICT tools in higher education”, *Internet Technologies and Applications (ITA)*, IEEE.
12. Roth, Philip L 2001, “Ethnic group differences in cognitive ability in employment and educational settings: A meta-analysis”, *Personnel Psychology*, vol. 54.2, pp. 297-330.
13. Swan, Gerry 2009, “Tools for data-driven decision making in teacher education: Designing a portal to conduct field observation inquiry”, *Journal of Computing in Teacher Education*, vol. 25.3, pp. 107-113.
14. Araka, Eric, et al 2020, “Research trends in measurement and intervention tools for self-regulated learning for e-learning environments—systematic review (2008–2018)”, *Research and Practice in Technology Enhanced Learning*, vol. 15, pp. 1-21.
15. Bartlett, Marian Stewart, and Jacob Whitehill 2012, “Automated facial expression measurement: Recent applications to basic research in human behavior”, *Oxford Handbook of Face Perception*, Oxford Library of Psychology, pp. 489–514.
16. Parkinson, Eric 2007, “Practical modelling and hypothesis testing in primary design and technology education”, *International Journal of Technology and Design Education*, vol 17, pp. 233-251.
17. Romero, Cristóbal, and Sebastián Ventura 2010, “Educational data mining: a review of the state of the art”, *IEEE Transactions on Systems, Man and Cybernetics*, Part C (applications and reviews), vol 40.6, pp. 601-618.
18. Zirkel, Sabrina, Julie A. Garcia, and Mary C. Murphy 2015, “Experience-sampling research methods and their potential for education research”, *Educational researcher*, vol. 44.1, pp. 7-16.
19. Ashraf, Mudasir, Majid Zaman, and Muheet Ahmed 2020, “An intelligent prediction system for educational data mining based on ensemble and filtering approaches”, *Procedia computer science*, vol. 167, pp. 1471-1483.
20. Tai, Joanna Hong Meng, et al 2017, “Implementing peer learning in clinical education: a framework to address challenges in the “real world” ”, *Teaching and learning in medicine*, vol. 29.2, pp. 162-172.
21. Zhang, Jinbao, et al 2015, “Innovation scale-up of ICT in education in China”, *Scaling Educational Innovations*, pp. 179-195.
22. Murray, Joy 2009, “The wider social benefits of higher education: What do we know about them?”, *Australian Journal of Education*, vol 53.3, pp. 230-244.
23. Kleinschmidt, Stefan, Christoph Peters, and Jan Marco Leimeister 2019, “How to scale up contact-intensive services: ICT-enabled service innovation”, *Journal of Service Management*, vol. 31.4, , pp. 793-814.
24. B. Pansri, V. Thongchotchat, and K. Sato 2023, “Leveraging DISC Personality Principle and Gamification for Enhancing Collaborative Skills in Education: A Conjecture Mapping Approach”, *The 7th International Conference on Information Technology (InCIT)*, pp. 114-119.