 ISSN 2809-8587

Implementation of the Use of an Annuity Calculator Application for Grade XII Students at Sekolah Khusus Islam Terpadu Yarfin

Satrio Budi Utomo[1], Oki Kurnia[2]
[1,2]Economic Education Study Program, Pamulang University, Kota Tangerang Selatan, Indonesia
Email : satriobudi321@gmail.com[1], oki.alves66@gmail.com[2]

Learning social arithmetic, particularly annuities, requires both conceptual understanding and procedural accuracy. For students with visual impairments, these demands are often intensified due to limited access to visual mathematical notation and multi-step calculations. This study aims to describe the implementation of a Windows-based annuity calculator application in teaching annuity concepts to Grade XII students with visual impairments at Sekolah Khusus Islam Terpadu Yarfin, as well as to identify its benefits and challenges. Using a descriptive case study approach, data were collected through classroom observations, semi-structured interviews with teachers and students, documentation analysis, and pretest–posttest assessments. The findings indicate that the application supports students' conceptual understanding by reducing procedural calculation burdens and enhances learning independence when operated via keyboard and screen reader. Challenges include varying ICT literacy levels, interface accessibility issues, and limited device availability. The study highlights the importance of integrating accessible assistive technology with appropriate pedagogical strategies to support inclusive mathematics learning.
Keywords: Visual Impairment, Assistive Technology, Annuity Calculator, Inclusive Mathematics Education, Universal Design For Learning

Corresponding Author:
Satrio Budi Utomo
Economic Education Study Program, Pamulang University
Jl. Raya Puspiptek, Buaran, Kec. Pamulang, Kota Tangerang Selatan, Banten 15310
satriobudi321@gmail.com

1. Introduction

Social arithmetic plays a fundamental role in developing students' numeracy and financial literacy, as it addresses real-life contexts such as interest rates, installment payments, loans, and annuities. In particular, the topic of annuities requires students not only to recall mathematical formulas but also to understand the relationships among key variables, including principal value, interest rate, time period, and installment amount. Mastery of these concepts is essential for enabling learners to make informed financial decisions and to interpret everyday economic phenomena (Ministry of Education and Culture of the Republic of Indonesia, 2020).

However, learning annuities presents significant challenges for students with visual impairments. Mathematics instruction commonly relies on visual representations such as symbols, exponents, fractions, and amortization tables, which are not easily accessible to blind or visually impaired learners without appropriate accommodations. Previous studies have shown that students with visual impairments often experience increased cognitive load when mathematical learning depends heavily on visual notation and multi-step procedural calculations (Bouck & Weng, 2014). As a result, these students may focus more on managing calculation procedures than on developing conceptual understanding.

Assistive technology has been widely recognized as a critical means of reducing accessibility barriers and supporting inclusive education for learners with disabilities. Screen readers, keyboard-based navigation, and accessible software applications allow students with visual impairments to interact with digital content

more independently and meaningfully (WHO & UNICEF, 2022). In the context of mathematics education, assistive tools can shift learners' attention away from labor-intensive procedural tasks toward higher-order conceptual reasoning and interpretation (Hansen et al., 2020). Nevertheless, the effectiveness of assistive technology depends strongly on its accessibility design and its integration into pedagogical practices.

One educational framework that supports the integration of assistive technology is Universal Design for Learning (UDL). UDL emphasizes the provision of multiple means of representation, action and expression, and engagement to accommodate learner diversity (CAST, 2018). The use of an accessible annuity calculator application aligns with UDL principles by offering an alternative mode of action and expression that does not rely on visual representations alone. When such applications are operable via keyboard and compatible with screen readers, they enable students with visual impairments to participate more fully in learning activities that would otherwise be inaccessible.

Despite the growing availability of digital tools, empirical studies focusing on the implementation of accessible financial–mathematical applications for students with visual impairments remain limited, particularly in secondary education settings. Existing research has tended to emphasize general assistive technologies rather than subject-specific applications that address complex mathematical concepts such as annuities (Bouck et al., 2018). Moreover, practical challenges related to students' information and communication technology (ICT) literacy, device availability, and interface accessibility are often underreported in the literature.

In response to these gaps, this study focuses on the implementation of a Windows-based annuity calculator application in teaching annuities to Grade XII students with visual impairments at Sekolah Khusus Islam Terpadu Yarfin. By adopting a descriptive case study approach, the study seeks to examine how the application is integrated into classroom instruction, to identify its benefits for conceptual understanding and learner independence, and to explore the challenges encountered during its use. Through this investigation, the study aims to contribute to inclusive mathematics education by providing practical insights into the role of accessible assistive technology in supporting the learning of financial mathematics for students with visual impairments.

2. Literature Review and Problem Statement

Annuity Concepts in Social Arithmetic Education

Annuities are a central topic in social arithmetic and financial mathematics, as they model periodic payments made over a fixed time interval, commonly applied to loan repayments, savings plans, and installment-based transactions. In educational contexts, annuities are typically introduced through the relationship between principal value, interest rate, payment period, and installment amount, alongside related concepts such as present value (PV) and future value (FV). Understanding annuities requires both procedural accuracy and conceptual comprehension, particularly in interpreting how changes in parameters affect payment structures (Ministry of Education and Culture of the Republic of Indonesia, 2020).

However, instructional practices often emphasize formula memorization and step-by-step manual calculation, which may inadvertently increase cognitive load and obscure conceptual meaning. This challenge is amplified for learners who experience barriers in accessing symbolic and tabular representations, as is frequently the case for students with visual impairments. As a result, alternative instructional supports are needed to facilitate meaningful engagement with annuity concepts beyond procedural computation.

Learning Barriers in Mathematics for Students with Visual Impairments

Students with visual impairments face distinctive challenges in mathematics learning due to the visual nature of mathematical notation, spatial representations, and multi-line symbolic expressions. Topics involving fractions, exponents, and tabular data such as amortization schedules are particularly difficult to access without appropriate accommodations. Research indicates that blind and visually impaired students often encounter increased difficulty when mathematical instruction relies heavily on visual formats, leading to slower task completion and reduced opportunities for conceptual exploration (Bouck & Weng, 2014).

Without accessible tools, these learners may depend extensively on teacher assistance or verbal explanations, which can limit learner autonomy and reduce opportunities for independent problem-solving. Consequently, there is a growing need for instructional approaches and tools that support accessibility while preserving mathematical rigor.

Assistive Technology and Accessible Mathematics Learning

Assistive technology plays a critical role in enabling students with disabilities to access learning materials and participate more independently in educational activities. For students with visual impairments, screen readers, keyboard-based navigation, and accessible software interfaces are among the most widely used technologies (WHO & UNICEF, 2022). In mathematics education, assistive tools can reduce procedural barriers by automating calculations, allowing students to allocate cognitive resources toward understanding concepts and interpreting results (Hansen et al., 2020).

Despite these advantages, the effectiveness of assistive technology is highly dependent on usability and pedagogical integration. Tools that are not fully compatible with screen readers or that require extensive mouse interaction may inadvertently introduce new barriers. Therefore, subject-specific applications such as annuity calculators that are designed or adapted for accessibility represent a promising yet underexplored area in inclusive mathematics education.

Universal Design for Learning as a Pedagogical Framework

Universal Design for Learning (UDL) provides a theoretical foundation for designing instruction that accommodates learner diversity by offering multiple means of representation, action and expression, and engagement (CAST, 2018). Within this framework, the use of an accessible annuity calculator aligns with the principle of providing alternative means of action and expression, enabling students with visual impairments to solve mathematical problems without relying on visual representations alone.

UDL emphasizes that accessibility should be embedded within instructional design rather than treated as an afterthought. Accordingly, integrating accessible digital tools into mathematics instruction not only supports students with disabilities but can also enhance learning flexibility for all students. However, empirical evidence demonstrating how UDL-aligned assistive technologies function in real classroom settings particularly in secondary-level financial mathematics is still limited.

Problem Statement

Although annuity concepts are essential for developing students' financial literacy, existing instructional approaches often present significant barriers for students with visual impairments due to their reliance on visual notation and manual calculation procedures. While assistive technologies such as screen readers are widely available, there is limited empirical research examining the implementation of subject-specific, accessible applications such as annuity calculator software in supporting conceptual understanding and learner independence among blind students at the secondary education level.

Furthermore, practical challenges related to students' information and communication technology (ICT) literacy, interface accessibility, and device availability are rarely discussed in depth, despite their influence on the effectiveness of assistive technology integration. Consequently, there is a need for context-specific studies that document not only the benefits but also the constraints and implementation strategies associated with accessible mathematical applications in inclusive learning environments.

Based on these considerations, the present study addresses the following problem: how can a Windows-based annuity calculator application be effectively implemented to support the learning of annuities among Grade XII students with visual impairments, and what benefits and challenges arise from its use in classroom practice?

3. Method

Research Design

This study employed a descriptive case study design to examine the implementation of a Windows-based annuity calculator application in teaching annuity concepts to Grade XII students with visual impairments. A case study approach was selected because it enables in-depth exploration of instructional practices, contextual conditions, and participant experiences within a real educational setting (Yin, 2018). This design is particularly appropriate for inclusive education research, where the interaction between learners, technology, and pedagogy must be understood holistically rather than through experimental control alone.

Research Site and Participants

The study was conducted at Sekolah Khusus Islam Terpadu Yarfin, an inclusive special education institution serving students with visual impairments. The participants consisted of Grade XII students with visual impairments and one mathematics teacher responsible for teaching social arithmetic, specifically the topics of interest and annuities. Participant selection followed a purposive sampling strategy, as recommended in qualitative case study research, to ensure that the subjects had direct experience with the instructional intervention under investigation (Creswell & Poth, 2018).

Data Collection Techniques

Data were collected using multiple techniques to support methodological triangulation and enhance credibility. First, classroom observations were conducted to document how the annuity calculator application was integrated into instruction, including navigation via keyboard, interaction with screen readers, and student engagement during guided and independent practice. Observation is widely used in educational case studies to capture authentic learning processes and technology use in situ (Merriam & Tisdell, 2016).

Second, semi-structured interviews were carried out with the mathematics teacher and participating students. Teacher interviews focused on instructional planning, perceived benefits, and implementation challenges, while student interviews explored usability, accessibility, and perceived support for conceptual understanding. Semi-structured interviews allow researchers to maintain focus on key issues while providing flexibility for participants to express their experiences in their own terms (Kvale & Brinkmann, 2015).

Third, documentation analysis was conducted on lesson plans, instructional materials, student worksheets, and relevant application screenshots when necessary. In addition, conceptual understanding tests in the form of pretests and posttests were administered using narrative, screen-reader-friendly questions related to annuities. The use of pretest–posttest comparison in descriptive studies helps identify patterns of conceptual change without implying causal inference (Fraenkel, Wallen, & Hyun, 2019).

Research Instruments

The research instruments included an observation checklist focusing on accessibility, independence, and conceptual engagement; interview guides for teachers and students; and a set of pretest–posttest items accompanied by an analytic scoring rubric. Content validity of the instruments was established through expert review, involving feedback from mathematics educators and academic supervisors to ensure alignment with annuity learning objectives and accessibility principles. Expert judgment is a commonly recommended strategy for validating instruments in educational research involving special populations (Cohen, Manion, & Morrison, 2018).

Data Analysis Techniques

Qualitative data from observations and interviews were analyzed using thematic analysis, following stages of data familiarization, coding, theme development, and interpretation. The analysis focused on themes such as accessibility, learner independence, conceptual understanding, technical constraints, and instructional strategies. Thematic analysis is suitable for identifying recurring patterns in qualitative educational data while maintaining sensitivity to contextual factors (Braun & Clarke, 2006).

Quantitative data from the pretest and posttest were analyzed descriptively by comparing average scores, score improvements, and common conceptual errors. This descriptive approach was adopted to complement qualitative findings and to illustrate learning trends without making inferential or causal claims, which aligns with the exploratory nature of case study research (Yin, 2018).

Research Ethics

Ethical considerations were addressed throughout the study. Permission to conduct the research was obtained from the school, and informed consent was secured from the teacher and students. Participant anonymity was preserved, and all data were used solely for research purposes. Particular attention was given to accessibility and dignity in data collection, ensuring that all instruments and interactions were appropriate for students with visual impairments, in line with inclusive research ethics guidelines (WHO & UNICEF, 2022).

4. Results and Discussion

The implementation of a Windows-based annuity calculator application in teaching annuity concepts to Grade XII students with visual impairments at Sekolah Khusus Islam Terpadu Yarfin revealed several important findings related to accessibility, conceptual understanding, learner independence, and instructional challenges. Overall, the results indicate that the application functioned as an effective assistive learning tool when integrated with appropriate pedagogical guidance and accessibility support.

From the observation data, the implementation process generally followed five instructional stages: technical preparation, conceptual orientation, guided practice, independent practice, and reflection. During the preparation stage, the application was installed and tested for keyboard navigation and compatibility with screen reader software. Observations showed that when interface elements were properly labeled and accessible via keyboard commands, students were able to operate the application with minimal assistance. This finding supports previous studies emphasizing that accessibility design is a prerequisite for the effective use of assistive technology in mathematics learning (WHO & UNICEF, 2022).

In terms of learning outcomes, both observational evidence and pretest–posttest results suggested an improvement in students' conceptual understanding of annuities. Students demonstrated clearer explanations of the composition of annuity payments, particularly the distinction between principal and interest components. Rather than focusing on lengthy manual calculations, learners were able to devote

more cognitive resources to interpreting outputs and reasoning about parameter changes, such as the effect of interest rate or loan duration on installment size. This shift aligns with the argument that assistive tools can reduce procedural cognitive load and facilitate higher-order conceptual processing (Hansen et al., 2020).

Interview data further indicated that the use of the annuity calculator contributed positively to students' learning independence. Many students reported increased confidence in completing tasks independently, as the application allowed them to input parameters, execute calculations, and review results without constant teacher intervention. This finding is consistent with Bouck and Weng (2014), who noted that accessible digital tools can enhance autonomy and engagement among students with visual impairments. From a pedagogical perspective, increased independence also enabled the teacher to adopt a more facilitative role, focusing on conceptual clarification and discussion rather than step-by-step procedural assistance.

Despite these benefits, several challenges were identified during implementation. Variations in students' information and communication technology (ICT) literacy affected the speed and ease with which they adapted to the application. Some students required additional time to become familiar with keyboard navigation and screen reader interactions. Moreover, certain interface elements were not optimally recognized by screen readers, necessitating repeated guidance from the teacher. These challenges highlight that assistive technology alone is insufficient without structured orientation and ongoing instructional support, as also emphasized in inclusive education literature (CAST, 2018).

Another notable constraint was the limited availability of compatible devices, which required students to share equipment or work in pairs. While collaborative arrangements mitigated access issues, they occasionally reduced opportunities for individual practice. Additionally, there was a pedagogical risk that students might rely on the application solely to obtain numerical answers without fully understanding the underlying concepts. To address this issue, the teacher employed assessment rubrics emphasizing explanation, reasoning, and interpretation rather than numerical accuracy alone. This strategy reflects UDL principles, particularly the provision of multiple means of action and expression that prioritize understanding over rote computation (CAST, 2018).

From a theoretical standpoint, the findings support the relevance of Universal Design for Learning as a framework for integrating assistive technology into mathematics instruction. The accessible annuity calculator provided an alternative pathway for action and expression, allowing students with visual impairments to engage with financial mathematics content on more equitable terms. At the same time, the results underscore the importance of aligning technological tools with instructional design, teacher mediation, and assessment practices to achieve meaningful learning outcomes.

In summary, the results demonstrate that the implementation of an accessible annuity calculator application can enhance conceptual understanding and learning independence among students with visual impairments when accompanied by appropriate pedagogical strategies. The discussion suggests that such applications should be viewed not as substitutes for instruction, but as supportive tools that enable inclusive and concept-oriented mathematics learning. These findings contribute practical insights for educators and policymakers seeking to strengthen inclusive financial mathematics education through accessible digital technologies.

5. Conclusion

This study examined the implementation of a Windows-based annuity calculator application in teaching annuity concepts to Grade XII students with visual impairments at Sekolah Khusus Islam Terpadu Yarfin.

The findings indicate that the application can serve as an effective assistive learning tool when it is accessible through keyboard navigation and compatible with screen reader technology. Its use enabled students to shift their focus from complex and repetitive procedural calculations toward a deeper understanding of core annuity concepts, particularly the relationship between principal, interest, payment period, and installment amount.

The implementation also contributed to increased learner independence and engagement. Students were able to input data, perform calculations, and interpret results with reduced reliance on continuous teacher assistance. This independence allowed instructional time to be used more productively for conceptual discussion and reflective learning. However, the study also identified several challenges, including variations in students' ICT literacy, limitations in interface accessibility, and constraints related to device availability. These issues highlight the importance of structured orientation, ongoing pedagogical guidance, and institutional support to ensure effective technology integration.

Overall, the study demonstrates that accessible subject-specific applications, when aligned with Universal Design for Learning principles, can meaningfully support inclusive mathematics education. While this research does not aim to establish causal or comparative performance outcomes, it provides practical evidence that assistive digital tools can enhance conceptual understanding and autonomy for students with visual impairments. Future research is encouraged to explore broader implementations across diverse contexts and to examine long-term impacts on financial literacy development.

6. References

Bouck, E. C., & Weng, P.-L. (2014). Reading mathematics: Accessibility and accommodations for students with visual impairments. Teaching Exceptional Children, 46(5), 52–60. https://doi.org/10.1177/0040059914530103

Bouck, E. C., Satsangi, R., Doughty, T. T., & Courtney, W. T. (2018). Virtual manipulatives and students with disabilities: A review of research. Learning Disability Quarterly, 41(1), 3–17. https://doi.org/10.1177/0731948717690114

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

CAST. (2018). Universal Design for Learning guidelines version 2.2. Author. https://udlguidelines.cast.org

Cohen, L., Manion, L., & Morrison, K. (2018). Research methods in education (8th ed.). Routledge.

Creswell, J. W., & Poth, C. N. (2018). Qualitative inquiry and research design: Choosing among five approaches (4th ed.). Sage Publications.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2019). How to design and evaluate research in education (10th ed.). McGraw-Hill Education.

Hansen, A., Drews, D., & Schreiber, S. (2020). Assistive technologies for inclusive mathematics education: Supporting conceptual understanding. International Journal of Inclusive Education, 24(9), 957–973. https://doi.org/10.1080/13603116.2018.1516824

Kementerian Pendidikan dan Kebudayaan Republik Indonesia. (2020). Modul matematika SMA: Pertumbuhan, peluruhan, bunga, dan anuitas. Kemendikbud RI.

Kvale, S., & Brinkmann, S. (2015). InterViews: Learning the craft of qualitative research interviewing (3rd ed.). Sage Publications.

Merriam, S. B., & Tisdell, E. J. (2016). Qualitative research: A guide to design and implementation (4th ed.). Jossey-Bass.

NV Access. (2025). NVDA user guide. https://www.nvaccess.org

OpenCourseWare Universitas Indonesia. (2016). Anuitas biasa (nilai sekarang dan nilai akan datang). https://ocw.ui.ac.id

World Health Organization, & United Nations Children's Fund. (2022). Global report on assistive technology. World Health Organization. https://www.who.int/publications/i/item/9789240049451

Yin, R. K. (2018). Case study research and applications: Design and methods (6th ed.). Sage Publications.