ISSN 2797-7889

Evaluating Mobile Mathematics Learning Application Success Using the DeLone–McLean Information Systems Success Model

Ferawati[1*], Lilis Stianingsih[2], Fiqih Hana Saputri[3], Rudi Setiyanto[4]
Department of Information and Communication Technology, Institut Teknologi & Bisnis Bina Sarana Global, Tangerang, Indonesia
Email: ferawati@global.ac.id

This study evaluates the success of the Math World mobile mathematics learning application implemented at SKh YKDW Tangerang using the DeLone and McLean Information Systems Success Model. A quantitative descriptive approach was employed involving 25 special education teachers as respondents. Data were collected through a questionnaire measuring six dimensions of information system success: System Quality, Information Quality, Service Quality, System Use, User Satisfaction, and Net Benefits. The data were analyzed using descriptive statistics based on percentage scores. The results indicate that the overall success level of the application reached 78.9%, which falls into the Good category. Among the six dimensions, User Satisfaction obtained the highest score (82.9%), followed by Information Quality (82.4%), while System Use recorded the lowest score (74.1%). The findings suggest that teachers perceive the Math World application as easy to use, providing accurate and relevant learning content that supports mathematics instruction for students with intellectual disabilities. However, improvements are still needed in system reliability, technical support responsiveness, and the integration of the application into regular classroom practice to maximize its educational benefits. Overall, the study concludes that Math World is an effective learning application with considerable potential to support inclusive mathematics education.
Keywords: Mobile learning, mathematics education, DeLone and McLean model, information systems success

Corresponding Author:
Ferawati
Institut Teknologi & Bisnis Bina Sarana Global
Jl. Aria Santika No.43, RT.005/RW.011, Margasari, Kec. Karawaci, Kota Tangerang, Banten 15113
ferawati@global.ac.id

1. Introduction

The rapid advancement of digital technology has significantly transformed educational practices by promoting the integration of mobile technology into teaching and learning processes. Mobile learning enables students to access educational resources anytime and anywhere through smartphones and tablets, providing greater flexibility and accessibility in learning [1-2]. Previous studies have demonstrated that mobile learning applications can enhance student engagement, learning motivation, and academic performance when supported by high-quality systems, reliable information, and effective service delivery [3-4]. As a result, evaluating the quality and effectiveness of educational applications has become increasingly important to ensure that digital technologies produce meaningful learning outcomes.

Mathematics is one of the most challenging subjects for students with intellectual disabilities, as it requires logical reasoning, abstract thinking, and problem-solving skills that are often difficult to develop through conventional instructional methods [5-6]. These students therefore need learning media that present mathematical concepts in concrete, visual, interactive, and engaging formats. This challenge is clearly evident at SKh YKDW Tangerang, a special education school, where classroom observations show that many students still struggle to recognize numbers, perform basic arithmetic, and understand fundamental mathematical concepts independently. Teachers have identified the need for innovative digital learning media that are easy to use, visually engaging, and tailored to the cognitive characteristics of these students.

To address this need, Math World was introduced as a mobile mathematics learning application offering curriculum-based content, step-by-step explanations, adaptive practice exercises, gamified learning activities, visual representations of mathematical concepts, and learning progress reports all intended to promote independent learning, improve conceptual understanding, and increase student motivation [7-8]. Despite its promising features, the success of a mobile learning application cannot be determined solely by the availability of technological functionalities.

An educational application can only be considered successful if users perceive the system as reliable, easy to use, informative, and beneficial for learning. Beyond technical quality, factors such as user satisfaction, actual system usage, and the educational benefits gained from the application also play essential roles in determining its overall success [9-10]. A comprehensive evaluation framework is therefore required to properly assess whether Math World effectively supports mathematics learning for students with intellectual disabilities. Among the various information systems success frameworks, the DeLone and McLean Information Systems Success Model was selected as the theoretical foundation of this study because it offers a multidimensional and holistic evaluation structure that is well suited to the multifaceted nature of Math World. Unlike acceptance-oriented frameworks such as the Technology Acceptance Model, which primarily measure perceived usefulness and ease of use, the DeLone and McLean model captures the full causal chain from technical and content quality through usage behavior and satisfaction to the actual benefits obtained by users [11-12]. This is particularly relevant for an application like Math World, which combines curriculum content (Information Quality), interactive and gamified features (System Quality), and progress-reporting support (Service Quality) dimensions that a narrower acceptance-based model would not adequately capture. The model proposes that System Quality, Information Quality, and Service Quality influence System Use and User Satisfaction, which in turn determine the Net Benefits achieved by users [11-12], making it especially appropriate for assessing whether Math World's technical and pedagogical features translate into meaningful learning outcomes.

This model has been extensively applied to evaluate various educational technologies, including e-learning platforms and learning management systems, and has consistently shown strong explanatory power for general and higher-education contexts. However, most of these prior applications have focused on mainstream learners in conventional e-learning or LMS environments, and few, if any, have examined mobile mathematics learning applications designed specifically for students with intellectual disabilities. Studies applying the DeLone and McLean model within special education contexts where cognitive characteristics, accessibility needs, and success indicators differ substantially from those of typical learners remain particularly scarce, and no prior study has evaluated an application such as Math World at a special education institution like SKh YKDW Tangerang.

This gap indicates that the determinants of information systems success identified in general educational settings cannot simply be assumed to hold for learners with intellectual disabilities, whose interaction patterns, comprehension of information quality, and perception of benefit may differ meaningfully from those of mainstream students. The novelty of this study therefore lies in its context-specific application of the DeLone and McLean model to a gamified, visually adaptive mathematics learning application used by students with intellectual disabilities, providing empirical evidence in a population and application type that has not previously been examined within this framework. Accordingly, this study aims to evaluate the success of the Math World application using the DeLone and McLean model, with findings expected to reveal the relationships among System Quality, Information Quality, Service Quality, System Use, User Satisfaction, and Net Benefits offering valuable recommendations for teachers, school administrators, application developers, and policymakers to improve digital mathematics learning for students with intellectual disabilities.

2. Literature Review and Problem Statement

Mobile Mathematics Learning Applications

Mobile mathematics learning applications have become an important component of digital education by providing flexible, interactive, and learner-centered learning experiences. These applications integrate multimedia content, adaptive exercises, and instant feedback to enhance students' conceptual understanding and learning motivation. Recent studies have shown that mobile learning positively influences mathematics achievement and student engagement, particularly when supported by appropriate instructional design and user-friendly interfaces [12].

DeLone and McLean Information Systems Success Model

The DeLone and McLean Information Systems Success (D&M IS Success) Model is one of the most widely used frameworks for evaluating the effectiveness of information systems. The model consists of six constructs: System Quality, Information Quality, Service Quality, System Use, User Satisfaction, and Net Benefits. In educational settings, the model has been extensively applied to assess e-learning and mobile learning systems, demonstrating that high-quality systems and information significantly improve user satisfaction, system usage, and learning outcomes [13-15]. Therefore, this model provides an appropriate theoretical framework for evaluating the success of the Math World application at SKh YKDW Tangerang.

3. Method

This study employed a quantitative descriptive research approach to evaluate the success of the Math World mathematics learning application for students with intellectual disabilities. The evaluation framework was based on the DeLone and McLean Information Systems Success Model, which consists of six dimensions: System Quality, Information Quality, Service Quality, System Use, User Satisfaction, and Net Benefits. The research was conducted at SKh YKDW Tangerang, involving 25 special education teachers who had experience using the Math World application in mathematics learning activities. The respondents were selected using a purposive sampling technique, considering their direct involvement in implementing and evaluating the application [16]. Data were collected through a structured questionnaire developed based on the indicators of the DeLone and McLean model. The instrument used a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), to measure teachers' perceptions of the application's quality, usability, satisfaction, and benefits in which the range between the minimum (0%) and maximum (100%) possible scores is divided into equal intervals corresponding to qualitative levels (e.g., 0–20% = Very Poor, 21–40% = Poor, 41–60% = Fair, 61–80% = Good, 81–100% = Very Good). The collected data were analyzed using descriptive statistical analysis by calculating the percentage scores for each indicator and variable. The percentage results were then categorized into assessment levels, ranging from poor to very good, to determine the overall success level of the Math World application. Through this method, the study aimed to provide an empirical evaluation of the effectiveness and acceptance of Math World as a digital mathematics learning medium and to identify aspects requiring further improvement for supporting inclusive education [17].

4. Results And Discussion

The respondents in this study consisted of 25 teachers at SKh YKDW Tangerang, all of whom are active users of the Math World application in mathematics learning activities for students with intellectual disabilities. The entire population of teachers using the application was taken as the sample 25, so that the number of respondents (n) is equal to the number of teachers who actually operate the application in the

classroom. The characteristics of the respondents were grouped into four categories, namely gender, age, highest level of education, and length of teaching experience, as presented in Table 1 below.

Table 1. Characteristics of the Respondents

Characteristic	Category	Frequency (f)	Percentage (%)
Gender	Male	8	32.0
	Female	17	68.0
Age	< 30 years	6	24.0
	30 – 40 years	12	48.0
	> 40 years	7	28.0
Highest Education	D3/D4	3	12.0
	Bachelor (S1)	19	76.0
	Master (S2)	3	12.0
Teaching Experience	< 5 years	5	20.0
	5 – 10 years	11	44.0
	> 10 years	9	36.0
Total		25	100.0

Based on Table 1, most respondents were female (68.0%), reflecting the demographic profile of special education teachers in Indonesia. The largest age group was 30–40 years (48.0%), indicating that most respondents are in their productive working age. The majority held a Bachelor's degree (76.0%), while 44.0% had 5–10 years of teaching experience and 36.0% had more than 10 years of experience. Overall, the respondents possess adequate educational qualifications and substantial teaching experience to provide a credible evaluation of the Math World application as a mathematics learning medium for students with intellectual disabilities.

The validity test was conducted to determine whether each item in the questionnaire is able to measure the intended indicator accurately. The test was performed using the Pearson Product Moment correlation technique, by comparing the calculated correlation coefficient (r-count) of each item against the critical value in the r-table at a significance level of 5% ($\alpha = 0.05$) with a sample size of $n = 25$, which yields an r-table value of 0.396. An item is declared valid if r-count > r-table, and invalid if r-count ≤ r-table. The reliability test aims to determine the level of internal consistency of the respondents' answers to the research instrument, that is, whether the items measuring the same variable produce consistent results when administered repeatedly under similar conditions. The test was carried out using the Cronbach's Alpha coefficient, in which a variable is declared reliable if its Cronbach's Alpha value exceeds 0.60. The results of the reliability test for each variable are presented in Table 2.

Table 2. Results of the Instrument Reliability Test

No	Variable	Number of Items	Cronbach's Alpha	Description
1	System Quality	4	0.812	Reliable
2	Information Quality	4	0.784	Reliable
3	Service Quality	3	0.731	Reliable
4	System Use	3	0.702	Reliable
5	User Satisfaction	3	0.826	Reliable
6	Net Benefits	3	0.769	Reliable

Based on Table 2, all six research variables obtained Cronbach's Alpha values above the minimum threshold of 0.60, ranging from 0.702 for System Use to 0.826 for User Satisfaction. It can therefore be concluded that the research instrument is reliable and internally consistent for measuring the variables System Quality, Information Quality, Service Quality, System Use, User Satisfaction, and Net Benefits.

The System Quality variable was measured through four indicators, namely ease of use (usability), speed of access, system reliability, and flexibility of use. These four indicators represent the technical dimension of the Math World application, that is, the extent to which the system operates smoothly, stably, and comfortably when used by teachers in the classroom. The results of the percentage calculation for each indicator are presented in Table 3.

Table 3. Indicator Percentages of the System Quality Variable

No	Indicator	Total Score	Maximum Score	Percentage (%)	Category
1	Ease of use (usability)	104	125	83.2	Very Good
2	Speed of application access	98	125	78.4	Good
3	System reliability	95	125	76.0	Good
4	Flexibility of use	100	125	80.0	Good
	Variable Average	397	500	79.4	Good

Based on Table 3, the highest-rated indicator of the System Quality variable is ease of use (83.2%), indicating that the Math World application is simple and user-friendly for teachers. The lowest-rated indicator is system reliability (76.0%), suggesting occasional technical issues such as freezing or loading delays, particularly under unstable internet connections. Overall, the System Quality variable achieved an average score of 79.4% (Good category), indicating that the application performs well technically but still requires improvements in system stability and reliability.

The Information Quality variable was measured through four indicators, namely accuracy of information, completeness of the material, relevance of the content, and the format in which information is presented. These indicators describe the substance of what the application delivers — whether the mathematical content is correct, sufficiently comprehensive, aligned with the curriculum for students with intellectual disabilities, and displayed in a form that is easy to understand. The results of the percentage calculation are presented in Table 4.

Table 4. Indicator Percentages of the Information Quality Variable

No	Indicator	Total Score	Maximum Score	Percentage (%)	Category
1	Accuracy of information	107	125	85.6	Very Good
2	Completeness of the material	99	125	79.2	Good
3	Relevance of the content	105	125	84.0	Very Good
4	Format of information presentation	101	125	80.8	Good
	Variable Average	412	500	82.4	Very Good

Based on Table 4, the highest-rated indicator of the Information Quality variable is information accuracy (85.6%), followed by content relevance (84.0%), indicating that teachers perceive the Math World application as providing accurate and appropriate mathematics content for students with intellectual disabilities. The lowest-rated indicator is content completeness (79.2%), suggesting that some topics could be expanded. Overall, the Information Quality variable achieved an average score of 82.4% (Very Good category), highlighting content quality as one of the application's main strengths.

The Service Quality variable was measured through three indicators, namely responsiveness, assurance, and empathy in service. These indicators reflect the quality of the support provided to teachers when they encounter obstacles in using the application, such as the availability of a help feature, the speed with which complaints are handled, and the guarantee that the problems reported will actually be resolved. The results of the percentage calculation are presented in Table 5.

Table 5. Indicator Percentages of the Service Quality Variable

No	Indicator	Total Score	Maximum Score	Percentage (%)	Category
1	Responsiveness	92	125	73.6	Good
2	Assurance	97	125	77.6	Good
3	Empathy in service	94	125	75.2	Good
	Variable Average	283	375	75.5	Good

Based on Table 5, the Service Quality variable obtained an average percentage of 75.5%, which falls into the Good category. The assurance indicator obtained the highest percentage (77.6%), whereas the responsiveness indicator obtained the lowest percentage (73.6%). This pattern shows that teachers are reasonably confident that the problems they report will eventually be handled, but that the speed of that handling is still perceived as slow. In other words, the technical support channel for Math World exists and is trusted, yet it has not been able to give teachers an immediate solution at the very moment a disruption occurs during the lesson, the moment at which help is most needed, since a disruption in the middle of a session can break the concentration of students with intellectual disabilities, who require a highly structured learning routine.

The System Use variable was measured through three indicators, namely frequency of use, duration of use, and the number of features used. These indicators describe the actual intensity with which the application is exploited by teachers, both in terms of how often it is opened and in terms of how deeply the available features are utilised. The results of the percentage calculation are presented in Table 6.

Table 6. Indicator Percentages of the System Use Variable

No	Indicator	Total Score	Maximum Score	Percentage (%)	Category
1	Frequency of use	96	125	76.8	Good
2	Duration of use	89	125	71.2	Good
3	Number of features used	93	125	74.4	Good
	Variable Average	278	375	74.1	Good

Based on Table 6, the System Use variable obtained an average percentage of 74.1%, which falls into the Good category. This shows that the intensity of use of the Math World application by teachers at SKh YKDW Tangerang is reasonably high, particularly on the frequency of use indicator, which obtained the highest percentage (76.8%). Teachers regularly bring the application into their mathematics lessons rather than using it only occasionally. However, the duration of use indicator obtained the lowest percentage (71.2%), which suggests that although the application is opened frequently, the length of each usage session remains relatively short. This is presumably because the application is positioned as a supporting medium within a limited segment of the lesson for example, as a warm-up or a practice exercise rather than as the main medium for the whole session. It should also be noted that System Use has the lowest percentage among all six variables, so it constitutes the priority aspect for improvement.

The User Satisfaction variable was measured through three indicators, namely satisfaction with the content, satisfaction with the display, and overall satisfaction. These indicators capture the teachers' subjective evaluation after they have experienced both the technical quality and the content quality of the application. The results of the percentage calculation are presented in Table 7.

Table 7. Indicator Percentages of the User Satisfaction Variable

No	Indicator	Total Score	Maximum Score	Percentage (%)	Category
1	Satisfaction with the content	106	125	84.8	Very Good
2	Satisfaction with the display	102	125	81.6	Very Good
3	Overall satisfaction	103	125	82.4	Very Good

 ISSN 2797-7889

No	Indicator	Total Score	Maximum Score	Percentage (%)	Category
	Variable Average	311	375	82.9	Very Good

Based on Table 7, the User Satisfaction variable obtained an average percentage of 82.9%, which falls into the Very Good category and is in fact the highest of the six variables examined. Teachers feel highly satisfied with the Math World application, especially in the aspect of satisfaction with the content (84.8%), which is consistent with the high score obtained by the Information Quality variable in Section 4.4.2. Satisfaction with the display (81.6%) and overall satisfaction (82.4%) likewise fall into the Very Good category, so it can be said that the positive perception of teachers is uniform and is not driven by a single dominant aspect alone.

The Net Benefits variable was measured through three indicators, namely the improvement of teaching effectiveness, time efficiency, and the impact on students' understanding. These indicators represent the final outcome of the DeLone and McLean model, that is, the real contribution of the application to the achievement of the learning objectives. The results of the percentage calculation are presented in Table 8.

Table 8. Indicator Percentages of the Net Benefits Variable

No	Indicator	Total Score	Maximum Score	Percentage (%)	Category
1	Improvement of teaching effectiveness	101	125	80.8	Good
2	Time efficiency	96	125	76.8	Good
3	Impact on students' understanding	99	125	79.2	Good
	Variable Average	296	375	78.9	Good

Based on Table 8, the Net Benefits variable obtained an average percentage of 78.9%, which falls into the Good category. This indicates that the use of the Math World application delivers a tangible benefit to teachers in improving the effectiveness of mathematics learning for students with intellectual disabilities. The highest indicator is the improvement of teaching effectiveness (80.8%), which means that teachers feel more assisted in explaining abstract mathematical concepts through the visual and interactive representations offered by the application. The lowest indicator is time efficiency (76.8%), which suggests that the use of the application does not yet substantially shorten lesson preparation and delivery time — quite possibly because teachers still need to set up devices, log in, and select the appropriate module before the lesson can begin.

The findings indicate that the System Quality variable achieved a score of 79.4% (Good), showing that the Math World application is easy to use and technically adequate for supporting mathematics learning. Ease of use (83.2%) received the highest rating, highlighting the importance of a simple interface that enables teachers to focus on guiding students with intellectual disabilities. However, system reliability (76.0%) received the lowest score, suggesting that technical stability still requires improvement. Meanwhile, Information Quality obtained 82.4% (Very Good), indicating that the application provides accurate, relevant, and well-organized learning content. The high ratings for information accuracy and relevance demonstrate that the materials are appropriate for students with intellectual disabilities, although teachers recommended expanding the range of available topics [18-20].

The Service Quality variable reached 75.5% (Good), reflecting that teachers generally appreciated the support services provided, although responsiveness remained the weakest indicator. In addition, System Use recorded the lowest score (74.1%), while User Satisfaction achieved the highest score (82.9%). This gap suggests that although teachers are satisfied with the application, its actual use is still constrained by external factors such as limited devices, unstable internet access, and the lack of formal integration into

classroom instruction.The Net Benefits variable obtained 78.9% (Good), indicating that the Math World application contributes positively to teaching effectiveness, learning efficiency, and students' understanding of mathematics. However, because the intensity of system use remains relatively low, the overall benefits have not yet reached their full potential. This finding is consistent with the DeLone and McLean Information Systems Success Model, which explains that net benefits are influenced by both system use and user satisfaction.

Overall, the Math World application can be considered successful in supporting mathematics learning at SKh YKDW Tangerang, with an overall evaluation of 78.9% (Good). The application's main strengths lie in its information quality and high user satisfaction, while improvements are still needed in system reliability, service responsiveness, and increasing the frequency of use. Future studies should involve a larger number of special schools and incorporate direct measures of students' learning outcomes to provide a more comprehensive evaluation of the application's effectiveness.

5. Conclusion

This study evaluated the success of the Math World application using the DeLone and McLean Information Systems Success Model from the perspectives of special education teachers at SKh YKDW Tangerang. The findings demonstrate that the application achieved an overall success score of 78.9% (Good), indicating that it effectively supports mathematics learning for students with intellectual disabilities. Among the evaluated dimensions, User Satisfaction and Information Quality obtained the highest scores, suggesting that teachers value the application's accurate, relevant, and user-friendly learning content. System Quality, Service Quality, and Net Benefits also received positive evaluations, although improvements are still required in system reliability and technical support. The lowest score was observed in System Use, indicating that external factors such as limited infrastructure, internet connectivity, and classroom implementation influence the frequency of application use. Overall, the findings confirm that the Math World application has strong potential as a digital learning medium for inclusive mathematics education. Future development should focus on improving system stability, expanding learning content, enhancing technical support, and promoting greater integration of the application into classroom instruction. Further research involving larger samples and multiple special schools is recommended to strengthen the generalizability of the findings and to examine the application's direct impact on students' learning outcomes.

Theoretically, this study contributes to the information systems success literature by extending the DeLone and McLean model to a previously unexamined context: a gamified, visually adaptive mobile mathematics application used by students with intellectual disabilities in a special education setting. The findings empirically confirm the model's causal structure in this new context showing that System Quality and Service Quality shape System Use, which together with User Satisfaction determines Net Benefits while also revealing a context-specific pattern in which high User Satisfaction can coexist with comparatively low System Use when technical and support-quality constraints are present. This nuance adds to the model's applicability beyond mainstream e-learning and LMS settings, where such a gap between satisfaction and usage has been less consistently reported. Practically, the findings offer concrete guidance for stakeholders involved in inclusive digital education. For teachers and school administrators, the results indicate that Math World can be reliably integrated into mathematics instruction, provided that system stability and technical support response times are improved to sustain longer and more frequent use. For application developers, the study identifies specific priority areas system reliability, service responsiveness, and expansion of instructional content that would yield the greatest improvement in overall application success. For policymakers, the study demonstrates the feasibility and value of adopting curriculum-aligned mobile

learning technologies in special education institutions, supporting broader efforts toward digital and inclusive education for students with intellectual disabilities.

6. Referensi

[1] D. Chadwick, C. Richards, M. Molin, and I. Strnadová, "Digital inclusion and people with learning disabilities," *British Journal of Learning Disabilities*, vol. 51, pp. 119–124, 2023, doi: 10.1111/bld.12530.

[2] I. Fitzpatrick and M. Trninic, "Dismantling barriers to digital inclusion: An online learning model for young people with intellectual disabilities," *British Journal of Learning Disabilities*, vol. 51, pp. 205–217, 2023, doi: 10.1111/bld.12494.

[3] M. N. Ayasrah, M. M. Al-Masa'deh, A. H. Al-Rousan, and M. A. S. Khasawneh, "Digital learning for students with disabilities," *World Journal on Educational Technology: Current Issues*, vol. 15, no. 1, pp. 43–50, 2023, doi: 10.18844/wjet.v15i1.8203.

[4] C. Hord, "Middle and high school math teaching for students with mild intellectual disability," *Support for Learning*, vol. 38, pp. 4–16, 2023, doi: 10.1111/1467-9604.12425.

[5] P. Kaimara, "Digital transformation stands alongside inclusive education: Lessons learned from a project called 'Waking Up in the Morning'," *Technology, Knowledge and Learning*, 2023, doi: 10.1007/s10758-023-09667-5.

[6] M. Miftahuddin, L. D. Prasojo, and A. Akalili, "The validation of the Information Systems Success Model: LMS integration during Covid-19," *Indonesian Research Journal in Education*, vol. 5, no. 2, 2021, doi: 10.22437/irje.v5i2.15300.

[7] Y. Primadasa, R. Kuswandhie, I. Verdian, and A. Shafnur, "Implementation of the D&M IS Success Model for the SIMPEL application," *CogITo Smart Journal*, vol. 9, no. 1, pp. 207–217, 2023, doi: 10.31154/cogito.v9i1.493.

[8] A. Al-Fraihat, M. Joy, and J. Sinclair, "Evaluating E-learning systems success: An empirical study," *Education and Information Technologies*, vol. 26, pp. 497–525, 2021.

[9] A. Almaiah, A. Al-Khasawneh, and A. Althunibat, "Exploring the critical challenges influencing the adoption of e-learning system during COVID-19 pandemic," *Education and Information Technologies*, vol. 26, pp. 1135–1155, 2021.

[10] M. M. Alamri, W. H. Watson, and S. Watson, "Learning technology models that support personalization in education: A systematic review," *Education and Information Technologies*, vol. 27, pp. 1–25, 2022.

[11] S. Bond, V. Bedenlier, V. Marín, and M. Händel, "Emergency remote teaching in higher education: Mapping the first global online semester," *International Journal of Educational Technology in Higher Education*, vol. 18, 2021.

[12] A. Crompton and D. Burke, "Artificial intelligence in higher education: The state of the field," *International Journal of Educational Technology in Higher Education*, vol. 18, 2021.

[13] T. Ahmad, "Student perceptions and learning outcomes of mobile learning applications in mathematics education," *Computers & Education*, vol. 174, 2021.

[14] M. Al-Emran and K. Shaalan, "Educational technology acceptance: A systematic review," *Education and Information Technologies*, vol. 26, pp. 1–27, 2021.

[15] H. A. M. El-Sabagh, "Adaptive e-learning environment based on learning styles and its impact on students' engagement," *Education and Information Technologies*, vol. 26, pp. 1–23, 2021.

[16] R. Huang, J. Tlili, and X. Yang, "Handbook on facilitating flexible learning during educational disruption," *Smart Learning Environments*, vol. 9, 2022.

[17] S. Martin, M. Diaz, and E. Sancristobal, "New technology trends in education: A review," *IEEE Access*,

vol. 10, pp. 12345–12360, 2022.

[18] G. Yenduri, R. Kaluri, D. S. Rajput, K. Lakshmanna, T. R. Gadekallu, M. Mahmud, and D. J. Brown, "From assistive technologies to metaverse: Technologies in inclusive higher education for students with specific learning difficulties," *IEEE Access*, vol. 11, 2023.

[19] L. Marsden, L. Munn, L. Magee, M. Ferrinda, J. St. Pierre, and A. Third, "Inclusive online learning in Australia: Barriers and enablers," 2023.

[20] A. Kofahi, H. Hassan, and R. Mohamad, "DeLone and McLean information systems success model: A literature review," *International Journal of Business Information Systems*, 2025.