



Development of the Mini Smart Cashier Application to Improve the Counting Ability of Students with Mild Intellectual Disabilities

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Abstract

This study aims to develop the Mikacer (Mini Smart Cashier) application as an Android-based counting aid to improve the ability to count money for students with mild intellectual disabilities phase D at SLB Negeri 2 Padang. Based on Piaget's cognitive development theory, Vygotsky's Scaffolding, and the principles of Universal Design (UD) in learning media, Mikacer is an assistive technology designed as an adaptive and interactive money counting medium, and is easily accessible to all students who need it. The research method used was Design, Development, and Research (DDR) procedure from Richey and Klein, which produced the Mikacer (Mini Smart Cashier) mobile application with ten students with mild intellectual disabilities at a special needs school (SLB) as subjects. Data collection techniques used were observation, interviews, questionnaires, and performance observation. The results of this research are an Android-based application available on the Google Play Store for direct download. The application contains a step-by-step cashier simulation menu for calculating the amount of money, reducing money, calculating total purchases and calculating change in simple purchases. After being validated by six expert validator teams, the product results are in the very feasible category and the validation results can be used according to revisions and suggestions. Interventions to improve the ability to count money for students with mild intellectual disabilities use the Mikacer application that has been developed. Based on the results of performance observations from all subjects, they succeeded in improving their counting abilities from the initial baseline, intervention and final baseline.

Introduction

Education for students with mild intellectual disabilities in phase D of secondary school occupies a crucial position, as students at this stage are on the path to adulthood, which demands independence. Learning is no longer solely focused on mastering basic academic skills; it needs to be oriented toward developing functional skills that can be applied effectively in everyday life. Students' independent participation in social settings and preparation for work are crucially determined by the alignment of learning with their actual abilities, so that education not only produces conceptual understanding but also concrete functioning in life (Wang et al., 2023; Dunlap & Grabinger, 2003; Kivunja, 2014; Rivai & Rahmawati, 2025). This is consistent with Mumpuniarti (2018) who stated that education for students with intellectual disabilities at the secondary school level is directed toward developing functional skills and independence as preparation for adulthood, whether through special or inclusive education. Learning at this stage emphasizes not only academic aspects but also life, social, and vocational skills relevant to everyday contexts, such as money management and work readiness.

This situation aligns with empirical findings at the research site, which indicate that students with mild intellectual disabilities have essentially mastered prerequisite skills, such as recognizing numbers and naming currency. However, these skills cannot be fully utilized when students are faced with real-life, functional money counting situations (Ramana et al., 2022; Bahrani et al., 2024; Diamandis et al., 2023). Obstacles are often seen when students are asked to add money, subtract the prices of several items, determine the appropriate payment amount, and follow the sequence of steps in simple transactions. This situation indicates that the main problem lies not in mastering number concepts, but rather in students' inability to connect abstract concepts to the real-life context of money use. Therefore, specifically designed learning media are needed to guide students in understanding money counting in a step-by-step, concrete, and contextual manner (Octaviani & Mulyawati, 2025; Marhamah et al., 2025; Handoko & Mubarikah, 2025; Simkins & Cole, 2002).

This problem is increasingly complex and evolving in the context of learning in the digital era. Despite rapid technological developments, its use for students with mild intellectual disabilities still faces various limitations. Many available learning applications do not fully consider students' cognitive characteristics, such as limited concentration, short-term memory, and the need for adult guidance (Jamaludin, 2026; Clemente-Suárez et al., 2024; Maringanti & Sahu, 2024). Based on this situation, the Mikacer application applies the theories of Piaget and Vygotsky in an integrated manner, as well as the principles of Universal Design (UD) for learning media. Where Universal Design (UD) in the learning media in the Mikacer application through a learning design that is arranged in a concrete and tiered manner, equipped with the provision of gradual assistance by teachers according to student needs, which is then designed to be more adaptive and easily accessible, easy for users to understand. The integration of the Universal Design foundation makes the Mikacer application a new research, because technology is positioned not only as an aid, but also as a pedagogical tool that is systematically designed to improve the ability to count money functionally and meaningfully for students with mild intellectual disabilities.

The ability to count money is part of the learning outcomes of number mathematics, serving as a foundation for functional skills, such as recognizing money, calculating total purchases, and independently determining change (Engel et al., 2016; Gaudette & Anderson, 2002). This activity is not simply arithmetic, but rather a practical skill that occurs repeatedly in everyday life, both in social contexts at home and at school. Without mastery of these skills, independence in students with mild intellectual disabilities will be difficult to achieve. Research shows that numeracy learning linked to real-life situations is more meaningful than abstract approaches, especially when supported by individualized, flexible, and experiential learning (Purwoko et al., 2025).

This view aligns with the constructivist approach proposed by Piaget and Vygotsky. Piaget emphasized that understanding is built through direct interaction with the environment, so numeracy learning needs to be presented concretely and closely related to students' daily activities (Piaget & Inhelder, 2015). On the other hand, Vygotsky emphasized the importance of social interaction and adult support through the concept of the Zone of Proximal Development (ZPD), where students' abilities can develop optimally with appropriate assistance or scaffolding (Vygotsky, 1978; Xi & Lantolf, 2021; Ohta, 2006; Rahman, 2024). These two perspectives provide a strong theoretical foundation for developing process- and function-oriented numeracy learning.

Technological developments offer significant opportunities for special and inclusive education, including for students with mild intellectual disabilities. Technology enables more

personalized, visual, and contextual learning, allowing numeracy concepts to be understood gradually and iteratively according to each student's individual abilities (Mumpuniarti & Purwandari, 2024). Studies show that technology-based learning experiences can be a safe and realistic means of preparing students for increasingly complex life and work situations (Alimuddin et al., 2023; Alfiansyah, 2024).

Intellectual disabilities are characterized by significant limitations in cognitive function and adaptive abilities that emerge before the age of 18, requiring students to achieve independence (Browder et al., 2020). This support is realized through functional learning that emphasizes practical skills, including functional numeracy, such as counting money, recognizing fractions, and determining change (Wehman & Kregel, 2004). Although simulation-based learning has been shown to help develop transaction skills (Barczak, 2019), the predominantly traditional learning practices and minimal technology integration make it difficult for students to transfer numeracy skills from the classroom to real-world transaction situations (Bagadood et al., 2025).

This situation is further reinforced by the results of a preliminary study at SLB Negeri 2 Padang, which showed the limitations of adaptive learning media, where the teaching provided was not effective enough in bridging mathematical concepts with everyday life practices. In Phase D at the SLB, learning outcomes directed students to be able to conduct transactions, use simple counting tools, understand the value of money, and shop independently. However, in reality, students still experienced significant difficulties in recognizing various denominations, adding up total purchases, and determining accurate change (Fitriani & Prahmana, 2021; Mazur & Szauer, 2024). Based on this, one of the main problems lies in the failure to transfer money counting skills into the context of financial transactions in students' daily lives.

Various studies have shown that digital simulations and assistive technology can strengthen money management skills, increase learning participation, and reduce the functional skills gap through adaptive learning designs (Ataviado et al., 2024). However, most innovations still focus on accessibility and learning motivation, without explicitly replicating the cognitive flow of real-life financial transactions. In Indonesia, learning to count money is still largely dominated by conventional methods, despite empirical evidence showing that digital applications can improve basic math skills in students with mild intellectual disabilities (Gaunt & Visnovska, 2025). This opportunity became the basis for the development of the Mikacer application through a Design and Development Research (DDR) approach as a pedagogical intervention based on the real needs of students (Richey & Klein, 2014; Hasbullah et al., 2022; Mannan et al., 2025; Omar, 2025).

Based on the above description, Mikacer (Mini Kasir Cerdas) was developed as an adaptive and inclusive digital learning medium to help students understand money numeracy functionally. The application is designed with a step-by-step and sequential transaction simulation flow to reduce the abstraction of numeracy concepts through real-world contexts, reinforcing numeracy procedures as a series of functional skills needed by students in their daily money counting activities. Based on the theories of Piaget, Vygotsky, and UD, Mikacer is expected to be a suitable pedagogical tool for supporting the strengthening of independence and vocational readiness of students with mild intellectual disabilities.

Methods

This research uses a Research and Development (R&D) approach with the Design, Development, and Research (DDR) model from Richey & Klein (2007). This research model consists of six stages.

Identify the Problem

In the first stage, namely identifying the problem through interviews with teachers of SLB Negeri 2 Padang and observations at the school. Based on interviews and observations, it was found that students with mild intellectual disabilities require visual and contextual learning media that can help them in counting money which includes understanding the value of money, calculating the amount of money, calculating subtraction of money, calculating total purchases and change in simple buying and selling processes at school.

Describe the Objectives

The formulation of objectives is the focus of the second stage, where the main objective of the application is to develop an Android-based learning application with an interactive and easy-to-use interface, specifically designed to improve the money counting skills of students with mild intellectual disabilities. The application specifically aims to train students to identify rupiah denominations, calculate total purchases, determine remaining change, and practice simulated buying and selling transactions similar to real life. In addition to achieving functional numeracy skills, this application is also expected to foster life skills and vocational independence, in line with the mandate of the Independent Curriculum Phase D for Special Education (Kemendikbudristek, 2025). The stage of explaining the objectives is important for formulating clear and directed goals and ensuring that the development of learning media is aligned with the needs of functional numeracy in counting money and the learning characteristics of students with mild intellectual disabilities, both concretely and procedurally.

Design & Develop the Artifact

At this stage, a design and development was made with a prototype of the Android-based Mikacer application with a simple interface screen display, icons of coins and paper money from Rp. 500-Rp. 100,000, bright and attractive colors, and a sound feature for nominal pronunciation feedback. Validation was carried out by media experts, material experts, and practicing teachers using a Likert-based validation sheet.

Test the Artifact

A limited trial was conducted on 10 students with mild intellectual disabilities in phase D of grades VII-IX of SMPLB at SLB Negeri 2 Padang. Data collection was conducted using a one-group pretest and posttest experimental design. Before the intervention began, students took a pretest to map their money counting skills. Next, students participated in the intervention using the Mikacer application. After the intervention was completed, a posttest was administered to measure the extent of improvement in students' counting skills.

Results and Discussion

Expert Validation Results

Validation data shows a very high level of suitability from six experts, consisting of two material experts, two media experts, and two practicing teachers. This indicates that the application is not only conceptually aligned with the intended learning objectives in money counting and transaction skills, but also technically appropriate in terms of interface design, usability, and classroom implementation. The involvement of practicing teachers further strengthens the validity of the evaluation, as their assessment reflects practical considerations related to student characteristics, instructional feasibility, and real classroom conditions.

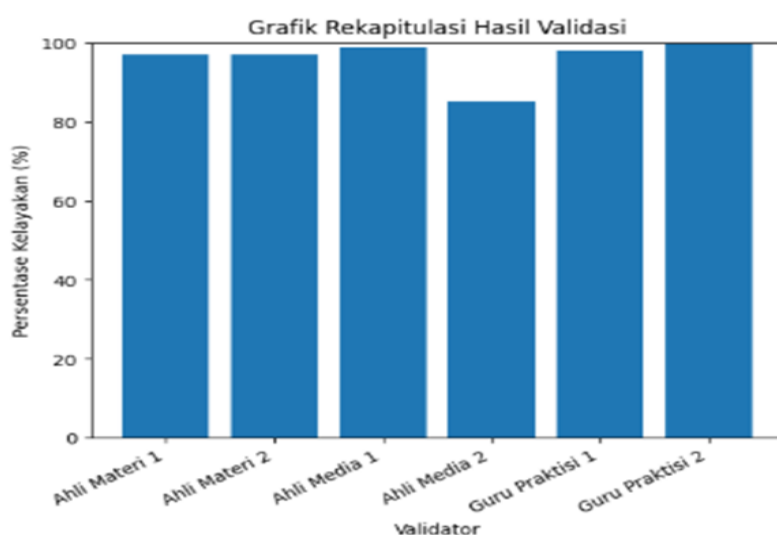


Figure 1. Recapitulation Graph of Validation Results

Based on the expert validation results graph, it shows that all validation results are in the very suitable category, with the lowest value being 85% and the highest being 100%. This figure is used as a learning medium that has met the suitability standards.

Trial Results

A limited trial was conducted with one pretest, four intervention sessions, and one posttest. The following are the results of the limited trial conducted on 10 subjects.

Table 1. Results of the Mikacer Application Trial

No	Initials	Pretest	Intervention 1	Intervention 2	Intervention 3	Intervention 4	Posttest
1	HK	35	50	75	85	95	100
2	AA	50	55	70	85	100	100
3	AP	60	70	90	100	100	100
4	EN	55	65	75	95	100	100
5	IA	30	60	70	85	90	90
6	FM	35	40	65	80	85	85
7	HE	20	35	65	70	90	95
8	AR	65	70	85	95	100	100
9	MK	40	50	80	85	100	100
10	ZR	45	55	75	80	95	95

Based on the table of the results of the Mikacer application trial, the students' pretest results were still at a low score, with the highest score only being 65. After four interventions, all students experienced an increase in their scores. At the end of the posttest meeting, all students achieved good and excellent scores in the range of 85-100. Based on the trial results, the use of the Mikacer application successfully improved the ability to count money for students with mild intellectual disabilities. The following is a graphical presentation of the results of the Mikacer application trial.

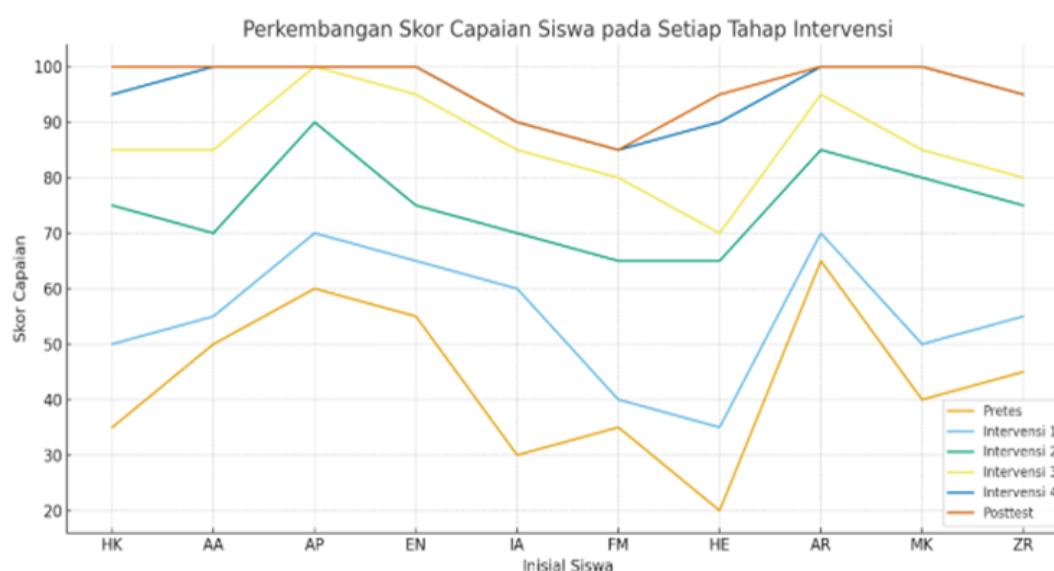


Figure 2. Mikacer Application Trial Results

The results show that the Mikacer application enhances counting and transaction abilities of students in aspects that go beyond mere numbers accuracy. The enhancement also demonstrates an increase in functional numeracy, especially in the skills to identify denominations, compute totals, and identify change in an organized buying pattern. The current studies also repeat that teaching mathematics to students with mild intellectual disabilities is best achieved when focusing on concrete and observable financial behaviors as opposed to abstract computing. According to Bagadood et al. (2025), functional mathematics competence is achieved when learning concepts with well-defined transactional steps are practiced repeatedly. On the same note, recent debates on financial literacy among people with intellectual and developmental disabilities emphasize the fact that changes in behavior, like payment and change calculation accuracy, are more effective than general financial literacy. Mikacer structure aligns well with these recommendations, since it pays much attention to the fundamental transactional processes.

The scaffolding perspective is also a possible way to understand the improvement. Students with cognitive challenges usually enjoy learning instructions which can break complex tasks into small and consecutive parts. According to Raslan (2024), scaffolding can be effective to improve learning when the support is implemented as a part of the task and is internalized by repetition. The step-by-step transaction flow presented by Mikacer seems to work this way and use the choice of denomination, summing up, and determining the change in a predictable order. Similar results are also seen in recent research on online and game based learning instruments. Ferawati et al. (2025) and Iswari et al. (2026) attest that the structured interactive applications are very useful in enhancing currency comprehension in students with mild disabilities, especially with repetition that enhances clarity in the procedures. Azzahra (2025) also demonstrates that the decomposition of transaction operations into a series of steps enhances the mastering of payment habits. The trend of these studies underpins the reading that the benefits witnessed in such studies are based on procedural practice which is systematic.

Another valuable explanation is cognitive accessibility. Cognitive load in students with intellectual disabilities has been found to be cut down with the assistance of digital learning tools that are developed with visual representation and the simplified findability feature. Rao et al. (2021) state that the availability of digital environments facilitates engagement by reducing the extraneous processing requirements. Borgis et al. (2022) extend the previous statement, saying that task structure is being externalized in digital media, which washes out working memory and executive functioning. The visual execution of currency and structured interface by Mikacer could have minimized the complexity of processing and allowed the students to concentrate on the logic of the transaction and not on the navigation of instructions.

The transactional simulation within the application is also in line with the results of the assistive technology research that highlights ecological relevance. According to Ha et al., (2022), structured digital rehearsal can make learners with the vulnerability of cognitive skills more engaged and less anxious. As noted by Zaharudin et al. (2024), mobile assistive technologies are most useful when they mimic everyday living activities and enhance personal autonomy. The Mikacer application puts arithmetic in a realistic purchasing scenario, which in turn reinforces the functional meaning of the skill in question.

All in all, the results are still consistent with the substantive focus of this research, that is, improving money counting and transaction competence in the group of students with mild intellectual disabilities with the help of a structured digital intervention. The observed improvement is in line with the recent research that indicates contextualized practice, embedded scaffolding, cognitive accessibility, and repeated procedural rehearsal are central in enhancing functional numeracy in special education classrooms.

Conclusion

The Mikacer application was developed based on Piaget's cognitive development theory, Vygotsky's Scaffolding, and the principles of Universal Design (UD). Mikacer is an assistive technology designed as an adaptive and interactive money counting medium, and is easily accessible to all students who need it. By using Design, Development, and Research from Richey and Klein, the Mikacer mobile application (Mini Smart Cashier) was produced. With the results of this research in the form of an Android-based application that is already available on Google Playstore and can be directly downloaded by users, which has previously been validated by six experts with very suitable results for use. Based on the results of trials and observations of the performance of all subjects, they succeeded in improving their counting skills from the initial baseline, intervention and final baseline.

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