INTERACTIVE LEARNING DESIGN FOR CHILDREN WITH SPECIAL NEEDS: IMPROVING EVERYDAY COMMUNICATION THROUGH TECHNOLOGY ENHANCED COURSEWARE

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ABSTRACT

Abstract— This study aims to design and develop interactive courseware for children with special needs to enhance their everyday communication skills. Using the ADDIE instructional design model, the research followed five stages: Analysis, Design, Development, Implementation, and Evaluation. The case study was conducted at Watchaiyaprucksamala School, Bangkok, in an inclusive classroom setting. The courseware was designed to stimulate communication development through multimedia-based content, including graphics, animations, voiceovers, and interactive assessments. The courseware's content focused on real-life scenarios to help learners apply communication skills in daily contexts. The research involved nine students with special needs and incorporated pre- and post-learning assessments to measure learning achievement. Evaluation criteria followed the 80/80 standard. The results indicated an efficiency of 85.56/86.67 (E1/E2), exceeding the targeted criteria. Expert evaluations from seven professionals in special education and UX/UI design showed a high level of satisfaction (mean = 4.07, SD = 0.69). These findings confirm that the interactive courseware effectively supports communication skill development and promotes learner engagement. The study recommends further improvements in visual design and incorporating auditory repetition to enhance learning retention. This research contributes a practical model for instructional design tailored to children with communication difficulties, suggesting significant implications for inclusive education and personalized learning technology.

Keywords— interactive courseware, special needs education, ux/ui, inclusive learning, instructional design

OBJECTIVES OF THE RESEARCH

This study was conducted with the following objectives:

1.1. To design and develop interactive courseware for children with special needs in order

to enhance their everyday communication skills, ensuring the courseware meets the instructional effectiveness criterion of 80/80.

1.2. To compare the learning achievement of children with special needs before and after the implementation of the interactive courseware

INTRODUCTION

The integration of interactive courseware into education has become a vital strategy in enhancing learner engagement, supporting differentiated instruction, and promoting inclusive learning. Rapid advancements in digital technology and instructional design have enabled the development of interactive environments that simulate real-world contexts, foster problem-solving, and adapt to individual learning profiles. Prior studies have demonstrated the effectiveness of such courseware across a variety of fields, including engineering, chemistry, and medicine. For instance, Hernández-Castellano et al. [1] highlighted the benefits of co-creating open educational resources, while Sújar et al. [2] reported the value of real-time X-ray simulations in radiographic training. These tools improve accessibility and learning outcomes by merging visual, auditory, and kinesthetic elements, and by allowing students to interact with content at their own pace. In higher education, systems such as CourseQ have leveraged visual interfaces to improve student satisfaction in course selection processes [3], and Ippoliti et al. [4] demonstrated how interactive tools enhance engagement in chemical education through active, game-based learning.

In the realm of special needs education, interactive courseware holds particular promise. Students with intellectual and developmental disabilities often struggle with traditional instructional methods, especially in developing communication skills crucial for daily living. Research by Chan [5] emphasizes that task-based instructional design and multimodal approaches are effective in addressing these learning needs. Moreover, system-level challenges, such as those seen in under-resourced or culturally diverse contexts, require instructional interventions to be adaptive and community-focused [6]. Inclusive education frameworks, such as those used in Finland, Norway, and Northern Ireland, emphasize not only the integration of learners with disabilities into mainstream education but also the importance of differentiated pedagogy, continuous assessment, and data-driven planning [7][8]. As educational systems embrace digital transformation [9], it becomes increasingly important to design courseware that is not only accessible but also culturally relevant, context-specific, and pedagogically sound. Theories of inclusive learning and universal design further advocate for environments that provide multiple means of representation, engagement, and expression—core features of effective interactive courseware.

This study addresses these imperatives by designing and developing interactive courseware for children with special needs, with the objective of improving their everyday communication skills in inclusive classroom settings. Using the ADDIE instructional design model, the courseware was developed and implemented with a focus on real-life scenarios,

multimedia support, and interactive feedback. The courseware was evaluated through pre- and post-tests and expert assessments using the 80/80 effectiveness criterion. The research not only contributes a practical framework for technology-enhanced special education but also demonstrates the potential of instructional innovation in addressing equity and accessibility in learning. By integrating user-centered design with pedagogical rigor, this study aligns with Sustainable Development Goal 4, supporting inclusive and quality education for all [10].

THEORETICAL BACKGROUND AND LITERATURE REVIEW

1.1. Interactive Courseware

Interactive courseware in education has demonstrated significant potential in enhancing learning experiences across various disciplines. The development of open educational resources, such as those created by the University of Las Palmas de Gran Canaria, showcases how interactive teaching materials can be co-created with students to improve engagement and learning outcomes in fields like additive manufacturing technologies [1]. Similarly, in the realm of medical education, the use of real-time X-ray simulation and patient positioning software bridges the gap between theoretical knowledge and practical application, providing a safe environment for students to learn without the risks associated with radiation exposure [2]. In the context of course selection, interactive systems like CourseQ have been shown to improve user satisfaction and understanding by offering a visual interface that enhances transparency and controllability in course recommendations [3]. Furthermore, in chemical education, interactive tools such as online tutorials and game-like resources have been developed to connect complex concepts to real-world applications, thereby engaging a broad audience and promoting active learning [4]. The implementation of an interactive virtual microscope laboratory system in histopathology education has also been effective, significantly improving students' academic performance and satisfaction by providing a rich array of learning resources and facilitating real-time interaction between teachers and students [11]. Collectively, these examples underscore the transformative impact of interactive courseware in making education more engaging, accessible, and effective across diverse fields.

1.2. Special Needs Education

Special needs education (SNE) is a multifaceted field that requires tailored approaches to effectively address the diverse needs of learners with disabilities. In Hong Kong, the adaptation of task-based language teaching (TBLT) for learners with intellectual disabilities emphasizes an ecological framework that integrates various pedagogical strategies to enhance language acquisition in special schools. This approach, which involves a task-supported ecology, allows for a more flexible and inclusive learning environment, accommodating the unique learning characteristics of students with mild intellectual disabilities [5]. In contrast, the context of a refugee camp in Eastern Africa highlights the

challenges of implementing inclusive education in resource-constrained settings. Here, a community-based system dynamics approach reveals the importance of community interaction and meeting basic needs to foster inclusion and wellbeing for children with disabilities, suggesting that Western models of inclusion may not be fully applicable without adaptation [6]. In Finland and Norway, special needs education is shaped by national policies that emphasize inclusion, yet the approaches differ, reflecting each country's educational philosophy and policy framework [7]. In Northern Ireland, the prevalence of special educational needs has been increasing, necessitating robust data collection and analysis to inform policy and improve educational provision. The use of administrative data sets is crucial for understanding trends and planning for future SEN needs [8]. Collectively, these studies underscore the importance of context-specific strategies, community involvement, and data-driven approaches in advancing special needs education globally.

1.3. Inclusive Learning

Inclusive learning is a multifaceted approach that aims to provide equitable educational opportunities for all students, regardless of their diverse needs and backgrounds. The concept has evolved from focusing on the physical placement of students to emphasizing the quality and methods of education provided. Digital transformation plays a significant role in this evolution, as demonstrated by the "Waking Up In the Morning" project, which utilizes gamification and transmedia applications to enhance inclusive education, though teachers often face challenges due to a lack of training and resources [12]. Globally, inclusive education is recognized as a priority, with international efforts led by organizations like UNESCO to ensure that every learner has access to effective educational opportunities, emphasizing the importance of social and political support for these initiatives [13]. In STEM education, the incorporation of learning assistants has been shown to enhance students' sense of belonging and engagement, thereby supporting inclusive learning environments by reducing feelings of isolation and promoting active participation [14].

Professional development is crucial for the successful implementation of inclusive education, as it enhances teachers' knowledge, skills, and beliefs, which in turn positively impacts student behavior. Long-term, practical training with active learning components is particularly effective in facilitating the transfer of inclusive practices to classroom settings [15]. Overall, inclusive learning requires a comprehensive approach that integrates digital tools, methodological strategies, and professional development to address the diverse needs of all students.

1.4. Interactive Learning Design

Interactive learning design is a multifaceted approach that integrates various educational strategies to enhance student engagement and learning outcomes. The shift to digital learning, accelerated by the COVID-19 pandemic, has highlighted the importance of culturally relevant interactive media in creating flexible and interdisciplinary educational ecosystems. This approach allows educators and students to co-design authentic learning experiences that are meaningful and contextually relevant [16]. Purposeful digital learning design incorporates

elements such as knowledge activation, integration of learning modes, and the creation of new learning spaces, which extend beyond game-based learning to include collaborative projects and problem-solving activities [17]. The HyFlex environment, which supports active learning strategies, addresses students' psychological needs by promoting autonomy, competence, and relatedness, thereby motivating students and enhancing their performance in various disciplines [18]. Teacher-student interaction models in online learning spaces are crucial for improving teaching quality and student engagement. These models, supported by real-time AI analysis, have been shown to enhance students' innovative problem-solving abilities and academic performance [19]. Additionally, interactive modules, such as those designed for understanding institutional antibiograms, utilize a stepwise approach and immediate feedback to improve learners' skills and confidence in applying complex concepts in practice [20]. Collectively, these studies underscore the significance of interactive learning design in fostering an engaging and effective educational experience across diverse learning environments.

RESEARCH METHODOLOGY

This research employed a developmental research methodology guided by the ADDIE instructional systems design model, comprising five key phases: Analysis, Design, Development, Implementation, and Evaluation. The methodology was specifically aligned with the research objectives: (1) to design and develop interactive courseware for children with special needs to enhance their everyday communication skills and ensure instructional effectiveness based on the 80/80 standard, and (2) to compare the learning achievement before and after the implementation of the developed courseware.

1.1. Analysis Phase

In the analysis phase, structured interviews were conducted with special education teachers to assess the communication challenges faced by children with special needs. Results revealed that students had limited instructional time, asynchronous availability with teachers, and displayed various communication difficulties such as non-verbal behavior, lack of eye contact, and limited vocabulary recognition. Based on this information, instructional goals were collaboratively developed with subject-matter experts, focusing on improving communication in real-life situations, evaluating learning outcomes, and encouraging knowledge transfer.

1.2. Design Phase

The courseware was designed to include behavioral objectives, pre- and post-tests, interactive media, instructional activities, and evaluation tools. The content was structured into four modules: (1) Daily routines, (2) Observation and data interpretation, (3) Categorization and classification, and (4) Discrimination and differentiation. Instructional planning tools such as flowcharts, storyboards, and a system flow diagram were utilized to

support the design process and ensure logical navigation through the content.

Figure 1 System Flow Diagram

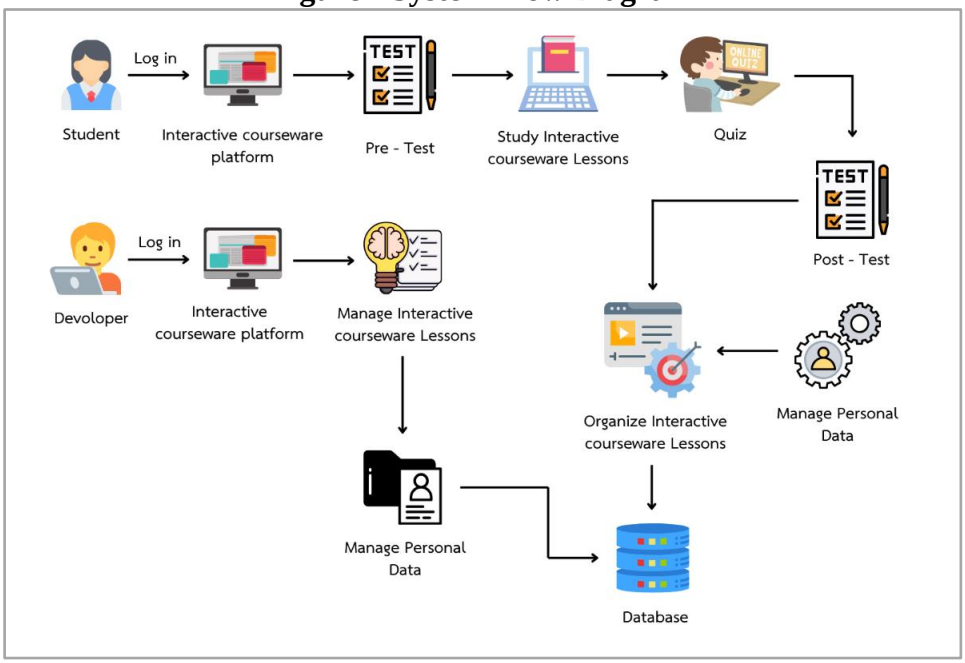


Figure 1 illustrates the system flow of the interactive courseware platform, encompassing the interactions between two primary user roles: students and developers. The diagram outlines a structured sequence of activities aimed at facilitating adaptive learning and personalized content management in a digital learning environment.

1.2.1. Student Workflow

The student begins by logging into the interactive courseware platform. Upon entry, the learner is required to complete a pre-test to assess prior knowledge and establish a learning baseline. Subsequently, the student engages with interactive courseware lessons, which integrate multimedia components such as animations, audio narration, and scenario-based tasks. During the instructional process, the student completes embedded quizzes to reinforce comprehension and practice real-life communication skills. Upon completion of all modules, the learner undertakes a post-test to evaluate learning gains and mastery of content. Throughout this process, the system collects and stores personal learning data—including scores, engagement metrics, and progress tracking—within a centralized database, ensuring continuity and personalized learning analysis.

1.2.2. Developer Workflow

Simultaneously, developers log into the same platform to perform content and system management tasks. Through the interactive courseware management interface, developers can design and update instructional lessons, ensuring alignment with educational standards

and learner profiles. They are also responsible for organizing the lesson structure via the organize interactive courseware lessons module, ensuring logical sequencing and usability. Additionally, developers oversee personal data management to ensure that user information, learning analytics, and platform interactions are secure and systematically stored within the shared database infrastructure.

1.3. Development Phase

The development phase involved the creation of multimedia elements including text, images, animations, and narration to support a learner-centered approach. Content and assessments were refined through analysis of objectives and insights gained from classroom observations. Learning activities were designed to foster discovery, autonomy, and engagement. Learners were encouraged to apply new skills through repetitive practice and real-world application scenarios.

1.4. Implementation Phase

The completed courseware was reviewed and validated by special education teachers and subject-matter experts. After revisions, it was deployed on a web-based platform and implemented with a target group of nine students with special needs at Watchaiyaprucksamala School. Students accessed the courseware via personalized accounts, completed a pre-test, participated in the learning modules, and completed a post-test. Their engagement and performance were monitored, and any technical or instructional issues were addressed in real-time.

1.5. Evaluation Phase

Evaluation was conducted in two dimensions: instructional effectiveness and learning outcome measurement. The efficiency of the courseware was evaluated using the 80/80 criterion (E1/E2), which measures the ratio of student performance during instruction and post-instruction. Additionally, a satisfaction survey was administered to seven experts using a five-point Likert scale to assess their perceptions of content quality, relevance, usability, and learner engagement. Descriptive statistics including mean and standard deviation were used to analyze responses, supporting conclusions regarding the courseware's pedagogical value and usability.

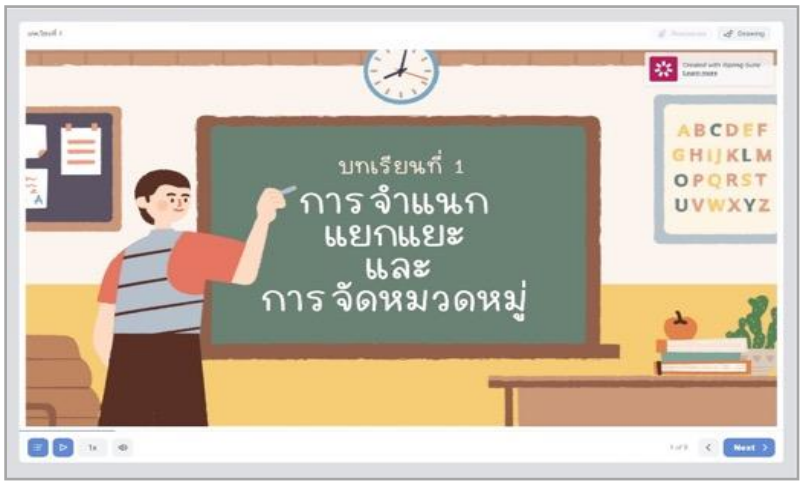
FINDINGS AND RESULTS

This section presents the findings of the study based on the research objectives and the methodology employed through the ADDIE instructional design model. The outcomes are reported in three dimensions: (1) the design and development of the interactive courseware, (2) the evaluation of its instructional efficiency using the 80/80 criterion, and (3) expert satisfaction assessment.

1.1. Design and Development of the Interactive Courseware

Following the analysis of learner needs and communication challenges identified by special education teachers, the research team designed and developed interactive courseware tailored to the context of children with special needs at Watchaiyaprucksamala School in Bangkok. The courseware incorporated multimedia elements such as animations, graphics, narration, and interactive assessments, structured across four instructional modules. Each module focused on real-life communication scenarios including daily routines, data interpretation, categorization, and discrimination tasks. The web-based interface allowed for individualized learner access, pre- and post-tests, and lesson completion tracking.

Figure 2 Introductory Screen of Lesson 1 – "Classification and Grouping"



The courseware was designed with a user-friendly interface and pedagogically structured content to support children with special needs in developing everyday communication skills. As shown in **Figure 2**, the introductory screen for Lesson 1 presents the topic titled *"Classification, Categorization, and Grouping"*, framed within a classroom context. The visual layout incorporates familiar educational cues such as a chalkboard, clock, and alphabet chart, designed to simulate a real-life learning environment and reduce cognitive load. The visual style uses warm colors and cartoon-style graphics, which are developmentally appropriate for the target learner group and aligned with principles of Universal Design for Learning (UDL).

Figure 3 Instructional Content Screen – Visual Categorization Activity

Figure 3 illustrates an example of a content screen from the same lesson, wherein learners are presented with a visual classification task involving two categories: "*Things for Use*" and "*Toys*". The use of concrete visual representations—such as a backpack, spoon, notebook, and various toys—supports vocabulary development and cognitive association. This layout is intentionally designed to promote visual discrimination, categorization, and semantic understanding through interactive sorting tasks. Navigation buttons, text-to-speech icons, and audio narration are embedded to enhance accessibility and learner autonomy

Figure 4 Interactive Activity Screen – Daily Routine Sequencing Task

Figure 4, the activity screen presents a drag-and-drop sequencing task titled "*Arrange the Daily Activities in the Correct Order.*" Learners are required to interpret visual prompts and logically organize a set of illustrated actions, such as waking up, exercising, and studying. This activity is designed to foster cognitive skills related to sequencing, time management, and task organization—crucial competencies in everyday communication and daily living. The activity layout follows Universal Design for Learning (UDL) principles, with clear visual cues, minimal text, and intuitive navigation, making it accessible to learners with various communication challenges

Figure 5 Post-Assessment Feedback Screen – Performance Summary and Review Prompt

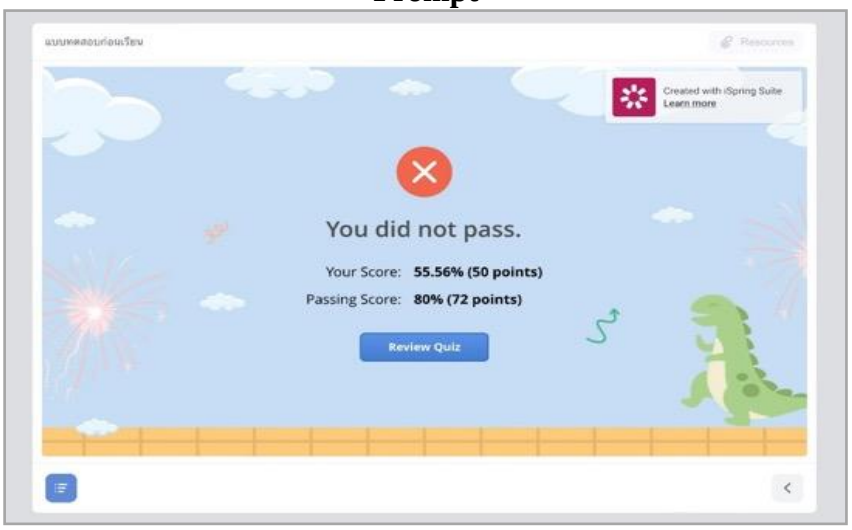


Figure 5 displays the post-assessment feedback screen, which provides immediate formative evaluation results to the learner. The platform automatically calculates the learner's performance, comparing it against the predefined mastery threshold of 80%. In this example, the learner scored 55.56%, which is below the required benchmark. The feedback interface communicates success or failure using visual indicators (e.g., color-coded symbols) and numerical results, followed by a prompt to review the quiz. This feature supports learner self-reflection, reinforcing metacognitive awareness and offering opportunities for remediation. Such a feedback mechanism aligns with evidence-based best practices in instructional design, particularly in special education, where repeated practice and structured feedback loops are

1.2. Instructional Effectiveness Evaluation (E1/E2)

To evaluate instructional efficiency, a total of nine students participated in the pre-test, lesson modules, and post-test. The process performance (E1) and learning outcome (E2) were analyzed quantitatively. As shown in Table 1, the E1 score was 85.56%, and the E2 score was 86.67%, which both exceeded the predefined instructional standard of 80/80. These results indicate that the interactive courseware was highly effective in facilitating learning processes and enhancing communication outcomes among the target group.

Table 1 Instructional Efficiency Evaluation (E1/E2)

Number of Learners	Process Efficiency (E1)	Outcome Efficiency (E2)
9	85.56%	86.67%

1.3. Expert Satisfaction Evaluation

Seven experts—comprising specialists in special needs education and UX/UI design—were invited to assess the quality of the courseware across three key dimensions: content quality, visual and media design, and usability. The evaluation employed a five-point Likert scale. Table 2 presents the average satisfaction ratings. The overall mean score was 4.07 with a standard deviation of 0.69, indicating a high level of satisfaction across all evaluated aspects. Specifically, content quality received a mean of 3.96, visual and media design scored 4.21, and usability was rated at 4.03

Table 2 Expert Satisfaction Ratings

Evaluation Criteria	Mean	S.D.
1. Content Quality	3.96	0.80
2. Visuals and Media Design	4.21	0.65
3. Usability and Functionality	4.03	0.62
Overall	4.07	0.69

These findings confirm that the interactive courseware developed in this study not only exceeded efficiency expectations but also achieved high satisfaction from experts, validating its potential as an effective tool for improving everyday communication skills in children with special needs.

DISCUSSION

The findings of this study demonstrate that the design and development of interactive courseware for children with special needs can significantly enhance their everyday communication skills. The courseware achieved high instructional efficiency, with E1 and E2 scores of 85.56% and 86.67%, respectively, exceeding the standard benchmark of 80/80. Additionally, the satisfaction evaluation by seven experts in special education and UX/UI design yielded a mean score of 4.07, indicating a high level of acceptance regarding content quality, visual design, and usability. These outcomes suggest the effectiveness of the interactive courseware and its potential to be adapted for broader applications in inclusive education.

The high efficiency scores and expert satisfaction can be attributed to the instructional design approach employed in this study. By integrating multimedia elements such as animations, voiceovers, and interactive exercises within the ADDIE model, the courseware created an engaging and responsive learning environment. This finding aligns with research emphasizing that game-based and interactive learning tools can increase engagement and learning outcomes by contextualizing abstract content [4]. Similarly, interactive systems have been shown to improve academic performance through real-time engagement and feedback [11]. The use of interactive learning design in this study reflects global trends in personalized and technology-enhanced education.

Furthermore, the results are consistent with existing literature on special needs education, particularly regarding the necessity for context-specific and learner-centered instructional tools. Task-based and interactive learning strategies have been recognized for their support in developing communicative competence in special education contexts [5]. This study adds empirical support to such claims by demonstrating measurable improvements in learners' performance and expert endorsement. The successful implementation of the courseware in an inclusive classroom setting also resonates with principles of inclusive learning, which advocate for equitable access to education regardless of learner diversity. The integration of user-centered design, adaptive multimedia content, and real-life learning contexts directly supports findings that emphasize the importance of culturally relevant, interactive media in promoting effective and inclusive learning environments [16].

In summary, the effectiveness of the courseware in enhancing communication skills and the high satisfaction reported by experts underscore the practical value of interactive learning design in special needs education. This research validates the use of ADDIE-guided instructional development and highlights its relevance to inclusive educational practices. The findings contribute to the growing body of literature that supports the use of digital, interactive tools for personalized learning, particularly for learners with disabilities. These results have important implications for future research and policy development in inclusive and special education, aligning with global educational priorities such as Sustainable Development Goal 4 [10].

CONCLUSION

This study developed and evaluated interactive courseware aimed at enhancing everyday communication skills among children with special needs, using the ADDIE model as a guiding framework. The courseware demonstrated strong instructional effectiveness with an E1/E2 score of 85.56/86.67, exceeding the 80/80 benchmark, and received a high expert satisfaction rating (mean = 4.07), indicating the quality of content, usability, and design. These findings affirm that interactive, multimedia-based instruction can significantly support communication development and learner engagement in inclusive educational settings. The results align with contemporary theories of learner-centered design and inclusive pedagogy, reinforcing the potential of technology-enhanced learning in supporting diverse learners. This research contributes a replicable instructional model and underscores the importance of expanding access to personalized digital tools in special education, offering valuable implications for practice, policy, and future research aligned with Sustainable Development Goal 4.

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