Jurnal Teknologi Informasi dan Pendidikan
Volume 19, No. 1, March 2026
https://doi.org/10.24036/jtip.v19i1.1118

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390
tip.ppj.unp.ac.id

Developing a Teacher Module on the Application of Unplugged Coding in Handwashing Skills Learning for Children with Down Syndrome

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Article Information

Article history:

No. 1118
Rec. February 27, 2026
Rev. March 13, 2026
Acc. March 16, 2026
Pub. March 27, 2026
Page. 1366 – 1379

Keywords:

- *Children*
- *Down syndrome*
- *Learning*
- *Unplugged Coding*
- *Handwashing Skills*

ABSTRACT

This study aims to develop a teacher module on the application of unplugged coding (coding without a computer) in learning handwashing skills for children with Down syndrome. This study also aims to test the feasibility of the module based on the assessment of material experts and media experts, as well as to test the Pub. This study also aims to evaluate the effectiveness of the module in enhancing teacher competency. The method used is Research and Development (R&D) with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The resulting product is a Google Sites-based digital module called "SI TEPAT." The validation results show that this module is "Very Feasible" with a score of 97.3% from material experts and 93% from media experts. The effectiveness test on 105 SLB teachers showed a significant increase in pre-test and post-test results, proving that this module is effective in improving teacher understanding in teaching coding concepts through daily activities.

How to Cite:
Wulandari, E., & Chamidah, A. N. (2026). Developing a Teacher Module on the Application of Unplugged Coding in Handwashing Skills Learning for Children with Down Syndrome. Jurnal Teknologi Informasi Dan Pendidikan, 19(1), 1366-1379. https://doi.org/10.24036/jtip.v19i1.1118

1. INTRODUCTION

Computational thinking has become an essential competence in modern education, enabling learners to break down complex problems into manageable steps, recognize patterns, and design algorithmic solutions [1], [2]. Recent educational research highlights the importance of introducing computational thinking concepts early to foster logical

reasoning and structured problem-solving skills among students [3]. This study highlights a fundamental issue regarding the independence of children with Down syndrome who face challenges in adaptive behavior, particularly in Activities of Daily Living (ADL) skills such as handwashing. Limitations of executive function in children with Down syndrome cause them difficulty understanding order and complex steps in maintaining cleanliness. Therefore, it is necessary to use a computational thinking approach, which can help children solve complicated problems by making them structured, concrete, and easy to remember. This approach aids in the completion of daily life activities. In line with the need, the student said the challenge is real on the side of energy-teacher-related implementation of a new lesson, "Coding and Intelligence" Artificial Intelligence in the Special Education (SLB) curriculum.

However, teaching coding concepts using computers may create challenges for learners with intellectual disabilities, such as difficulties in understanding abstract concepts or using technology effectively. Therefore, unplugged coding has emerged as an alternative instructional approach that allows students to learn computational thinking concepts without relying on digital devices [4], [5]. Unplugged learning typically involves physical activities, simulations, games, and collaborative problem-solving tasks that represent algorithmic thinking in a tangible and accessible form [6].

Children with Down syndrome often experience limitations in executive functioning, memory processing, and sequential task organization, which can affect their ability to perform daily living activities independently [7], [8]. These cognitive characteristics require structured learning strategies that simplify complex tasks into smaller and more concrete sequential steps [9].

Activities of Daily Living (ADL) skills, like washing your hands, are important for keeping kids with intellectual disabilities clean and helping them become more independent [10]. Teaching these skills using algorithmic or step-based approaches aligns with computational thinking principles and may help students understand the correct sequence of actions required to complete daily tasks successfully [11]. Many SLB (Special Learning Behavior) teachers experience difficulty in integrating material coding, which refers to the process of creating instructions for computers to follow. This is because it is still difficult to understand that coding must always use a computer or technology, which poses a significant challenge for children with intellectual disabilities. There is no guide or relevant module because of an occurrence mismatch between the must-have curriculum and practice learning in the field. As a response to the second issue, researchers developed an unplugged coding-based teacher module, which is a method of teaching draft coding without the use of a computer device. The “SI TEPAT” module (Adaptive Teaching Plan System) aims to give practical guidance for teachers in teaching skills through a simple approach algorithm.

The module is expected to provide a dual solution: it aims to enhance student independence through concrete methods while simultaneously improving teacher competence in teaching computation to meet contemporary needs.

1.1. Unplugged Coding Module Review

Unplugged coding is a method of learning without digital devices with an approach to knowledge through computer-based activities, such as simulations, games, and physical activities. Others explain unplugged learning as "learning knowledge without a computer." Learning can involve using a game board, cards, stacked blocks, or activities that involve 21 physical movements to understand coding and development principles and algorithms, such as simulating a “robot/machine" that is capable of thinking with the child involved. Unplugged coding is a form of learning that involves activities using a tangible representation, without the need for a computer. In unplugged coding, children are given the chance to do related activities with coding concepts such as algorithms, loops, units, and commands without the need for digital technology [11].

Unplugged coding leads to computational thinking without the use of device learning computing. Unplugged coding activity is activity without a cable or a computer. In activity, the child does explorative activities in games and challenges. Experts conclude that unplugged coding involves learning computer coding without daily use of software or hardware, allowing children to explore simple concepts more effectively. However, it still leads to the system coding basics, such as understanding algorithms, logic, and problem-solving skills, which are essential for further learning in computer programming. Unplugged coding learning is the required ability to organize, analyze, and solve problems. Learning will enhance critical reasoning by encouraging students to think algorithmically or systematically, without relying on machines and devices. Integration of unplugged coding activities with daily lives makes learning more contextual and easier for a child to understand. For example, a child can learn a draft algorithm through routine daily activities like making tea, brushing teeth, or tidying up their school bag.

1.2. Hand Washing Study

Washing hands is very important in guarding against disease and preventing the distribution of disease. Washing hands is a daily activity that can be understood as an algorithm or a series of steps sequentially to reach a certain objective, namely, clean hands from dirt and microorganisms. Washing hands is an action of cleaning hands and fingers with running water and soap to remove dirt, dust, and various microorganisms like bacteria, viruses, and parasites.

This process involves cleaning the skin physically; second, washing with soap as cleaning, scrubbing, and rinsing with running water will clean hands of particle lots of dirt containing microorganisms. Washing hands is one of the actions to clean hands and fingers using running water and soap to clean your hands and make them clean. Washing your hands is a crucial step in removing microorganisms from your hands, preventing cross-infection, maintaining a sterile environment, and safeguarding yourself from infection.

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390
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Based on the Regulation of the Minister of Health Concerning Community-Based Total Sanitation, as stated in the Decree of the Minister of Health of the Republic of Indonesia No. 852/SK/Menkes/IX/2008, washing your hands with soap is a behavior that involves washing hands using running water and soap. Washing hands with soap (CTPS) is one of the actions for clean hands and fingers using running water and soap. Washing Hands with Soap (CTPS) is the action of cleaning hands and fingers with water and soap to become clean and cut the chain of germs. CTPS is done because hands spread germs and pathogens directly and indirectly.

Washing hands with soap (CTPS) is one of the indicators of clean and healthy living behavior. Clean and healthy living behavior is behavior that is carried out with awareness so that members of the family can help themselves alone in the field of health and play an active role in health activities in society.

Modern education widely recognizes computational thinking as an essential competence, as it fosters logical reasoning, problem decomposition, and algorithmic thinking. Numerous studies have shown that unplugged coding activities can effectively teach young learners about computational thinking without the use of digital devices. These activities typically involve games, physical simulations, and collaborative tasks that help learners understand algorithms, sequencing, and problem-solving processes.

However, most past studies on unplugged coding have mainly looked at regular classrooms and students without disabilities. There is very little research on how to use computational thinking for children with intellectual disabilities, especially those with Down syndrome. Also, existing studies seldom combine computational thinking with teaching important daily living skills, like handwashing, which are crucial for helping children with special needs become more independent.

Another important issue is related to teacher readiness. In Indonesia, the recent introduction of coding and artificial intelligence concepts in the curriculum has created challenges for special education teachers, particularly in special schools (SLB). Many teachers still perceive coding as an activity that must involve computers or digital technologies, which may not be appropriate for students with cognitive limitations. As a result, teachers lack practical instructional resources that translate computational thinking concepts into concrete learning activities suitable for children with Down syndrome.

Therefore, this study aims to develop and evaluate an unplugged coding-based teacher module called “SI TEPAT” that supports teachers in teaching handwashing skills to children with Down syndrome through algorithmic and step-based learning activities. The novelty of this research lies in integrating computational thinking principles with adaptive daily living skill instruction, while simultaneously improving teacher competency in implementing unplugged coding strategies in special education contexts.

2. RESEARCH METHOD

This study employed a Research and Development (R&D) approach using the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. The ADDIE model was selected because it provides a systematic framework for developing and evaluating educational products. The study was conducted in special schools (Sekolah Luar Biasa, or SLB), located in the Special Region of Yogyakarta and Central Java, Indonesia.

The participant is a teacher who has a background in teaching students in need special education and has gotten exposure to beginning-related material coding through program assistance. Selection subject to ensure that the "SI TEPAT" module (System Teaching Plan Adaptive Integrated), which was developed, can be tested. Try it on a group of relevant and representative users. To collect accurate data, this research uses several main instruments. The first instrument is a sheet validation filled out by experts in materials and media, which evaluates the eligibility of the content as well as the graphical aspects of the modules. The second instrument is a test of teacher competencies consisting of pre-test and post-test questions.

An instrument test designed to measure the level of a teacher's understanding of the implementation of unplugged coding before and after using the developed module. Data analysis techniques used are divided into two parts in accordance with the type of data obtained. Eligibility data products from results validation are analyzed using a descriptive quantitative technique with percentage calculations to determine category eligibility. The analysis aims to determine whether there is a significant difference in the average competence value of teachers, which will statistically prove the effectiveness of the module in enhancing teacher understanding.

2.1. Participants

The participants of this study consisted of 105 special education teachers from 12 special schools. Participants were selected using purposive sampling based on the following criteria:

1) Teachers are currently teaching students with special needs.
2) Teachers who had received initial exposure to coding or computational thinking through educational programs.
3) Teachers are responsible for teaching students with Down syndrome in grades 3–5.

The purposive sampling approach was used to ensure that participants were relevant to the objective of the study, namely evaluating the usability of the developed module for teachers working with children with Down syndrome in the Special Region of Yogyakarta and Central Java.

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390
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There are 12 schools in place for implementation, among them:

1) Special Needs School 2 Gunung Kidul as the only one Candidate School Google Reference (KSRG) for SLB levels in Indonesia.
2) Special Needs Schools in the Branch IV area of the Education and Culture Office Central Java Province has 10 institutions, namely ABCD YSD Polokarto Special School, B YPLB Danyang Special School, C YPLB Danyang Special School, Budi Mulyo Jepon Special School, Budi Mulyo Kunduran Special School, Ceria Mandiri Special School Blora, Muhammadiyah Cepu Special Needs School, Grobogan State Special Needs School, Purwodadi PGRI Special Needs School, and Sartika Special Needs School.
3) Special Needs Schools in the Branch Office IX of the Education and Culture Office Central Java Province include Banjarnegara State Special School, which is supported by Garuda-21 (Central Java).

2.2. Measurement scale

Instrument validation was used to measure suitability and eligibility from the development of an unplugged coding module in learning handwashing for children with Down syndrome. Instruments are used to identify possible errors that happen during data collection so that researchers can do repair/correction. Instrument validation in research. This use of instrument validation experts, materials, and media experts.

Table 1. The material indicator grade

Indicator	Question Number
Guide Material	1, 2, 3, 4, 5, 6
Compliance guide with materials used by teachers	7, 8, 9
Function and Purpose of the Guide	10, 11, 12, 13
Effectiveness and Quality of Guidelines	14, 15

Table 2. The media indicator grade

Indicator	Question Number
Appearance design guide	1, 2, 3, 4, 5, 6
Media presented in the guide	6, 7, 8, 9
Access the information displayed on	10, 11, 12, 13, 14, 15

Trials are used to evaluate the effectiveness and relevance of the presented material. Implementation trials involved 105 teachers at SLB who have been implementing unplugged coding. Teachers are asked to implement it in the learning process during a day at school. During the trial, teachers recorded various feedback related to convenience, usage, understanding of the material, and 63 impacts on children with Down syndrome. Teachers are asked to fill out the feedback forms provided by the researchers. The following served as a feedback grid for the unplugged coding guide.

Table 3. Trial result

Indicator	Question Number
Draft basis and relevance guide with material	1, 2
Content in the guide	3, 4, 5, 6, 7, 8, 9
Guide to becoming reference	10, 11
Usefulness guide	12, 13, 14, 15

Table 4. Pre-test and Post-test Question Grid

Indicator	Question Number
Children with Down Syndrome (DS)	1, 2, 3, 4
The concept of unplugged coding and Computational Thinking	5, 6, 7, 8, 9, 10
Learning Hand Washing (CTPS) and Computational Thinking Integration	10, 11, 12, 13, 14, 15, 16
Teacher Module Development	17, 18, 19, 20

On trial, these SLB teachers conducted pre-tset and post-tests to determine the effectiveness of the developed teacher module. The following is presented in Table 4. Grid pretest and post-test questions.

2.3. Data Analysis

Based on results validation, researchers do data measurement with a scale as follows:

Table 5. Assessment Scores

Information	Score
Very Suitable	5
In accordance	4
Not Suitable	3
It is not in accordance with	2
Absolutely not in accordance	1

Result of eligibility that has been filled in by validators, researchers use the technique of measurement of percentage eligibility as follows:

$P = f/n \times 100\%$

P = Percentage score

f = Amount scores obtained

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390
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n = Number score maximum

Trials to determine the effectiveness of the module will involve answering questions from both the pre-test and post-test, which will be displayed within the module to assess its impact on learning. In measurement mark theory, two modules studied by teachers are used for a test, namely the paired T-test. The utility of this test lies in analyzing results from data presented as descriptive statistics and pre-test & post-test rankings, which will generate hypothesis tests to determine whether H1 or Ho is accepted at a significance level of 1%.

At this stage of development, the researcher creates teacher module sites focused on the application of unplugged coding for students with Down syndrome. This module, given the name "SI TEPAT," is an acronym for "Adaptive Teaching Plan System Integrated View." At the beginning of the site page, a cover is presented in the form of a header from "SI TEPAT." Then go to the Home page on the right menu bar. On the "home" page, some of the site menus are presented, including background and objectives, pre-test menu, unplugged coding understanding menu for Down syndrome, application menu, post-test menu, and questions menu. Teachers can select the appropriate menu with the order that has been provided and use the account, learn ID, or Google. Access to these sites is restricted to the Learn ID and Google, so no one can access them with others' accounts. The following information pertains to the display of the "SI TEPAT" site.

Figure 1. The display of SI TEPAT header view

Jurnal Teknologi Informasi dan Pendidikan
Volume 19, No. 1, March 2026
https://doi.org/10.24036/jtip.v19i1.1118

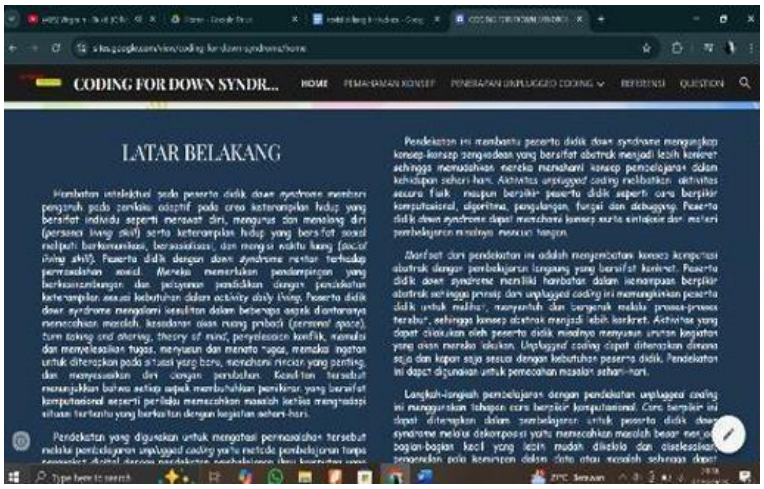

Figure 2. The display of SI TEPAT background view

Figure 3. The display of SI TEPAT menu view

3. RESULTS AND DISCUSSION

3.1. Implementation results

Table 6. Pre-test and post-test scores

Statistics	Pre-Test	Post-Test
N	105	105
Average (Mean)	**42.29**	**181.43**
Standard Deviation	17.99	7.90

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390
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Based on the average obtained from the pre-test and post-test, an improvement occurred with an average pre-test score of 42.29 and a post-test score of 181.43. The increase can be seen through the chart below.

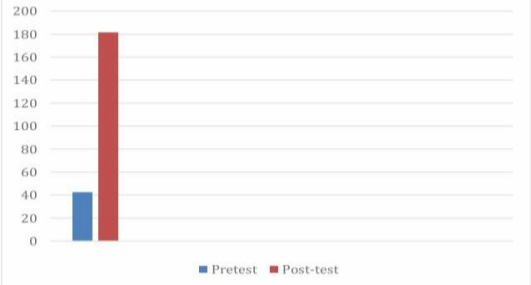

Figure 4. The diagram of pre-test and post-test result

The graph above shows improvement between the pre-test and post-test.

3.2. Normality Test

Normality test results are presented in Table 6. This table shows the mark statistic W = 0.896 and p-value (Sig.) < 0.001 for the distribution difference score. Because the p-value is smaller than $\alpha = 0.05$, the assumption of normality is not fulfilled (the difference data score is not normally distributed). Before conducting the effectiveness test, a normality test was performed to determine whether the pre-test and post-test data followed a normal distribution. The results indicated that the data did not meet the assumption of normality.

Table 6. Normality test result

Normality Test (Shapiro-Wilk)	W	p-value
Difference score (Posttest – Pretest)	0.896	<0.001

Therefore, instead of using a paired sample t-test, this study employed the Wilcoxon Signed-Rank Test, a non-parametric statistical method used to compare two related samples when the normality assumption is violated. The Wilcoxon test was used to determine whether there was a statistically significant difference between teachers' pre-test and post-test scores after using the developed module. The significance level used in this study was $\alpha = 0.05$.

3.3. Discussion

The results of this study demonstrate that the developed "SI TEPAT" module effectively improves teachers' understanding of integrating unplugged coding concepts into daily learning activities. These findings support previous studies indicating that unplugged

computing activities can successfully introduce computational thinking concepts without requiring advanced technological infrastructure [12]. Main results from the study development. This item is a creation product in the form of Google Sites-based digital modules that are given the name "SI TEPAT" (System Teaching Plan Adaptive Integrated). The module was produced through a series of strict ADDIE model stages. Based on the validation results from experts, the module demonstrated its very good quality. Subject matter experts gave an average score of 97.3%, which was entered in the "Very Eligible" category, while media experts provided an evaluation, 93% of which was also entered in the "Very Worthy" category. The high score validation shows that the unplugged coding material presented, as well as the design interface module, has fulfilled standard eligibility for use as a guide for SLB teachers. The effectiveness module increased proven teacher competence in a significant way through field trials involving 105 SLB teachers. Before using the module, the pre-test results show an average teacher competence value of only 42.29, which indicates a low understanding of the beginning of integration coding in learning adaptively. The results indicate a significant improvement in teachers' competency after using the "SI TEPAT" module. This finding suggests that unplugged coding approaches can serve as an effective instructional strategy for introducing computational thinking concepts to special education teachers.

However, after the implementation of the "SI TEPAT" module, the average post-test score of teachers increased sharply to 181.43. Analysis statistics using a paired t-test (paired sample t-test) produce a mark of significance (p) less than 0.001. This results in a way convincing proof that there is a real and significant improvement in teachers' understanding before and after using the module. In the discussion, the research finds that the "SI TEPAT" module was successful in answering the challenge of implementing new synchronization in SLB. This module effectively explains previous teacher misconceptions about the "Coding and Intelligence" lesson, considering "Artificial" as material programming and complicated and uncomplicated computers as relevant for children in need of special education. One possible explanation for this improvement is that unplugged activities translate abstract coding concepts into concrete and sequential actions. For teachers working with children with Down syndrome, this approach aligns well with instructional strategies commonly used in special education, such as task analysis, step-by-step instruction, and visual sequencing.

Game-based and activity-based instructional strategies have also been widely reported to enhance engagement and conceptual understanding in computational thinking education [13]. By integrating unplugged coding with real-life activities such as handwashing routines, the module provides contextual learning experiences that align with authentic and experiential learning principles. These findings are consistent with previous studies showing that unplugged coding activities can enhance understanding of algorithmic thinking and problem-solving processes without relying on digital technologies. However, the present study extends previous work by applying computational thinking principles

P.ISSN: 2086 – 4981
E.ISSN: 2620 – 6390
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specifically to adaptive daily living skills, particularly handwashing routines for children with Down syndrome.

The significant improvement observed in teachers' post-test scores further supports earlier research suggesting that structured instructional modules can substantially improve teacher competence and readiness to implement new curriculum innovations [14], [15]. Teachers can also use well-designed digital learning modules in a flexible and accessible way, especially when they are delivered through web-based platforms like Google Sites [16]. This integration is important because children with Down syndrome often experience difficulties with executive functioning and sequential task processing. By structuring handwashing activities as algorithmic steps, teachers can help students better understand and remember the correct sequence of actions.

Furthermore, the developed module also addresses the lack of practical instructional resources for teachers in special education settings. Many teachers initially perceived coding as a complex digital activity. The unplugged coding module provides a more accessible approach that can be implemented in classrooms without requiring advanced technological infrastructure. Through an unplugged coding approach enabled with the activity "wash hands," the teacher becomes understanding that essence coding is practicing logic and computational thinking (such as algorithms and decomposition) that can be taught concretely without a computer. Thus, the module increases the competence of professional teachers and provides functional learning strategies to increase the independence of children with Down syndrome. Furthermore, computational thinking instruction has been recognized as an effective approach to strengthening analytical and problem-solving skills among learners with diverse educational needs, including students in inclusive and special education settings [17].

4. CONCLUSION

Based on the overall series study development that has been done, it can be concluded that products produced in the form of a teacher module, "SI TEPAT" (System Teaching Plan Adaptive Integrated), have fulfilled the standard high eligibility for implementation in special schools. Validation results from the experts show a very good product. From the material experts, the evaluation was given by 97.3%, and from media experts by 93%, both of which entered the "Very Eligible" category. This confirms that this Google Sites-based digital module, in a way, has substance material and media design that is already accurate and valid as a guide in the principal application of unplugged coding for handwashing skills for children with Down syndrome. In addition to the aspects of feasibility, research also concludes that the "SI TEPAT" module is proven very effective in increasing teacher competence. This is indicated by the presence of significant improvements in the statistics from pre- and post-teacher tests using the module, which show a change in the average score from 42.29 to 181.43.

The improvement serves as strong evidence that the module successfully bridges the gaps in teachers' understanding of eye lessons and the new concepts of artificial "coding and intelligence." This module is capable of changing teachers' perceptions that coding is not just complicated programming but rather pattern thinking (thinking computationally), which can be taught in a simple and functional way to support independent students. Referring to the conclusion said, this research submits some strategic suggestions for stakeholders' interests. For SLB teachers, it is very important to recommend utilizing this module as a main reference in compiling learning integrated independence with draft coding, as well as starting to get used to using belajar.ID account for access to digital learning sources.

These results reinforce previous research emphasizing the importance of computational thinking and unplugged learning approaches in inclusive education contexts [18]. Integrating algorithmic thinking into daily activities allows students with intellectual disabilities to understand structured procedures more effectively, which can enhance their problem-solving skills and promote greater independence in learning tasks. Temporary implementation is recommended for party schools to provide support. This initiative will provide facility infrastructure and adequate technology, such as internet networks and computer devices, making it easier for teachers to access and apply the digital module in class. Finally, for future researchers, it is recommended to expand coverage development that has been pioneered in this study. Other researchers can develop modules similar to ones that focus on other Activities of Daily Living (ADL) skills—such as skills for eating, dressing, or self-cleanliness—and adapt them for the characteristics of educated participants with different types of needs and specialties. Development is advanced and very required for enriching variations in learning media relevant to demands of an independent curriculum in a special education environment.

In addition, professional development programs that provide practical digital learning modules can significantly enhance teachers' readiness to adopt innovative teaching practices, particularly in the context of teaching students with diverse needs in special education settings. Therefore, integrating unplugged coding modules into special education curricula may contribute to improving instructional quality and supporting students' independence in performing daily living skills [20].

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