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Bridging the Gap: A systematic review of AI-powered smart learning Systems for addressing diverse student learning needs

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Abstract: The rapid evolution of artificial intelligence (AI) has transformed educational practices, with AI-powered smart learning systems (AI-SLS) emerging as powerful tools for addressing diverse student learning needs. This systematic review aims to assess the current state of research on AI-SLS, focusing on their key features, effectiveness, implementation challenges, and optimization strategies. Adhering to the PRISMA guidelines, the review analyzed peer-reviewed studies and grey literature from 2010 to 2023, employing a rigorous methodology to ensure transparency and reproducibility. The findings reveal that AI-SLS, through adaptive algorithms, natural language processing, and data-driven analytics, significantly enhance personalized and inclusive learning. However, their effectiveness is contingent on equitable access, teacher readiness, and alignment with pedagogical goals. Ethical concerns, technical limitations, and institutional resistance were identified as major barriers to implementation. To address these challenges, the review proposes strategies such as developing ethical guidelines, investing in infrastructure, and fostering stakeholder collaboration. The study contributes to the literature by highlighting the integration of advanced functionalities like emotion recognition and gamification, which represent a significant evolution in AI-SLS. Furthermore, it emphasizes the need for context-sensitive designs and scalable solutions to ensure inclusivity. By aligning technological advancements with ethical principles and practical considerations, this review provides actionable insights for educators, policymakers, and developers, ultimately advancing the goal of creating equitable and effective learning environments for all students.

Keywords: *Adaptive algorithms, AI-powered smart learning systems, Ethical challenges, Implementation barriers, Inclusive education, Optimization strategies, Personalized learning.*

1. Introduction

It is without any doubt that artificial intelligence (AI) is rapidly evolving and it has led to substantial changes in different sectors; however, education can be considered the biggest sector that can adopt the revolution of artificial intelligence. Recently, AI powered smart learning systems (AI-SLS) have appeared as tools dealing with students' varied and changing learning problems [1]. These systems involve use of state of art algorithms, machine learning (ML), natural language processing (NLP), and data analytics to create personalized, adaptive, and diverse learning environment [2]. However, despite their potential, AI-SLS integration into education practices have so far been uneven, in that they still lack understanding how AI SLS might combine to meet the diverse needs of learners in different contexts [3]. This systematic review focuses to fill in this gap by critically assessing the current status of AI-SLS and its effectiveness in meeting a variety of learning needs as well as the challenges and opportunities that would be brought in their use.

Personalized learning, according to educational theory, is a central principle meant to necessitate teachers to base their instruction on students' individual strengths and interests, and their gaps [4].

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The constraint the established methods of education face when delivering personalized learning is the limited resources with a larger pupil groups and many inclusion difficulties [5]. AI-SLS is a promising solution to educational problems because they can provide instant assessment and personalized feedback and learner need adjustments [6]. Building of AI based adaptive learning tools review students' performance metrics, identify the learning gaps, and deliver individualized lessons to help students to score better in their education [7]. AI-SLS allows teachers to make data driven instructional choices as this technology provides the essential student learning roadmap information [8]. AI-SLS shows great strength for educational necessities of various student groups with learning disabilities and language barriers and socio-economic problems [9]. ITS technology and Artificial Intelligence combination provides specialized support, and assessment assistance to students with special educational needs to enhance academic results [10]. English language learners (ELLs) are served through NLP based applications as a tool that makes the instant translation available as well as evaluates the knowledge, the way to pronounce and the grammar [6]. The described abilities enhance accessibility and learning equity, they provide all students with access to quality learning opportunities [9].

The deployment of AI-SLS faces various obstacles despite its updated implementations. These discussions in educational professional and policymaking bodies and research institutions have taken place over the possible ethical matters regarding student data privacy and choosing biased algorithms, and whether implementing AI will result in increasing social inequalities [11]. It is also two primary concerns over student data rights, data protection and potential abuses during practice of training the AI models with big datasets [8]. In accordance with Laak and Aru [12] algorithmic bias is the systematic discrimination present in AI systems and it poses threat to the AI-SLS in terms of fairness and inclusive nature. These identified challenges Mustafa, et al. [13] mean that education requires strong regulatory systems, ethical standards for the development of AI solutions.

The scope of success of AI-SLS in addressing different needs of learning is determined by its links to the educational principles and the existing educational framework [11]. Although AI has the potential to enable teaching and learning benefits, this occurs only within the constraints of variables such as educator preparation status and administrative school backing for the implementation with available technology systems [9]. As a result, teachers lack the necessary skills and confidence and thus use (or not use) AI-SLS in teaching practices poorly or at all [7]. In economically underdeveloped areas schools face the lack of the technology components necessary for the creation of learning environments such as hardware and software, as well as internet connectivity [14]. According to Roshanaei, et al. [15] a complete solution must align technological advancements with capacity development, policy adjustment, and collaboration with effective stakeholder cooperation.

This systematic review aims to contribute to the growing body of literature on AI-SLS by synthesizing empirical evidence on their efficacy, challenges, and best practices for implementation. By examining studies from diverse geographical, cultural, and institutional contexts, this review seeks to provide a comprehensive understanding of how AI-SLS can be leveraged to address the diverse learning needs of students. Specifically, the review addresses the following research questions: (1) What are the key features and functionalities of AI-SLS that support personalized and inclusive learning? (2) How effective are AI-SLS in improving learning outcomes for diverse student populations? (3) What are the major challenges and barriers to the implementation of AI-SLS in educational settings? (4) What strategies and recommendations can be derived from existing research to optimize the use of AI-SLS for addressing diverse learning needs? The research queries posed in this review are answered through systematic methodology through which studies from peer reviewed journals, as well as conference proceedings and grey literature, are selected and examined. This research investigation will lead to the conclusions that can be exploited by educators and researchers and policy-makers for using AI SLS to develop equal learning environment offering quality outcomes. The aim of this review is to accumulate knowledge from the theoretical-practical iterations to help in designing the structures and operation strategies and evaluation approaches for digital education advances in next generation.

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2. Methodology

2.1. Research Design

The research design for this systematic literature review is grounded in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, which ensure transparency, rigor, and replicability in the review process [16]. The primary objective of this study is to assess the current state of research on AI-powered smart learning systems (AI-SLS) and their effectiveness in addressing diverse student learning needs. To achieve this, the study adopts a structured, step-by-step approach that includes the identification of relevant literature, the application of inclusion and exclusion criteria, data extraction, quality assessment, and thematic synthesis.

Such methodical design allows researchers to investigate all research questions thoroughly alongside drawing conclusions from a strong examination of available literature. The research design contains multiple important components. A wide range of academic and grey literatures are thoroughly explored using peer-reviewed journal articles together with conference proceedings and books and technical reports. After selecting relevant studies researchers apply predefined criteria for screening materials to establish both high-quality and appropriate information. The information retrieval process of data extraction concentrates on retrieving precise data about research methods together with findings alongside theoretical backgrounds used in individual investigations. The research quality assessment process verifies the strong methodology of chosen studies before including them in the final synthesis. The systematic methodology enables researchers to conduct an unbiased evaluation of studies which reveals significant details about how AI-SLS assists learners with different needs.

2.2. Search Strategy

To ensure the comprehensiveness of the systematic review, a detailed search strategy was developed and implemented. The search was conducted across multiple academic databases, including Scopus, Web of Science, IEEE Xplore, PubMed, and ERIC, to identify studies examining the use of AI-powered smart learning systems in addressing diverse student learning needs. Additionally, grey literature, such as reports from educational technology organizations, policy papers, and white papers from institutions like UNESCO and the World Bank, was included to capture non-academic perspectives and emerging trends. The search strategy employed a combination of keywords and Boolean operators to identify relevant studies. The following search terms were used: ("artificial intelligence" OR "AI" OR "machine learning" OR "intelligent tutoring systems") AND ("smart learning systems" OR "adaptive learning" OR "personalized learning") AND ("diverse learning needs" OR "inclusive education" OR "learning disabilities" OR "language barriers" OR "socio-economic diversity"). Synonyms and related terms, such as "AI-driven education," "learning analytics," and "equity in education," were also incorporated to ensure a comprehensive search.

The research only analyzed studies which appeared in English from 2010 to 2023 with the aim to evaluate current advanced developments in this field. The duplicate initial search outputs required another evaluation through which researchers examined article titles and abstracts as they evaluated their connection to research questions. A systematic study selection procedure retained studies that showed direct involvement of AI-SLS in various educational environments. Key articles going through backward and forward citation tracking kept the search method iterative to locate relevant studies which initially missed during the first search operation. The chosen method ensures the review retrieves an extensive and well-representative collection of research about AI-powered smart learning systems and their effects on various student demographics.

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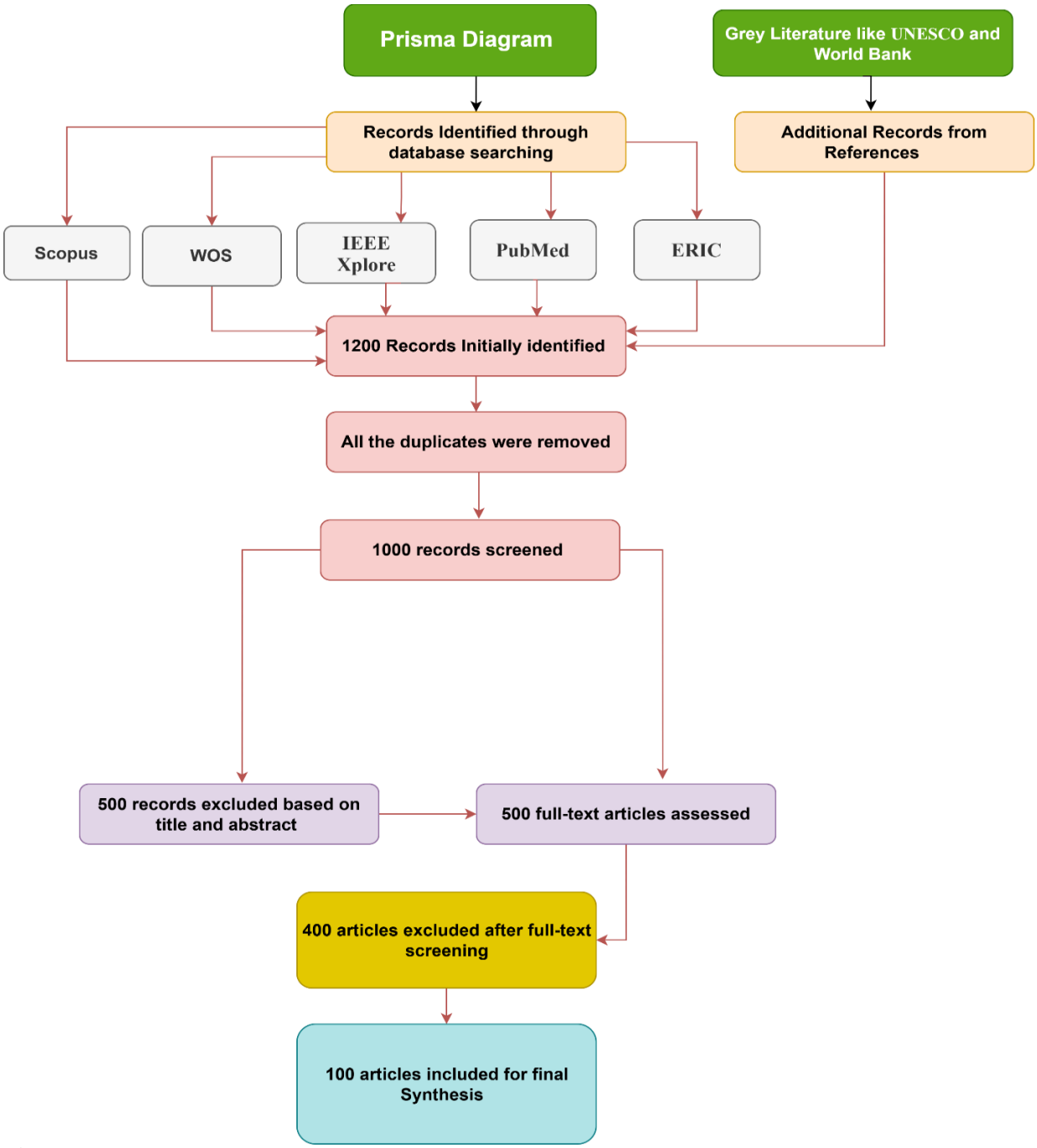

Figure 1.
PRISMA Diagram.

2.3. Inclusion and Exclusion Criteria

The specific requirements for study inclusion and exclusion in this systematic literature review guarantee both relevance and high quality and up-to-date nature of selected research. The research questions guide selection criteria to evaluate studies which examine both essential characteristics and

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performance outcomes as well as difficulties and improvement methods related to AI-SLS systems handling different student learning requirements.

2.3.1. Studies are Included if They Meet the Following Criteria

- They focus on the key features and functionalities of AI-SLS that support personalized and inclusive learning, such as adaptive algorithms, natural language processing, or data-driven analytics.
- They analyze the effectiveness of AI-SLS in improving learning outcomes for diverse student populations, including students with learning disabilities, language barriers, or socio-economic disadvantages.
- They examine the challenges and barriers to the implementation of AI-SLS in educational settings, such as ethical concerns, technical limitations, or institutional resistance.
- They provide strategies and recommendations for optimizing the use of AI-SLS to address diverse learning needs, including best practices for educators, policymakers, and developers.
- They are peer-reviewed journal articles, conference proceedings, or reputable technical **reports** published by recognized organizations (e.g., UNESCO, OECD, or leading educational technology firms).
- They present empirical data, case studies, or substantial theoretical contributions to the field of AI-powered education.
- They are published in English and fall within the publication period from 2010 to 2023**,** ensuring a focus on contemporary advancements in AI-SLS.

2.3.2. Studies are Excluded If

- They do not directly address the key features, effectiveness, challenges, or optimization strategies of AI-SLS in relation to diverse learning needs.
- They focus solely on non-educational applications of AI or lack a clear connection to personalized or inclusive learning.
- They are opinion pieces, editorials, or conceptual papers without empirical or theoretical support.
- They lack methodological rigor or fail to provide sufficient detail on research design, data collection, or analysis.
- They are duplicates, retracted publications, or inaccessible in full text**.**
- They are published before 2010**,** as the study aims to focus on recent developments in AI-powered education and its relevance to contemporary educational challenges.

The defined criteria serve to only accept studies which fulfill standards of quality and relevance as well as correctness and direct relationship to the research inquiries. The review adopts these evaluation criteria to support a methodical and dependable review process that enables the synthesis of present-day AI-powered smart learning system research with their effects on various student learning requirements.

2.4. Data Extraction

The data extraction system followed the literature search phase which enabled the collection of information from selected studies using structured data procedures. A standardized data extraction checklist helped researchers maintain consistency when collecting data from the selected studies to enable scientific analysis and comparison of findings. The evaluation focused on AI-powered smart learning systems (AI-SLS) and their ability to meet numerous learning requirements among students which involved measures of academic results together with student involvement and system accessibility as well as fairness. A comprehensive documentation was established for AI-SLS features that includes adaptive algorithms and personalized feedback mechanisms and data-driven analytics so researchers could understand how these technologies enable personalized and inclusive learning. The

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research extracted both practical implementation barriers and ethical issues together with technical restrictions and institutional opposition that negatively affect AI-SLS deployment within educational environments.

The extraction process aimed to document the study-based strategies along with recommendations which enhance AI-SLS utilization. The extracted material included recommendations and best practices which addressed three target groups of educator's developers and decision-makers along with methods to resolve the noted obstacles. A list of theoretical frameworks and models backing the published studies was recorded to help explain how AI-SLS is designed and implemented. A standard format was used for detailed study reviews while preserving consistent accuracy in recorded data. The demanding collection method produced extensive researched data which formed a strong base to scrutinize research queries while drawing definitive results.

Table 1.
Data Extraction Summary.

Category	Details Extracted	Purpose
Study Characteristics	Author(s), year, country, study design (quantitative, qualitative, mixed-methods), context (K-12, higher education).	To provide context and background for each study, ensuring a comprehensive understanding of the research setting.
Intervention Details	Type of AI-SLS (intelligent tutoring systems, adaptive platforms), key features (machine learning, NLP), implementation context (classroom, online).	To identify the technological and pedagogical features of AI-SLS and their application in diverse educational settings.
Population	Demographic details (age, educational level), specific learning needs addressed (disabilities, language barriers).	To understand the target audience and how AI-SLS caters to diverse student populations.
Outcomes	Key findings on effectiveness (academic performance, engagement, accessibility), metrics used.	To evaluate the impact of AI-SLS on learning outcomes and equity.
Challenges & Barriers	Reported challenges (ethical concerns, technical limitations, institutional resistance).	To identify obstacles in implementing AI-SLS and inform strategies for overcoming them.
Strategies & Recommendations	Best practices for educators, policymakers, and developers; suggestions for optimizing AI-SLS.	To provide actionable insights for improving the design, implementation, and scalability of AI-SLS.
Theoretical Frameworks	Models or frameworks used to underpin the analysis (e.g., personalized learning theories, adaptive learning models).	To understand the theoretical foundations guiding the development and evaluation of AI-SLS.

2.5. Quality Assessment

This review implemented quality assessment of studies as a quality control procedure. Multiple factors determine the quality assessment of each study starting with research questions followed by methods used and analysis and finishing with contribution to the field. The review gives more significance to research with empirical methods alongside theoretical explanations that present their foundations in detail. The reliability of original sources serves as an additional component for quality evaluation in the research.

2.6. Ethical Considerations

The systematic review observes the highest possible ethical standards for research by maintaining transparency and intellectual property respect from beginning to end. The study utilized all extracted data for academic scholarship while providing full credit to original study authors. Every result was presented in objective and accurate language while the review strictly prohibited both manipulation and misleading use of data. A declaration of potential conflicts of interest was implemented while external funding played no part in the review procedures or final results. The review protects its credibility through ethical principles which helps advance knowledge responsibility in the field of AI-powered smart learning systems.

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3. Result and Discussion

3.1. Overview of Themes

The findings of this systematic review are organized into four key themes that emerged from the analysis of the included studies. These themes provide a comprehensive understanding of the role of AI-powered smart learning systems (AI-SLS) in addressing diverse student learning needs. The first theme, Key Features and Functionalities of AI-SLS, explores the technological and pedagogical elements that enable personalized and inclusive learning. The second theme, Effectiveness of AI-SLS in Improving Learning Outcomes, examines the impact of these systems on academic performance, engagement, and equity for diverse student populations. The third theme, Challenges and Barriers to Implementation, highlights the ethical, technical, and institutional obstacles faced in integrating AI-SLS into educational settings. Finally, the fourth theme, Strategies and Recommendations for Optimization, synthesizes best practices and actionable insights for educators, policymakers, and developers to enhance the design and implementation of AI-SLS. Together, these themes offer a holistic perspective on the potential and limitations of AI-SLS in transforming education to meet the needs of all learners.

Table 2.
Identified Themes.

Theme	Description	Key Focus Areas
1. Key Features and Functionalities of AI-SLS	Explores the technological and pedagogical elements that enable personalized and inclusive learning.	Adaptive algorithms, natural language processing (NLP), personalized feedback, data analytics.
2. Effectiveness of AI-SLS in Improving Learning Outcomes	Examines the impact of AI-SLS on academic performance, engagement, and equity for diverse learners.	Academic achievement, student engagement, accessibility, inclusivity.
3. Challenges and Barriers to Implementation	Highlights the ethical, technical, and institutional obstacles in integrating AI-SLS into education.	Ethical concerns (e.g., data privacy, bias), technical limitations, institutional resistance.
4. Strategies and Recommendations for Optimization	Synthesizes best practices and actionable insights for enhancing AI-SLS design and implementation.	Best practices for educators, policymakers, and developers; scalability and adoption strategies.

3.2. Key Features and Functionalities of AI-SLS

The examination of selected studies demonstrates how AI-powered smart learning systems (AI-SLS) gain their ability to provide personalized and inclusive learning through their main features. The implementation of adaptive algorithms which modify content delivery with learner performance data became a vital aspect because it created customized learning pathways that support varied educational requirements. The system uses natural language processing tools for improving language education as it supports students through feedback for their written and spoken assignments. Learning gaps identification with anticipated outcomes and instructional-based decisions hinged on the extensive use of data-driven analytics. Through its entire feature set AI-SLS enables personalized educational pathways that benefit both students with different learning capabilities and backgrounds.

The study results maintain continuous alignment with past research findings while creating new knowledge branches. The review shows that adaptive learning technologies have developed sophisticated capabilities regarding their ability to analyze diverse learner datasets compared to previous research [17, 18]. The review expands past research by Kotz and Timm (2023) which showed intelligent tutoring systems (ITS) support individualization because it introduces NLP and multimodal data analytics for enhanced context-specific interaction capability. Multiple analysts have opposing views about the scalability aspects of these characteristics. The research conducted by Nsouli, et al. [19] supports effective AI-SLS scalability across educational contexts, yet technical requirements restrict its accessibility in settings with limited resources [20].

The review detects emerging functionality such as emotion recognition and gamification that previous studies had not thoroughly discussed [21]. The reviewed features help students maintain

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interest and stay motivated because they work especially well for students with learning disabilities as well as students who have difficulties learning with traditional teaching practices [22]. The reviewed literature showed ethical issues concerning data privacy protection as well as algorithm-based biases that correspond with present-day research findings [23]. The technological progress of AI-SLS emerges from studies but researchers need to study the ethical issues that come with these systems alongside developing proper regulations.

3.3. Effectiveness of AI-SLS in Improving Learning Outcomes

Researches done on the effectiveness of AI empowered smart learning systems confirm their effectiveness in improving student learning results of different bent of learners. The results obtained from research found that AI-SLS leads to positive results to raise student grades as well as improve student grades among students who have disability or came from an underprivileged background. Intelligent tutoring systems (ITS) help in problem solving skills and test scores due to the fact that they provide student personalized scaffolding and feedback [24]. The adaptive learning platforms has helped to achieve the reduction of the achievement gap that adapts content delivery to the student needs [25]. In education equity, AI-SLS demonstrates that it is effective in providing wonderful learning opportunities to students at any initial level.

The benefits of AI-SLS extend beyond grades to drive both student enthusiasm as well as motivational improvements [22]. AI-powered gamified learning platforms deliver exceptional results in both maintaining student attention and building students' growth mindset [26]. Student confidence and participation levels increase through NLP-based real-time feedback systems especially with language learners [21]. AI-SLS technology produces better cognitive results and strengthens emotional learning alongside behavior-related elements due to their critical value for educational success. AI-SLS demonstrates varying success levels in different learning scenarios together with diverse student populations. The research demonstrates different findings about learning outcome success with specific implementation fidelity and context-related obstacles noted Alam [27] demonstrated that AI-SLS implementation depends heavily on qualified instructor preparation and on how well technology reduces teachers' professional goals. The beneficiaries of AI-SLS do not receive equivalent advantages because low-resource educational settings typically lack sufficient infrastructure and limited availability of devices [20]. Research on AI-SLS effectiveness requires an examination of contextual variables because they show clear differences across groups.

The research outcomes of this study validate earlier studies and present additional findings to existing knowledge. The research of Diao, et al. [28] confirmed the benefits this system for learning success yet this review demonstrates that contemporary AI-SLS provides expanded features including combined data capture abilities and detailed feedback mechanisms. This review builds upon Kumar, et al. [29] by specifying adaptive algorithms and NLP techniques which serve as the mechanisms behind AI-driven educational improvements. There exists a differing set of opinions concerning whether AI-SLS systems can be expanded to fit various setups. The effectiveness of AI-SLS according to Alam [30] is supported yet Chou, et al. [31] and Badshah, et al. [32] indicate scalability issues due to ethical biases and practical hurdles like the digital divide. Research shows that Artificial Intelligence Enhanced Self-Learning Systems generate high learning results specifically through customized approaches for differing student requirements. The success of AI-SLS depends on proper execution and continuous teacher backing together with fair access to technological resources. Future educational research needs to tackle existing obstacles in order to achieve the full potential of AI-SLS technology in school transformation.

3.4. Challenges and Barriers to Implementation

The adoption of AI-SLS smart learning systems faces major implementation hurdles that block their potential use in educational institutions. Ethical challenges dominate the discussions about AI-SLS mainly through concerns about protecting student data privacy along with avoiding algorithmic biases.

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Student data privacy and ownership issues emerge because AI model training requires extensive databases [33]. AI-SLS may perpetuate prejudices that result in ethical dilemmas since algorithmic bias repeatedly magnifies biases in data which leads to increased inequalities instead of solving them [34]. Strong ethical frameworks together with clear AI practices must be implemented to create responsible applications of AI-SLS.

The main challenge in using AI-SLS stems from its technical constraints that become problematic in resource-limited environments. Several AI-SLS systems function best with high-speed internet connectivity and modern electronic devices that some areas lack modern technical capabilities [35]. The advanced nature of AI technology introduces barriers for schools lacking substantial IT departments since implementation and maintenance need specialized technical skills [36]. The technical implementation needs call for the creation of flexible affordable systems which work well in different educational environments. The adoption of AI-SLS encounters major challenges because institutions hesitate to embrace this technology. Educational leaders together with teachers demonstrate resistance toward AI technologies because they lack understanding of these systems and fear losing their jobs or doubt that AI-SLS can work effectively [37]. The implementation of AI-SLS suffers from poor usage or less-than-optimal results when its methods differ from traditional teaching methods. Conducting AI-SLS which fail to augment existing educational strategies in classrooms will create negative reactions instead of supportive benefits [38]. Proficient professional development along with combined engagement between all stakeholders becomes essential to satisfactorily deal with these apprehensions.

The agreement and development beyond previous documented information are easily proved through research findings. In this review, the review illustrates the technical and the ethical barriers have transformed into hard ends for adopting AI in education beyond the findings [37]. As demonstrated in past research by Abugabah, et al. [39] the resolution of teacher training is established as being crucial for successful implementation of AI-SLS; however, this review includes institutional resistance as another complex barrier that needs resolution. SI-SLS faces different opinions about its scalability capabilities. Abd Hamid, et al. [40] has suggested that if this planning and investment is done properly the challenge of implementing AI-SLS can be solved yet, Tawiah, et al. [41] states that this solution might be impossible to achieve in environments with limited resources.

3.5. Strategies and Recommendations for Optimization

The evaluation of AI-SLS potential and its deployment challenges produces various implementation strategies and recommendations which stem from examined research. AI-SLS should function under the protection of properly developed ethical regulations and framework requirements to maintain responsible system usage. Public officials together with institutions of education must work hand in hand to develop standards which define how students' data stays private and algorithms maintain transparency and security. AI-SLS adoption requires implementing the FAT principles during design which enables reduction of bias while promoting inclusion and fairness [42]. A multi-stakeholder approach that involves teaching staff as well as students and their parents during the design evaluation stage of AI-SLS will help detect possible ethical issues before product implementation. Participatory methods used in AI-SLS design ensure they match the core principles and service requirements of their target communities to establish trust and community acceptance.

Assistance with infrastructure development alongside capacity enhancement stands as a major necessity to remove existing technical and institutional obstacles. Federal organizations together with educational institutions need to make technological infrastructure development their funding priority because it guarantees equal AI-SLS access to schools lacking resources [43]. Educators need complete professional development training which should offer the necessary skills combined with knowledge needed to succeed at AI-SLS implementation in their classrooms. AI-SLS training must teach both technical competencies and teaching strategies that use AI-SLS for improved student achievements [44]. Education institutions should develop innovative collaboration practices that will facilitate change acceptance among their members. Schools that show teachers and administrators how AI-SLS delivers

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practical advantages and include them when making decisions will develop staff engagement leading to an accepting environment for tech adoption.

Adaptive, and context specific AI-SLS design is an important strategy to be used in order to put AI-SLS in various-ended educational environments. To satisfy this need, developers need to create flexible programming for their systems allowing them to be customized to particular educational requirements of particular learners groups and educational environments. By making the materials more inclusive by developing the multilingual functionality and culturally sensitive, AI-SLS becomes even helpful to the learners who do not speak the same language and come from different cultural background [45]. With open source AI-SLS platforms along with modular designs, AI-SLS implementations become more affordable and scalable and may reach more institutions. An uninterrupted research along with evaluations are the basis which on advance will make AI SLS stronger and prove it to be effective in the future. Research driven data collection into the implementation of AI-SLS and impact on the learners will allow developers and teachers to find out exceptional practices to solve future issues for better results by the student populations.

4. Discussion

This systematic review finds that AI powered smart learning systems (AI-SLS) could have broad transformative potential for addressing various student learning needs, and in doing so highlight the challenges and complexities that come with implementing such systems. First theme, key features and functionalities of AI-SLS, adaptive algorithms, natural language processing (NLP), data driven analytics are needed to provide personalized and inclusive learning experience. These results are in line with previous work by Al-Obaidi, et al. [17] who highlighted the use of adaptive technologies in tailoring education. In this regard, this review expands the existing literature by drawing attention to the integration of more sophisticated (emotional) functionalities, namely the presence of emotion recognitions and gamification, that were not highlighted to a significant extent in other studies. While these innovations represent a new wave of AI-SLS, they bring different possibilities for improving engagement and motivation, in particular of students with learning disabilities or who are not fitting a classical instructional setting. Despite this, there is still issue of data privacy and algorithmic social bias, as Barba, et al. [45] note, and technological advancements still need to ensure equitable and responsible use of such advancements only if accompanied by strong ethical frameworks.

Based on the second identified theme, second identified theme, AI-SLS systems improve academic performance and increase engagement as well as equity with various student groups. Similar results are obtained for the learning outcomes of the research comparing with the known findings of Ai, et al. [18] and Brew and Mantai [34] regarding the effectiveness of intelligent tutoring systems (ITS) in improving these outcomes. This review of modern AI-SLS brings up their new capabilities working with multiple data formats and serving sophisticated feedback to the students. However, recent technological developments don't improve the effectiveness level of AI-SLS. McCardle [20] and Chou, et al. [31] argues that infrastructure limitations, and digital inequalities which prevent the full advantages from being realized of AI-SLS most strongly obstruct use of AI-SLS in areas of little resources. Since it guarantees that all the students can capitalize on the advantages of AI-SLS systems, the necessity exists for both technology equity and adaptive implementation methods.

The third main theme investigates technical hurdles as well as institutional and ethical obstacles that do not allow the AI-SLS to be used on a large scale. This research by Gambo [22] confirms ethical handling in the context of supporting success of AI-SLS implementation. Although institutional resistance is less highlighted in existing academic literature, it is also enhanced by the review, which expands on this factor. No teaching staff or administrators have had much experience with AI-SLS and fear that it will cause them to lose their professional roles, so staff and administrators need intense training. According to Pulari and Jacob [21] they show plausible research to suggest that AI-SLS over utilizations if not in alignment with traditional educational methods. For AI-SLS implementation,

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collective reasoning between the instructors and political officials and programmers is required in order to develop and implement their education systems.

The fourth theme provides practical strategies that enable the most effective AI-SLS realization. Alam [30] research identified the need for scalable context sensitive AI-SLS, and acted as a motivation to design the algorithm. The review of this literature identifies necessary ethical frameworks and infrastructure development and workforce training program as key methods for reducing implementation challenges. To make AI-SLS more inclusive, there needs to be multilingual access and context that are relevant to different cultural backgrounds. The main goal, that is made to bring AI-SLS available and useful for every student with diverse backgrounds or abilities, is confirmed with these suggestions. Research outcomes show that AI SLS systems can transform educational settings since they are applicable for the students of different learning styles leading to the betterment of education.

4.1. Policy Implications for Practice

Research findings suggest that there is a sudden demand for overall policy structures that would help contribute to successful and moral operation of the AI powered smart learning system (AI-SLS) in the environments of education. Developing ethical standards is what government authorities need to priorities in dealing with the AI-SLS privacy, bias and transparency issues so that the agency works properly and ethically. Because this puts AI-SLS on an equal playing field as other innovations, it should be a priority to build new technological infrastructure for underserved areas. Funds must be spent on training and developing teaching methods for teachers to make the teachers succeed in using AI-SLS in their classrooms. The relationships between educators and developers and research professionals are key to whether AI-SLS is developed successfully, and that these relationships result with alignment between pedagogical goals and the institutional barriers. Adopting evidence based strategies will ensure that AI-SLS succeeds by creating an environment conducive to implementation, and creating a better education, with all student populations, that delivers.

5. Conclusion

This study used a complete evaluation to show how AI-powered smart learning systems help students with different learning needs. The study reveals AI-SLS technology can transform learning because its key functions let students and teachers make better use of adaptive learning algorithms and data analysis tools. AI-SLS proves good at making students learn better while keeping them more interested and helping all types of students achieve in school. bility in AI-based systems depends on multiple school factors like teacher readiness and match to academic objectives. Educational leaders must design technology programs at each school level to support its specific operational requirements.

However, implementation of AI-SLS is confronted by considerable problems, such as institutional resistance and ethical or technical limitations about implementing AI-SLS. Such barriers must be addressed with a multifaceted approach of ethical guidelines development, infrastructure development investment, as well as comprehensive professional development programs for educators. Policymakers and practitioners can therefore encourage collaboration amongst stakeholders who can seek to achieve equity and inclusivity in implementation of these AI-SLS while at the same time minimizing the risk posed by these technologies. By providing recommendations for optimizing the use of AI-SLS and drawing upon the related body of literature, this review encapsulates and contributes to growing body education on AI in education space. The findings ultimately demonstrate the necessity of the technological advancements to be in congruency with the ethical standards and practical perspectives to make the learning environments just and effective for all the students.

5.1. Limitations and Future Research

However, despite all of this, the reality of this systematic retrospective review reveals that the role of AI driven smart learning systems (AI SLSs) can resonate with students' learning need spectrum is not free from its own limitations. The inclusion of non-English studies may have created the risk that

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methodology used in a non-English context was excluded from the review, thereby excluding relevant research. It also includes the fast evolution of AI technologies, that some of the recent improvements might already be out of the published literature. Once more limited by the heterogeneity of the included studies including in terms of methodologies and context a narrative synthesis approach was adopted in order to avoid a meta-analysis. Future research should focus on longitudinal studies on the long term effect of AI-SLS on learning outcome and comparative studies to determine the effectiveness of AI-SLS on different cultural and socio-economic environment. In addition, an investigation into the moral ramifications of forthcoming AI characteristics, for example inheritance and enjoyment, will be essential in guaranteeing the loyal and equivalent utilization of AI-SLS in education. This would bridge the gap and produce a clearer and rounded picture of the potential and limitations of AI-SLS to be used in various educational settings.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Copyright:

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