Design and Development of an Adaptive Multi-Platform Mobile Learning Application Using Chaining Technique for Children with Autism Spectrum Disorder

Bagoes Maulana[1], Harvei Desmon Hutahaean[2], Rosma Siregar[3], Saras Pratama[4], Putra Afriadi[5], Sidik Permadi[6], Dwi Febrina[7], Wira Yudha Pratama[8], Anjelita[9], Muhammad Bahrul Ilmi[10]

bagoesmaulana@unimed.ac.id[1], harvey11@unimed.ac.id[2], rosma.siregar@unimed.ac.id[3]

Computer and Informatics Technology Education Department, Faculty of Engineering, Universitas Negeri Medan, Indonesia 20221[1,2,3,4, 6,7,8,9,10],
Elementary School Teacher Education Department, Faculty of Educational Sciences, Universitas Negeri Medan, Indonesia 20221[5]

Abstract. This study presents a continuation of previous development research on an adaptive mobile learning application designed to support learning activities for children with autism spectrum disorder. While the core system architecture and development framework remain consistent, this study shifts its focus toward the validation and assessment phase of the developed application. The research emphasizes expert-based feasibility evaluation and user acceptability testing to determine the readiness of the system for broader implementation. The feasibility assessment was conducted by media and content experts, while acceptability data were collected from users through structured instruments. The results indicate that the application demonstrates a high level of feasibility and positive user acceptance, suggesting that the system is suitable for practical use and further refinement. This study contributes by providing empirical validation results and implementation insights that extend beyond the initial development phase of the application.

Keywords: autism spectrum disorder, adaptive mobile learning, expert feasibility evaluation, user acceptability, educational technology validation

1 Introduction

The global push towards inclusive education is a cornerstone of modern pedagogical philosophy, underpinned by legal frameworks that enforce the right to equitable education for all students, including those with disabilities. In Indonesia, this mandate is codified in regulations such as the National Education System Law No. 20 of 2003 and its implementing regulation, Permendiknas No. 70 of 2009. These policies explicitly affirm the right of children

with physical, emotional, mental, or social disabilities, as well as those with exceptional intelligence and talents, to receive an inclusive education tailored to their individual needs and abilities [1].

Children with Autism Spectrum Disorder (ASD) encounter significant challenges within inclusive settings, often exhibiting maladaptive behaviours that hinder their social integration and development [2]. These behaviours present considerable obstacles not only for the children themselves but also for their parents and educators, necessitating the application of structured behavioural modification techniques to foster more adaptive and socially acceptable alternatives [3].

The integration of technology offers a promising avenue to support such interventions. There is increasing scholarly interest in leveraging digital tools to aid the behavioural development of children with special needs [4]. Research has consistently identified Computer-Aided Instruction (CAI) as an effective, evidence-based practice for students with ASD, notably for improving academic and behavioural outcomes [5]. The predictable, consistent, and non-intrusive nature of digital devices aligns well with the learning preferences of many children with ASD, providing a comfortable medium that mitigates the anxieties associated with complex social interactions [6].

Aligned with this potential, this study builds upon a previously developed adaptive multi-platform mobile learning application that utilizes the chaining technique to support behaviour modification in children with ASD. While the core system design has been established, the present study focuses on the validation and evaluation phase of the application. The research employs the Multimedia Development Life Cycle (MDLC) model as part of an extended development process to examine the feasibility and acceptability of the implemented system. By embedding this proven behavioural methodology within a digital framework, the application serves as a practical tool for educators and parents, contributing to the advancement of inclusive educational technology.

Although various studies have reported the successful development of technology-assisted learning tools for children with ASD, many focus primarily on system design and functionality. Limited attention has been given to systematic validation involving expert feasibility assessment and user acceptability evaluation as indicators of readiness for real-world implementation. Therefore, this study extends previous development-oriented research by emphasizing expert-based media feasibility and user acceptability assessment. The findings are expected to provide empirical evidence regarding system readiness and offer insights for further refinement and deployment of adaptive mobile learning solutions in inclusive education settings.

2 Method

This study employed a research and development approach guided by the framework established by Borg and Gall [7] as part of an extended development cycle, focusing specifically on the validation and evaluation phase of an adaptive mobile learning application. While the core development framework follows established models, the emphasis of this research is not on initial system construction, but on assessing the feasibility and acceptability of the implemented application.

This approach is integrated with the systematic stages of the Multimedia Development Life Cycle (MDLC) model developed by Luther [8] to facilitate the creation and subsequent evaluation of the proposed mobile learning application. The primary objective of this combined methodological approach is to develop a functional and effective digital product and to assess its feasibility and performance in supporting behavior modification for children with autism spectrum disorder (ASD). In the present study, the R&D framework is positioned as part of an extended development cycle, with particular emphasis on the validation and evaluation phase of the implemented system. Rather than focusing on initial system construction, this research prioritizes feasibility assessment and user acceptability evaluation to determine the readiness of the application for practical use.

The R&D process was conducted iteratively with an emphasis on product refinement and validation rather than initial development. The research progression focused on the evaluation phase, including usability assessment and feasibility testing, to examine the performance of the implemented application in real usage contexts. Findings from this phase were used to identify improvement opportunities and to enhance the final version of the system. The comprehensive workflow, illustrating the integration of the R&D and MDLC stages, is presented in **Figure 1**.
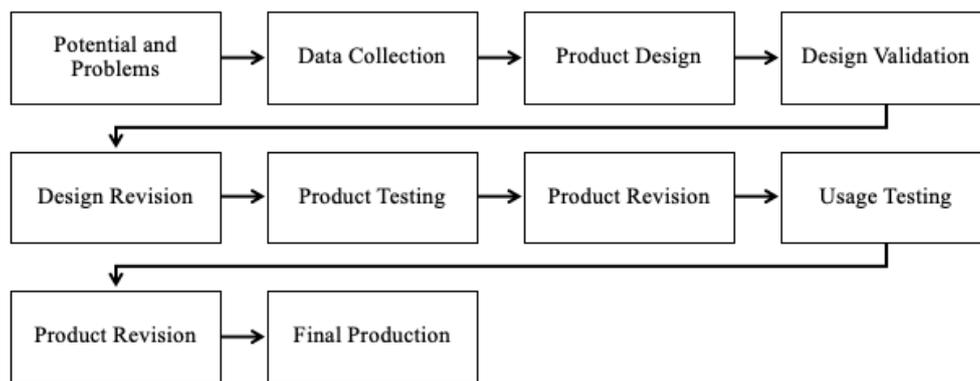

Fig. 1. The sequential phases of the R&D methodology, as conceptualized by Borg and Gall.

The MDLC model itself consists of six sequential stages: concept, design, material collection, assembly, testing, and distribution. An illustration of this developmental process is provided in **Figure 2**.
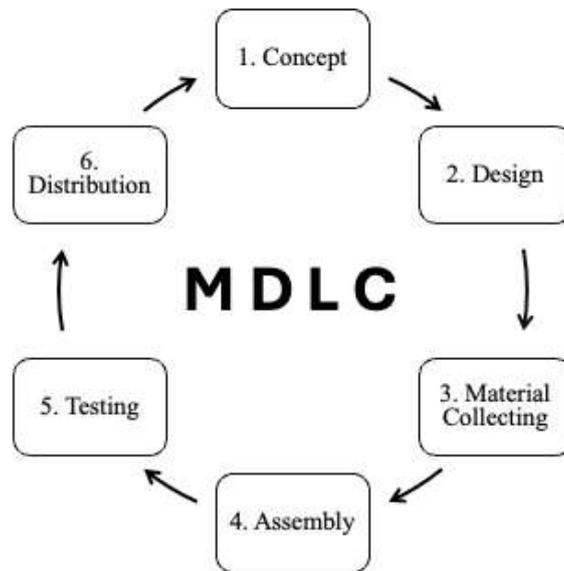
Fig. 2. The developmental stages of the MDLC model according to Luther.

In this extended study, the MDLC framework is applied as a validation-oriented process rather than a purely developmental one. Each stage of the MDLC is utilized to support systematic evaluation, refinement, and documentation of the implemented multimedia components. The testing and distribution stages are particularly emphasized to assess media feasibility, usability, and user acceptance, ensuring that the application meets both technical and pedagogical requirements prior to broader implementation.

Proposed by Luther in 1994, the Multimedia Development Life Cycle (MDLC) provides a systematic and specialized strategy for developing multimedia applications. A significant advantage of this model is its clear and structured methodology, which ensures that every phase of the project is executed in a methodical fashion, thereby minimizing potential errors and omissions [8]. The model is highly versatile and is well suited for a diverse range of multimedia projects. It emphasizes the integration of multiple media formats, including text, audio, and video, to achieve a unified and coherent final product [9].

Moreover, the MDLC places a strong priority on enhancing the user experience and incorporates iterative testing to facilitate continuous product improvement. Another notable benefit of this framework is its emphasis on comprehensive documentation and evaluation at each stage of the development process. This focus aids in the management of complex projects and simplifies future modifications. The distinct phases of the MDLC enhance overall project management efficiency by enabling effective resource allocation, meticulous scheduling, and consistent alignment with project goals. In summary, the MDLC offers a robust structure that supports the efficient development of multimedia applications through its integration of user centered design, iterative testing, and detailed documentation.

3 Results and discussion

The results of this study focus on the validation outcomes of the developed application, including expert feasibility assessment and user acceptability evaluation. These results provide empirical evidence regarding the readiness of the system for implementation and highlight areas for potential improvement.

3.1 Results

Expert Feasibility Assessment Results. The feasibility of the developed application was evaluated by experts using a structured assessment instrument. The evaluation covered key aspects of learning media quality, including interface design, content suitability, clarity of instructions, and alignment with the characteristics and needs of children with ASD. The results of the expert assessment indicate that the application achieved a high feasibility score across all evaluated aspects as given in Table 1. The overall feasibility percentage demonstrates that the learning media meets the criteria for instructional use and is considered appropriate for its intended educational context. These findings suggest that the multimedia components, interaction design, and instructional structure of the application are suitable for supporting adaptive learning activities. This evaluation was performed by two experts from the Computer and Informatics Technology Education Department at Universitas Negeri Medan and the school psychologist at Yayasan Pendidikan Shafiyyatul Amaliyyah.

Table 1. Results of the Media Feasibility Test

No	Aspects	E1	E2	Mean
1	Readability of text elements	5	5	5
2	Appropriateness of text layout and positioning	5	4	4,5
3	Suitability of font type and size	5	4	4,5
4	Effectiveness of color combinations in the learning media	5	4	4,5
5	Attractiveness of the overall interface design	5	4	4,5
6	Consistency of color usage throughout the application	5	4	4,5
7	Relevance of images to the learning material	5	5	5
8	Quality of image resolution	5	5	5
9	Logical placement of navigation buttons	5	5	5
10	Functional reliability of navigation buttons	5	4	4,5
11	Responsiveness of buttons and interactive features	5	5	5
12	Relevance of video content to the learning material	5	5	5
13	Appropriateness of video resolution	4	5	4,5
14	Clarity of instructions for using the learning media	3	3	3
15	Adequacy of product and media descriptions	5	5	5
16	Ease of use of the learning media	5	5	5

No	Aspects	E1	E2	Mean
17	Ease of searching for learning materials	4	5	4,5
18	Interactivity of the learning media	4	4	4
19	Accessibility and intuitiveness of menu and button structures	5	4	4,5
20	Application functionality under various connectivity conditions (online and offline)	5	4	4,5
	Total of Average	92,0		
	Category	Highly Feasible		

Based on the data presented in Table 1, the average score obtained from the media experts' evaluation was 92.0, which falls under the "Highly Feasible" category. These results indicate that the developed learning media is of high quality, meets design and functionality standards, and is deemed appropriate for use in educational settings. The positive validation from experts confirms the application's readiness for implementation and its potential to support effective digital learning experiences.

User Acceptability Evaluation Results. Following revisions based on expert feedback, the subsequent phase involved the implementation of a user trial to evaluate the acceptability of the application among its intended users [10][11]. The trial was conducted with 15 students diagnosed with autism spectrum disorder (ASD), with feedback collected through questionnaires administered to their parents or guardians. This approach aimed to assess the application's usability, engagement potential, and overall user satisfaction from the perspective of both learners and their families. The trial sought to gather insights into the following key areas: ease of use and navigability of the application, level of engagement and interaction during learning activities, user satisfaction with the application's features and content, and perceived effectiveness of the application in supporting behavioral and learning objectives [12][13].

To quantitatively evaluate user responses, qualitative data obtained from the questionnaires were converted into quantitative measures through a scoring system. Each response was assigned a numerical value based on a five-point Likert scale [14]. The resulting scores were then analyzed to determine the overall acceptability of the application and to identify areas requiring further refinement. This user-centered evaluation provides critical insights into the practical applicability of the application in real-world educational contexts and will inform future iterations aimed at enhancing its accessibility, functionality, and impact for children with ASD.

Table 2. User acceptability evaluation results

Student	Aspect				Total
	Learning	Material	Interface	Usability	
1	10	10	14	15	49
2	10	10	14	14	48
3	10	10	15	15	50

4	10	10	15	15	50
5	10	10	15	15	50
6	10	10	15	15	50
7	10	10	15	15	50
8	10	10	15	14	49
9	10	10	15	14	49
10	10	10	15	15	50
11	10	9	15	15	49
12	10	10	14	15	49
13	10	10	15	15	50
14	9	10	15	15	49
15	10	10	15	15	50
				Total	742
				Conversion	49,47
				Category	Highly Accepted

Based on the user acceptability evaluation results shown in Table 2, the application achieved an average score of 49.47, which falls under the category of "Highly Acceptable". This indicates that the developed learning media was well-received by both students and their parents. The high level of acceptability underscores the application's usability, engagement, and alignment with the needs of children with ASD, affirming its potential for broader implementation in educational settings.

Implications for System Readiness and Refinement. In addition to quantitative scores, the validation results provide important insights into the readiness of the application for broader implementation. The high feasibility and acceptability scores indicate that the system has reached a level of maturity suitable for practical use [10]. Furthermore, the evaluation outcomes highlight areas that can be refined to further enhance instructional clarity and user interaction. These findings serve as a basis for future improvements and support the continued development of adaptive mobile learning solutions for children with ASD.

3.2 Discussion

The findings of this study demonstrate that validation plays a critical role in determining the readiness of adaptive mobile learning applications for practical implementation, particularly in inclusive education contexts. Unlike development-oriented studies that primarily focus on system construction and functionality, this research emphasizes expert feasibility assessment and user acceptability as essential indicators of system maturity.

The high feasibility scores obtained from expert evaluation indicate that the application meets instructional media standards in terms of content suitability, interface clarity, and alignment with the learning characteristics of children with autism spectrum disorder (ASD). These results

suggest that integrating structured behavioral techniques, such as chaining, within a multimedia learning environment can produce instructional media that is both pedagogically appropriate and technically viable.

Furthermore, the positive user acceptability results highlight the importance of user-centered validation in educational technology research. Favorable user perceptions regarding usability, navigation, and learning experience indicate that the application can be effectively adopted by its intended users, including parents and educators. This finding supports previous research that emphasizes the role of intuitive interaction and predictable digital environments in facilitating learning engagement for children with ASD.

By focusing on validation rather than initial development, this study extends existing research on technology-assisted learning for children with ASD. The results provide empirical evidence that feasibility and acceptability assessments can bridge the gap between system development and real-world application. This validation-oriented approach strengthens the reliability of adaptive learning systems and supports their potential scalability in inclusive educational settings.

Overall, the findings suggest that adaptive mobile learning applications that have undergone systematic expert and user validation are better positioned for practical deployment. Future research may build upon these results by examining long-term usage, learning outcomes, or broader implementation scenarios to further enhance the effectiveness of adaptive educational technologies for learners with special needs.

4 Conclusion

This study focused on the validation phase of an adaptive mobile learning application designed to support behavior modification for children with autism spectrum disorder (ASD). Through expert feasibility assessment and user acceptability evaluation, the results indicate that the application demonstrates a high level of instructional feasibility and positive user reception. These findings suggest that the system is suitable for practical use in inclusive learning contexts and has reached a level of readiness for implementation.

By emphasizing validation rather than initial development, this research contributes empirical evidence that supports the importance of feasibility and acceptability assessments in educational technology studies. The outcomes provide a foundation for further refinement and broader deployment of adaptive mobile learning solutions for learners with special needs. Future research may explore long-term usage, learning effectiveness, and scalability to strengthen the impact of technology-assisted interventions in inclusive education.

References

[1] Rezieka, D. G., Putor, K. Z., & Fitri, M.: Faktor Penyebab Anak Berkebutuhan Khusus dan Klasifikasi ABK. Jurnal Pendidikan Anak Bunayya. Vol. 8 no. 2, pp. 40-53 (2021)

[2] Daulay, N.: Perilaku Maladaptive Anak dan Pengukurannya. Buletin Psikologi. Vol. 29 no. 1, pp. 45-63 (2021)

[3] Asri, D. N., & Suharni.: Modifikasi Perilaku: Teori dan Penerapannya. Madiun: UNIPMA Press (2021)

[4] Sansosti, F. J., Doolan, M. L., Remaklus, B. & Krupko, A.: Computer-assisted interventions for students with autism spectrum disorders within school-based contexts: a quantitative meta-analysis of single-subject research. Review Journal of Autism and Developmental Disorders. Vol. 2, pp. 128 (2015)

[5] Wong, C., Odom, S. L., Hume, K. A., Cox, A. W., Fettig, A., Kucharczyk, S., Brock, M. E., Plavnick, J. B., Fleury, V. P. & Schultz, T. R.: Evidence-based practices for children, youth, and young adults with autism spectrum disorder: a comprehensive review. Journal of Autism and Developmental Disorders. Vol. 45, pp. 1951–1966 (2015)

[6] Salter, T., Davey, N., & Michaud, F.: Designing & developing QueBall, a robotic device for autism therapy. The 23rd IEEE International Symposium on Robot and Human Interactive Communication, Edinburgh, UK, 25-29 August 2014, pp. 574-579 (2014)

[7] Borg, R.W. & Gall, M.D.: Educational Research and Introduction The Eight Edition. Sydney: Pearson Education, Inc. (2007)

[8] Luther, A. C.: Authoring Interactive Multimedia. Boston: AP Professional (1994)

[9] Putri, D. R. D., Fahlevi, R. M., & Putri, A. F.: Implementasi Metode Pengembangan Multimedia Development Life Cycle (MDLC) Pada Website Pembelajaran Sistem Multimedia. Jurnal Riset Sistem Informasi dan Teknik Informatika. Vol. 8 no. 1, pp.70-81 (2023)

[10] Maulana, B., Siregar, R., & Sinaga, T.: The Design of The Alumni and Career Development Center (ACDC) Application at Faculty of Engineering, Universitas Negeri Medan. In Proceedings of the 5th International Conference on Innovation in Education, Science, and Culture, ICIESC 2023, 24 October 2023, Medan, Indonesia (2024)

[11] Maulana, B., Feriyansyah, F., & Sari, R. D.: The Design of Web-based Thesis Management Information System to Increase the Quality and Efficiency of Guiding Process and Document Management. INFOKUM. Vol. 10 no. 2, pp. 1358-1361 (2022)

[12] Panjaitan, J., & Pakpahan, A. F.: Perancangan Sistem E-Reporting Menggunakan ReactJS dan Firebase. Jurnal Teknik Informatika Dan Sistem Informasi. Vol. 7 no. 1 (2021)

[13] Himawan, Harjanti, T. W., Supriati, R., & Setiyani, H.: Evolusi Penggunaan Teknologi Web 3.0: Semantic Web. Journal of Information System, Graphics, Hospitality and Technology. Vol. 2 no. 2, pp. 54-60 (2020)

[14] Sukardjo, M., Pd, M., & Komarudin, U. (2019). *Landasan pendidikan konsep dan aplikasinya*. Rajawali Pers.