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CSF AND INFLUENCE OF ITS ON 4D EDUCATION : SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Computer literacy has evolved to become more integrated with AI approaches as technology advances, enabling the development of an adapted education system. Intelligent Tutoring System (ITS) is the name of this system. ITS is a system of tutoring that uses technology to provide assignments without the need for an educator to be there. A systematic literature review(SLR) was conducted in this study to identify the factors of an intelligent tutoring system, the determining factors for the success of ITS perpetration in the 4d-education framework, and the results are presented. The system used in this literature review is the prism system. The Prisma system uses the SLR protocol to search, opt for literature, recapitulate substantial results, and propagate results. The SLR protocol consists of determining a research question, searching for scientific reference sources with the keyword intelligent tutoring system, sorting out the appropriate articles, and making conclusions. This article provides a detailed overview of how the critical success factors and influence of ITS are related to 4D education. Our contribution is in the form of complete information regarding the ITS components that influence 4d-education related to the factors that determine the successful use of IT in higher education to improve learning and practical use of this technology.
Keywords: *Components, SLR, Its, Intelligent Tutoring System*.

1. INTRODUCTION

Intelligent Tutoring Systems (ITS) can help realise effective learning with the help of computers and without the support of a human teacher. For example, strengthening the knowledge gained in lectures or processing homework can be supported usefully by ITS[1]. Based on the results of these achievements, ITS is focused on a model that combines learning styles, a learning model that is understood as part of education, user attention levels as cognitive psychology, and estimates of students' ability to use learning to create pathways to complete computer-based courses with the shortest time and highest performance[2]. For tutoring systems, this description illustrates that although tutoring systems vary significantly in task domain, user interface, package structure, database, etc., their behaviour is very similar. Many consider human tutoring the most effective teaching method globally, and empirical studies confirm that professional human tutors provide excellent academic results. SRL has numerous confines, including cognitive, affective, and metacognitive processes. Cognitive strategies include note-taking, summarising, and making consequences used during thinking, understanding, and problem-working. In discrepancy, metacognitive processes involve making learning judgments and passions of knowing while covering the product of strategy use. Affective processes include scholars' feelings and how they regulate them to ameliorate literacy. Exploration shows positive emotions can impact learning further than negative ones [3].

2. THEORITICAL FOUNDATION

Intelligent tutoring systems (ITS) are computer systems supported by integrated intellectual techniques that simulate tutors who know what they are teaching, how to lead, and how to communicate their knowledge and ideas. As a result, they are included in precious banking systems. After 40 years of research and development, today's intelligent tutoring system results from all that work. Many different designs are made, used, and tried out as part of the teaching process at schools and universities. It has been possible to agree on the sound's architectural design—an intelligent tutoring system(ITS). Intelligent Tutoring System(ITS), which is an elaboration of Computer–Aided Teaching(CAI), is a form of information and communication technology which is included in educational technology and has endured five stages of development. The first phase was intuitive guidance on the 17th-18th. century and the main factor was textbooks with non-fiction and visual images. A necessary step was visual teaching of the 19th and 20th centuries, supplemented by visual remains in the form of illustrations, slides and pictures. The third phase was audiovisual teaching from the 1920s to the 1950s with more advanced media such as educational television. The fourth phase was audiovisual broadcasting from the 1950s to the 1970s, when network systems such as PLATO first appeared. The fifth stage is information and communication technology in the 1970s [4]. CSF is usually used to implement various business company strategies and programs smoothly. This refers to the limited number of objective areas that will guarantee the successful competitive performance of the organisation if it meets and satisfies the demands of constant attention from directors in the named regions. CSF covers critical factors where performance is essential to achieving organisational success. thus, there must be a strong focus on these factors to achieve [4]. Although dimensions and CSFs are critical for organisational success, this research can help the successful implementation of ITS components that influence 4d-education. The goal of the 4D Education Framework is to define and summarize the field of ecology for students, encouraging professionals to pursue national certification efforts that will lead to the formalization and validation of best practices in environmental education and ultimately to increased environmental literacy[5].

ITS typically has modules instructor, student, expert information, and user interface. The purpose of the module and the name is to unify and strengthen understanding in this work. The teacher module is responsible for making pedagogical statements and implementing pedagogical instructions. This module requires an algorithm to determine the threshold of intervention of ITS in the learning, making it operational and recommending content. Student module terms for saving, updating and restoring student biographies. The expert knowledge module must represent and manipulate the literacy researchers and provide input to the tutor module to perform its tasks. Modular interface modules allow researchers to interact with the content and gestures of an ITS person[6].

3. METHODOLOGY

A systematic literature review is a lengthy document examination approach. The implementation is divided into three stages, namely introducing the research topic, determining the scope of the research, and determining the research subject. After that, you should look for sources and keywords to include. Finally, develop inclusion and exclusion criteria to classify study types and collect data from studies that require additional investigation and analysis using meta-analysis(PRISMA)[7]. Soon after, we provide SLR to identify the determinants of success and the influence of intelligent teaching system components on 4D education. Figure 1 displays the PRISMA process for data collection and analysis.

3.1. Search Strategy

Papers from the Scopus database were searched for 2020 to 2023 (November 6) using publish and perish. The search string is an intelligent tutoring system.

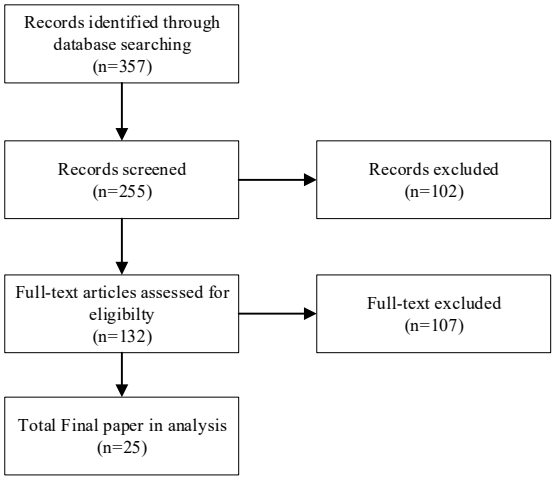

Figure 1. The process of PRISMA for data collection and analysis

3.2. Literature Search Research

The review looked at 359 articles from all sources. Of the 359 articles assessed, 107 were chosen as contenders based on their titles and edited works. Following review, only 25 publications could be utilised in this study.

4. RESULTS

4.1. Selection Literature Review

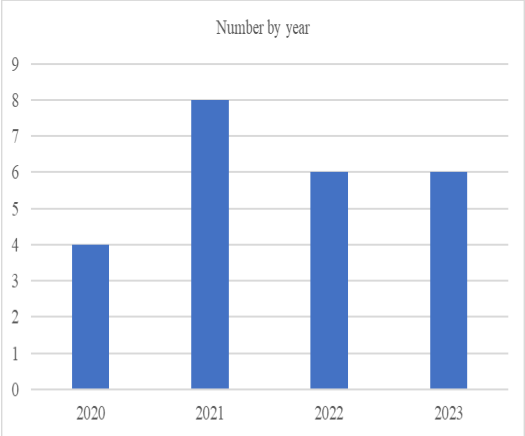

Figure 2. Demographic and trend characteristics

From the data paper, 25 papers were selected from 2020 to 2023, most of which were 8.

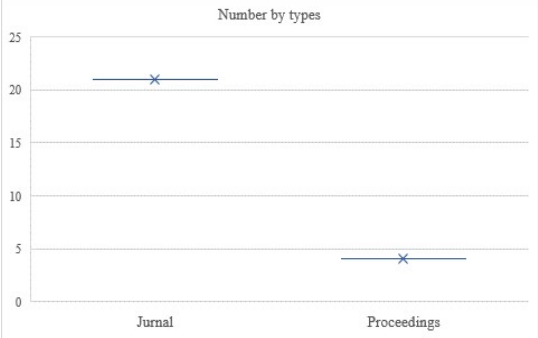

Figure 3. Number of articles by type

The selected data paper consists of 25 documents consisting from 21 journals and 4 proceedings.

4.2. Summarize Evidence

Specifically, this investigation aimed to discover the components of a higher education intelligent tutoring system. A summary of the demographic characteristics and trends discovered in the "selected studies" may be found in the next section. Each piece of information includes (i) the publication's source, (ii) the year it was published, (iv) a classification of dynamic components, and (v) a mapping of e-learning approaches from relevant articles.

You can find the journal identifier, title, year, kind, and title of the journal or conference on the following pages.

Table 1. Publications Sources

No	Title	Year	Type
1	Intelligent tutoring systems: a systematic review of characteristics, applications, and evaluation methods	2021	journal
2	How are students' emotions related to the accuracy of cognitive and metacognitive processes during learning with an intelligent tutoring system?	2021	journal
3	Student acceptance of intelligent tutoring systems during COVID-19: The effect of political influence	2021	journal
4	Examining the relationship between emotion variability, self-regulated learning, and task performance in an intelligent tutoring system	2021	journal
5	A Systematic Review of Literature on the Effectiveness of Intelligent Tutoring Systems in STEM	2021	proceedings
6	Intelligent tutoring system as a tool of formative assessment in design education	2021	proceedings
No	Title	Year	Type
7	Responsive student model in an intelligent tutoring system and its evaluation	2021	journal
8	Combined inner and outer loop feedback in an intelligent tutoring system for statistics in higher education	2021	journal
9	A systematic literature review of intelligent tutoring systems with dialogue in natural language	2020	journal
10	Design framework of adaptive intelligent tutoring systems	2020	journal
11	Understanding the Implications of the Use of Intelligent Tutoring Systems in Driver Training	2020	proceedings
12	Intelligent tutoring systems' measurement and prediction of students' performance using predictive function	2020	journal
13	Intelligent tutoring systems in education: a systematic review of usage, tools, effects and evaluation	2023	journal
14	Performance increases in mathematics during COVID-19 pandemic distance learning in	2023	journal

	Austria: Evidence from an intelligent tutoring system for mathematics		
15	Supporting skill integration in an intelligent tutoring system for code tracing	2023	journal
16	Game-based assessment tool using the convergence of gamification and motivation theory in an intelligent tutoring system	2023	journal
17	A systematic review of intelligent tutoring systems based on Gross body movement detected using computer vision	2023	journal
18	Intelligent tutoring systems for word problem-solving in COVID-19 days: could they have been (part of) the solution?	2023	journal
19	Meta-Affective Behaviour within an Intelligent Tutoring System for Mathematics	2022	journal
20	Intelligent Tutoring System for Computer Science Education and the Use of Artificial Intelligence: A Literature Review	2022	journal
21	Design of an Intelligent Tutoring System to Create a Personalized Study Plan Using Expert Systems	2022	proceedings
No	Title	Year	Type
22	An intelligent tutoring system to maintain the students' motivation	2022	journal
23	Few-Shot Question Generation for Personalized Feedback in Intelligent Tutoring Systems	2022	journal
24	A graph-based approach to learner profiling in an intelligent tutoring system	2022	journal
25	Understanding the Implications of the Use of Intelligent Tutoring Systems in Driver Training	2020	journal

4.3. Disseminate Result

The CSF and Influence ITS of the selected papers are presented in Table 2.

Table 2. CSF and Influence it's on 4D-Education

Dimension	Critical Success Factor	Knowledge	Skills	Character	Citation
System Maturity and Quality	Feedback	√			[8][9][10] [1][11][2] [12][13] [14][15] [16][3]
	Adaptive Hints	√			[11][17] [18]
	Adaptive recommendations	√			[8][10]
Information Quality	Adaptive learning materials	√	√		[8][10][1] [17][14] [6][16][3]
	Adaptive learning path navigation	√	√		[2][18]
Service Quality	Presents practice questions	√	√		[8][14][1 5]
	Presenting the final test	√	√		[8][1][19] [11][12] [20][13][14][15] [16]
	Knowledge Evaluation			√	[8][6]
	Performance evaluation			√	[8][10][1] [2][21] [22][13] [18][23] [24]
	Skills Evaluation		√		[8][25] [18]
Dimension	Critical Success Factor	Knowledge	Skills	Character	Citation
User satisfaction	Learning Style			√	[8][10] [2]
	Knowledge level	√			[8][26] [27]
	Influence/Affect			√	[8][24]
	Characteristics			√	[8]
	Communication			√	[8][10] [23]
	Exercise difficulty level		√		[10][18]
Intention to use	Material classification	√			[8][28]
	Topic Interest	√			[2]
	Important topic	√			[2]
	Topic Utilities	√			[2]
	Efficacy Topic	√			[2]

4.3.1. System maturaty and quality

This paper discusses 3 critical success factors in the System Maturity and Quality dimensions, including;

4.3.1.1. Feedback

Behavior in the learning process includes interaction or feedback with the system, time to learn, number of clicks, etc., which were the most common attributes. [9]. The feedback information can be represented and sent through text, numerical data, visual, speech or audio, and others[10]. Content adaptation was generally used, based chiefly on such criteria as feedback, student level, student learning and cognitive styles, and student performance. To adapt, the user profile was first determined and then implemented[11]. The control of the generated feedback by the teachers before sending it to the students showed that not all designs could be evaluated by the system in a target-oriented way and had to be corrected manually[1]. Additionally, the results indicated that good quality feedback (rated by two human experts) correlates with students' progress through the dialogues (rated by two human experts) and with learning. This finding suggests that students utilise the system's feedback and can extract the necessary information to improve their explanations[12]. The students' feedback shows some promising comments and will be a recommendation for adaptive learning systems[2]. Elaborate inner loop feedback was provided as a domain reasoner for tasks where students set up hypothesis tests. Students with prior domain reasoning experience benefited from this feedback on hypothesis testing tasks, but students with no experience did not.[13]. To give immediate feedback to learners, ITS must be suitable to interpret scholars ' generally complex responses. ITS should also be suitable to estimate the degree of mastery of each pupil on the underpinning knowledge of a particular subject. Through the mentioned capabilities, ITS's training geste can be acclimated according to individual scholars [14]. Provide the learner with performance feedback to reward their performance[15]. Provide empirical evidence that emotionally charged feedback affects students differently personalities while studying. Overall, these findings highlight the importance of considering student influences on learning [16]. ITS is an artificial intelligence application designed to provide immediate and personalized instruction or feedback to students, usually without the intervention of a human teacher[17]. At completion, partisipants were given a 30-item posttest, followed by a series of tonal report questionnaires about their passions and feedback about the system. Actors were also researched, paid and thanked for their time. Before literacy, actors were randomly assigned to either the prompts and feedback or the control condition [3].

4.3.1.2. Adaptif hints

In general, intelligent transportation systems provide feedback and guidance for each step of the problem-solving process. In some cases, input and feedback appear as soon as the student completes a step; in other cases, ITS waits until the student has presented a complete solution[12]. This module focuses on adaptive feedback, questioning, generating recommendations, navigating the learning path, and presenting adaptive learning content[9].

4.3.1.3. Adaptive recommendations

The core of this module is adaptive recommendation generation, learning path navigation and adaptive training content presentation[9]. Recommendations are made for ITS developers to improve service quality and for educators to rethink their role in reforming Internet education through ITS[4].

4.3.2. Information quality

This paper discusses 2 critical success factors in the Information Quality dimensions, including

4.3.2.1. Adaptif learning materials

The systems presented in these articles are designed using technology to effectively provide attractive and high-quality learning environments, produce high-quality learning materials and adapt content to different levels and needs[11]. The first concerns system-related factors that lead to behavioral intentions. For example, perceived ease of use and usability, quality of technical systems and quality of content and information, playfulness, perceived value, digital friendliness, etc. The second is factors related to learning/teaching services, such as learning content and learning planning. . material, which facilitates requirements and communication. The third concerns individual factors such as teacher characteristics, subjective norms and social image, self-confidence and resistance to change, visible personality, innovation, importance of analysis, optimism, discomfort, uncertainty, anxiety, self-efficacy and satisfaction, etc.[4] . In addition to comprehensive learning platforms that provide learning materials and communication options, interactive and adaptive learning programs are also developed for many subjects[1]. Teachers must model the learning process in INTUITEL in relation to their learning materials and strategies,

and INTUITEL handles this modeling in an ontology-based way. [7]. Commonly used cognitive learning strategies and metacognitive monitoring processes help students ensure they understand complex material [3].

4.3.2.2. Adaptif learning path navigation

The student's learning path depends on the level of knowledge accumulation. Each lesson consists of topics; Subjects that have not been accumulated are the next goal in the learning process [2]. In the arithmetic solution of one-step text problems, combining these two requirements is easier, because these problems are mostly related to one solution path (one structure of relationships between quantities) and thus also to reasoning ability. necessary to solve the task corresponds to two interactive options[17].

4.3.3. Service quality

This paper discusses five critical success factors in the Service Quality dimensions, including;

4.3.3.1. Presents practice questions

ITS is used to practice punctuation rules or to practice argumentative strategies in law. Intelligent traffic systems can be considered as a support measure in the practice of certain processes or departments and their extensive implementation[1]. A scatterplot class guides the student to create and interpret a scatterplot, including choosing variables, placing them on the correct axes, labeling values on the axes, plotting points, and answering questions about the relationships shown on each graph[16] .

4.3.3.2. Presenting the final test

ITS describes learning ability using a standardized effect size, which is calculated as the difference between the mean posttest scores of the experimental and control groups divided by the standard deviation of the within-group population [12]. Analysis of three-way sequences involving confusion and frustration finds statistically significant relationships between sequences involving frustration and posttest scores, but not between sequences involving frustration and learning disability [16], [18].

4.3.3.3. Knowledge Evaluation

The expert module must present and process the learning content. The student and expert data modules provide input to the instructor module to perform its tasks. The user interface module allows students to interact with the content and operation of the ITS. Various vocabularies have been introduced in the ITS literature to describe the components of ITS. The general term is model instead of module. An Expert Knowledge Module (EKM) is sometimes called a Domain Model[9]. ITS has a classic four-module architecture known by various names in education. The first part is the experience module. This section contains information that the student wants to learn (domain knowledge)[9].

4.3.3.4. Performance evaluation

The assessment of changes in the performance of intelligent educational systems requires sufficient[23], and the assessment of the possibilities of the game-based assessment tool for its educational usability is positive. In addition, this system is open for anyone to review and use, so it can be applied to other online training programs [21]. A meta-analysis of ITS examined in more detail the types of trials conducted, particularly the appropriateness of control groups and the assessment tools used to assess the effectiveness of ITS as an educational tool[20].

4.3.3.5. Skills Evaluation

Some participants felt disadvantaged because they lacked gaming skills, while others were not motivated because they did not see leaderboard points as important [18]. The authors proposed a virtual reality driving simulator system including an intelligent control system to train users skills [25].

4.3.4. User satisfaction

This paper discusses six critical success factors in the User Satisfaction dimensions, including;

4.3.4.1. Learning style

First steps for students using the system for the first time. In this phase, learning styles are assessed and students are classified for material assessment in the next phase [2]. The second part is the student diagnostic module, or the student model, which is built from factors such as the student's level of knowledge, activities, responses, behavior, learning styles, knowledge gaps and other information collected about the student. and updated for learning. in the system[9]. These systems usually use content adaptation and are mainly based on criteria such as feedback, student level, student learning and cognitive styles, and student performance[11].

4.3.4.2. Knowledge level

System performance tests the system through various measurements. In addition, the evaluation of student performance evaluates the system and performance by examining the impact of ITS on students and #039; level of knowledge or skills [11]. Other parts of the system use the predicted progress of the ITS student model to adjust driving behavior and various other tasks. This article proposes a learner profiling method - accurate profiling of the learner and the level of knowledge about a certain course in the shortest possible time [26]. From the creation of simple systems that provide the same learning content, paths and approaches to all students, educators and researchers have moved to a higher level, namely personalized online learning[27].

4.3.4.3. Influence/Affect

A study was conducted in Austria that provides the first evidence of how Austrian students learning mathematics using an intelligent teaching system were affected by school closures during the COVID-19 pandemic [24].

4.3.4.4. Characteristics

ITS is an adaptive learning system that combines artificial intelligence technologies with learning methods. An important feature of this system is the ability to adapt learning activities and strategies to learner characteristics and needs [9].

4.3.4.5. Communication

ITS consists of four modules: the user interface module, which ensures the link between the system and the student; the student module, which contains important information about students; learning modules that include decisions about further education; and data modules containing thematic content [11]. In communication, ITS must provide the ability to estimate data loss related to the transmission of a specific message, knowing the probability distribution of possible messages. Basically, Shannon entropy measures the uncertainty and complexity of data based on a probability distribution [23].

4.3.4.6. Exercise difficulty level

Define the difficult parameters and select the appropriate material from the content of the study material [11]. Therefore, the FGI method does not aim to reach a specific consensus in the opinions of each participant. However, it is an assessment method that is mainly used when it is difficult to make interpretations based on quantitative data alone or when trying to understand a new field [18].

4.3.5. Intention to use

This paper discusses five critical success factors in the intention to use dimensions, including;

4.3.5.1. Material classification

Participants in the ITS are first classified into good and poor performers based on two performance indices. These variables represent the videos, texts, quizzes and tasks from the learning material that we selected when creating the course material[2].

4.3.5.2. Topic interest

Each topic has prerequisites that depend on the lesson and its content. Prerequisite courses are content that must be completed before other courses. In order to present the terms of each topic, it is necessary to create connections between topics so that students can easily track which material they follow first[2].

4.3.5.3. Important topic

Students' learning models play a key role in an intelligent teaching system and are a determining factor in the success of adaptive systems in education [2]. It is especially worth examining whether some approaches or ways of using technology (mainly teacher-mediated work) and other approaches or ways of using technology (mainly independent student work) have been too focused in research on tracking certain materials.), which can influence poor learning, is an important factor in today's educational environment and can be more productive in distance learning situations[17].

4.3.5.4. Topic Utilities

In addition to maintainability, most of the reviewed intelligent training systems used online interfaces such as ITSB, Auto Tutor, etc. in the development process. Also, the most intelligent participants in educational systems were university researchers, which confirmed the importance of ITS implementation in colorful university courses[28].

4.3.5.5. Efficacy Topic

We extend the study to examine how emotional variability interacts with other potentially influential factors analogous to those linked by experimenters. previous knowledge, metacognitive

factors, emotional regulation and motivational factors(e.g., bournes and tonal performance) are considered in pupil performance [23]. The third concerns individual factors similar to speaker characteristics 9, private morality and social image5, confidence and resistance to change, 11 big five personalities, 13 invention, applicability of analysis, instability, discomfort, instability, anxiety 15 and satisfaction, 7[4].

5. CONCLUSIONS

This research investigates the success factors and influence of an intelligent tutoring system on 4D education for higher education. In this Systematic Literature Review study, we conclude that the design of an intelligent tutoring system includes (i) student models, (ii) knowledge models, and (iii) interaction models that must refer to critical success factors and their influence on 4d education. These approaches are essential to apply to create smarter tutoring to improve the quality of the tutoring system. In addition, understanding the critical success factors for implementing information and tutoring systems can help students understand the content being studied more quickly. We argue that the proposed intelligent tutoring system map will be valuable reference material for researchers and higher education institutions producing products using learning technologies.

These documents must undergo a comprehensive evaluation. We define the determinants of the success of implementing an information system and the influence of the components of the student model, knowledge model, and intelligent guidance system interaction model on the 4D education framework. More research programs in intelligent tutoring systems are expected in the future. Personalised learning research focusing on learning styles can optimise online learning for better outcomes.

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