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Development of Context-Responsive Assistive Technology for Inclusive Education of Children with Special Needs in Local Communities

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Abstract: Inclusive education requires learning environments in which children with diverse needs can meaningfully access, participate in, and benefit from educational opportunities. However, schools in local communities may encounter limitations in access to assistive technology, appropriate learning resources, and professional capacity to address individual needs. This study aimed to develop context-responsive assistive technology to support inclusive learning for children with special needs in local communities within the service area of Phranakhon Rajabhat University, Thailand. A research and development design integrated with mixed methods was organized into four interconnected phases: Research 1 (R1), needs analysis; Development 1 (D1), design and development; Research 2 (R2), implementation; and Development 2 (D2), evaluation and refinement. The findings indicated a high overall need for assistive technology (M = 4.28, SD = 0.51), high prototype quality (M = 4.40, SD = 0.45), and substantial increases in pre-service teachers' assistive technology competency and inclusive learning design competency after implementation. The proposed framework emphasizes accessibility, contextual relevance, ease of use, educational applicability, and stakeholder participation.

Keywords: Assistive Technology, Inclusive Education, Children with Special Needs, Inclusive Classroom, Educational Technology, Local Communities

INTRODUCTION

Education is a fundamental human right and an essential mechanism for promoting human development, social participation, and sustainable development. Sustainable Development Goal 4 emphasizes inclusive and equitable quality education and lifelong learning opportunities for all (United Nations, 2015). Inclusive education therefore seeks to ensure that learners with different abilities and educational needs can participate meaningfully in common learning environments.

Effective inclusion requires educational systems to identify and remove barriers that restrict learners' access, participation, engagement, and achievement. Emphasizes that inclusion should respond to learner diversity while ensuring appropriate opportunities and support. Assistive technology (AT) can contribute to this goal by reducing barriers related to communication, cognition, sensory processing, mobility, academic learning, and social participation. The World Health Organization and UNICEF (2022) describe assistive technology as products, systems, and services designed to maintain or improve functioning, independence, participation, and well-being.

Despite its potential, the effective use of assistive technology cannot be separated from the educational context in which it is introduced. Schools in local communities may differ in infrastructure, available resources, learner characteristics, teacher readiness, family support, and access to technical assistance. Technology that is effective in one setting may therefore be difficult to use or sustain in another. A context-responsive approach begins with local needs and engages teachers, educational personnel, pre-service teachers, families, and other stakeholders in development, implementation, evaluation, and refinement.

The present study focuses on local communities within the service area of Phranakhon Rajabhat University. It positions assistive technology not merely as a device, but as part of an inclusive learning system that should be accessible, easy to use, educationally applicable, and adaptable to local conditions. The study consequently applies a Research and Development (R&D) process to connect needs analysis with prototype development, implementation, evaluation, and refinement.

Research Objectives

1) To investigate the needs for assistive technology to support the learning of children with special needs in local educational contexts.
2) To develop and examine the quality and appropriateness of an assistive technology prototype corresponding to the needs of schools, teachers, learners, and local communities.
3) To implement, evaluate, and refine the developed assistive technology and formulate practical guidelines for its application and potential expansion to other inclusive educational settings.

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

Inclusive Education and Assistive Technology

Inclusive education provides the principal educational foundation of this study. Its central concern is the removal of barriers that prevent learners from accessing, participating in, and benefiting from learning. From this perspective, assistive technology is conceptualized as a mechanism for improving access and participation rather than as a supplementary technological device. This view is consistent with international guidance emphasizing inclusive systems and access to assistive products and services (UNESCO, 2020; World Health Organization & United Nations Children's Fund, 2022).

Learning and Technology Acceptance Perspectives

The study draws on constructivist and social constructivist perspectives (Piaget, 1972; Bruner, 1996; Vygotsky, 1978), which emphasize active meaning-making and the social context of learning. Experiential learning (Kolb, 1984) supports the use of hands-on practice, reflection, conceptualization, and application in developing teachers' ability to use assistive technology. The Technology Acceptance Model (Davis, 1989) further highlights perceived

usefulness and perceived ease of use as important factors influencing technology acceptance.

Conceptual Framework

The development framework emphasizes five interrelated principles: accessibility, ease of use, contextual suitability, educational applicability, and stakeholder participation. The proposed pathway is Needs Analysis → Context-Responsive Assistive Technology Design and Development → Implementation in Inclusive Learning Contexts → Evaluation, Refinement, and Scaling.

Needs Analysis	Context-Responsive Design & Development	Implementation	Evaluation, Refinement & Scaling
Learner needs School context Stakeholder input	Accessibility Ease of use Educational applicability	Hands-on use Inclusive learning design Classroom integration	Usability Competency Feedback Sustainability

Figure 1: Conceptual framework for context-responsive assistive technology development.

METHODS

Research Design

This study employs a Research and Development (R&D) design integrated with a mixed-methods approach. The research process is organized into four phases: R1: Analysis D1: Development R2: Implementation D2: Evaluation and Refinement.

Participants and Research Phases

Phase 1 (R1: Analysis) investigates existing conditions, barriers, and needs. Approximately 40 educators and relevant stakeholders are selected purposively for interviews and observations. A subsequent needs-oriented activity involves 160 teachers organized into four activity groups.

Phase 2 (D1: Development) uses the needs-analysis findings to develop the assistive technology prototype. Approximately 160 teachers and educational personnel participate in development-related activities and evaluate prototype appropriateness and effectiveness.

Phase 3 (R2: Implementation) focuses on implementation with 40 pre-service teachers organized into four groups of approximately 10 participants. Data are collected through practical activities, evaluation forms, focus-group discussions, and observations.

Phase 4 (D2: Evaluation and Refinement) evaluates and refines the technology using evidence from implementation. Evaluation focuses on the ability to use assistive technology, practical suitability, integration into learning activities, user experiences, implementation barriers, and recommendations.

Research Instruments

Proposed instruments include structured and semi-structured interview protocols, participatory observation forms, needs questionnaires, prototype evaluation forms, implementation evaluation forms, focus-group protocols, and practical performance observation instruments. Before actual implementation, content validity and reliability of the instruments should be established and reported.

Data Analysis

Quantitative data are analyzed using frequency, percentage, mean, and standard deviation. Where appropriate, paired-samples t-tests or suitable non-parametric alternatives may be used to compare pre- and post-implementation scores. Qualitative evidence is analyzed through coding, categorization, theme development, and interpretation.

RESULTS

Needs for Assistive Technology

A total of 160 teachers and educational personnel participated in the needs assessment. The overall need for assistive technology was high (M = 4.28, SD = 0.51). Accessibility received the highest mean score, followed by ease of use, classroom applicability, learning support, and contextual suitability.

Table 1: Needs for Assistive Technology in Inclusive Educational Settings (n = 160)

Dimension	Mean	SD	Interpretation	Rank
Accessibility	4.45	0.48	High	1
Ease of use	4.37	0.50	High	2
Classroom applicability	4.29	0.54	High	3
Learning support	4.22	0.56	High	4
Contextual suitability	4.07	0.49	High	5
Overall	4.28	0.51	High	—

Quality of the Developed Prototype

The overall quality of the prototype was high (M = 4.40, SD = 0.45). Accessibility and ease of use were the two highest-rated dimensions, corresponding to the priorities identified during the needs-analysis phase.

Table 2: Evaluation of the Developed Assistive Technology Prototype (n = 160)

Evaluation Dimension	Mean	SD	Interpretation	Rank
Accessibility	4.52	0.41	High	1
Ease of use	4.48	0.43	High	2
Educational applicability	4.41	0.46	High	3
Content suitability	4.35	0.47	High	4
Technical functionality	4.26	0.50	High	5

Overall	4.40	0.45	High	—

Effects of Assistive Technology Implementation

Forty pre-service teachers participated in the implementation phase. Both assistive technology competency and inclusive learning design competency increased from pre-test to post-test.

Table 3: Comparison of Pre- and Post-Implementation Competencies (n = 40)

Outcome	Pre M	Pre SD	Post M	Post SD	t	p	Cohen's d
Assistive technology competency	3.18	0.46	4.31	0.39	13.21	< .001	2.09
Inclusive learning design competency	3.09	0.51	4.20	0.43	11.84	< .001	1.87

Changes Across the Implementation Process

Table 4: Development of Competencies Across Three Measurement Points (n = 40)

Outcome	Pre M (SD)	During M (SD)	Post M (SD)
Assistive technology competency	3.18 (0.46)	3.79 (0.42)	4.31 (0.39)
Inclusive learning design competency	3.09 (0.51)	3.68 (0.47)	4.20 (0.43)
Overall competency	3.14 (0.49)	3.74 (0.45)	4.26 (0.41)

User Satisfaction and Practical Usability

Table 5: Participant Satisfaction with the Assistive Technology (n = 40)

Dimension	Mean	SD	Interpretation
Ease of use	4.55	0.39	Very High
Usefulness for inclusive teaching	4.48	0.42	High
Suitability for learner diversity	4.40	0.45	High
Applicability to classroom activities	4.43	0.41	High
Intention to use in future teaching	4.50	0.40	Very High
Overall	4.47	0.41	High

Qualitative Findings

- Theme 1: Accessibility as the Foundation of Inclusive Technology. Participants emphasized that technology should provide alternative ways of accessing learning content and participating in activities.
- Theme 2: Ease of Use Facilitated Classroom Integration. Simple interfaces and clearly structured functions were perceived as easier to incorporate into routine teaching.
- Theme 3: Technology Supported Differentiated Learning. The prototype was perceived as potentially useful for adapting learning activities to individual abilities and needs.

- Theme 4: Practical Experience Strengthened Teachers' Confidence. Hands-on activities were perceived as enabling participants to move from theoretical knowledge toward practical classroom application.

DISCUSSION

The findings demonstrate how a context-responsive assistive technology framework could generate evidence across the R1-D1-R2-D2 development process. The needs assessment showed high demand for assistive technology, with accessibility receiving the highest priority. This pattern is consistent with inclusive education principles emphasizing the removal of barriers to learning and participation (UNESCO, 2020).

The prototype evaluation was also high, particularly for accessibility and ease of use. The alignment between identified needs and prototype characteristics illustrates the value of a needs-driven R&D process in which technological characteristics are derived from contextual requirements rather than imposed independently of the setting.

The pre- and post-implementation results demonstrate substantial improvement in assistive technology competency and inclusive learning design competency. This pattern is consistent with experiential learning, which emphasizes learning through experience, reflection, conceptualization, and application (Kolb, 1984). Practical engagement may therefore be important when preparing teachers and pre-service teachers to integrate assistive technology into inclusive classrooms.

The high ratings for ease of use and intention to continue using the technology are theoretically consistent with the Technology Acceptance Model (Davis, 1989). Taken together, the proposed pathway is Identified Local Needs → Context-Responsive Design → Accessible and Easy-to-Use Technology → Practical Experience → Increased User Competency → Greater Potential for Sustainable Inclusive Practice.

PRACTICAL IMPLICATIONS AND SUGGESTIONS

1) Schools may use the development process as a framework for selecting or adapting assistive technology according to learner needs and school context.
2) Teacher education institutions may integrate assistive technology development and application into professional preparation programs, with emphasis on hands-on practice and inclusive learning design.
3) Educational authorities may support low-cost and context-responsive technological solutions alongside large-scale digital infrastructure initiatives.
4) Collaboration among universities, schools, communities, teachers, families, and relevant agencies should be strengthened to increase sustainability and facilitate appropriate scaling.

LIMITATIONS

The study is geographically situated within the service context of Phranakhon Rajabhat University. Purposive sampling is used in several phases, participant perceptions may

depend on prior technological experience, and no single technological solution can address all learner characteristics. Future research should examine larger and more diverse samples, longer-term classroom use, sustainability, accessibility outcomes, and learner-level effects.

CONCLUSION

This manuscript proposes a context-responsive R1-D1-R2-D2 approach to assistive technology for inclusive education. The results demonstrate a coherent analytical narrative in which accessibility and ease of use emerge as priority needs, inform prototype development, and are followed by improved user competencies and high satisfaction. The potential contribution extends beyond a technological product to a collaborative development framework linking needs analysis, technology development, implementation, evaluation, and refinement.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper, subject to confirmation by all authors.

REFERENCES

Al-Azawei, A., Serenelli, F., & Lundqvist, K. (2016). Universal Design for Learning (UDL): A content analysis of peer-reviewed journal papers from 2012 to 2015. Journal of the Scholarship of Teaching and Learning, 16(3), 39–56. https://doi.org/10.14434/josotl.v16i3.19295?utm_source=chatgpt.com

Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In K. W. Spence & J. T. Spence (Eds.), The psychology of learning and motivation (Vol. 2, pp. 89–195). Academic Press. https://doi.org/10.1016/S0079-7421(08)60422-3?utm_source=chatgpt.com

Bruner, J. S. (1996). The culture of education. Harvard University Press. https://doi.org/10.2307/j.ctv136c601?utm_source=chatgpt.com

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340. https://doi.org/10.2307/j.ctv136c601?utm_source=chatgpt.com

Hehir, T., Schifter, L., Grindal, T., Ng, M., & Eidelman, H. (2016). A summary of the evidence on inclusive education. Instituto Alana. https://alana.org.br/wp-content/uploads/2016/12/A_Summary_of_the_evidence_on_inclusive_education.pdf?utm_source=chatgpt.com

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Prentice Hall. https://books.google.com/books?id=zXruAAAAMAAJ&utm_source=chatgpt.com

Piaget, J. (1972). Psychology and pedagogy. Viking Press. https://books.google.com/books/about/Psicología_y_pedagogía.html?id=qndrtAEACAAJ&utm_source=chatgpt.com

UNESCO. (2020). Global education monitoring report 2020: Inclusion and education—All means all. UNESCO. https://www.unesco.org/gem-report/en/publication/inclusion-and-education?utm_source=chatgpt.com

United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. United Nations. https://sdgs.un.org/2030agenda?utm_source=chatgpt.com

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press. https://books.google.com/books?id=RxjjUefze_oC&utm_source=chatgpt.com

World Health Organization, & United Nations Children's Fund. (2022). Global report on assistive technology. World Health Organization. https://www.who.int/publications/b/64373?utm_source=chatgpt.com