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SMART ACCOUNTING MEDIA TO ENHANCE SELF-DIRECTED LEARNING: EVIDENCE FROM ECONOMIC EDUCATION STUDENTS AT UNIVERSITAS NUSA CENDANA

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ABSTRACT

The rapid advancement of digital technology requires innovation in higher education learning processes; however, learning in the service company accounting cycle is still predominantly conducted using conventional methods, highlighting the need for innovative and accessible digital learning media. This study aims to develop and examine the effectiveness of an Android-based learning media, Smart Accounting, in enhancing students' self-directed learning in the service company accounting cycle material. This study employed a research and development approach using the ADDIE model, which consists of the stages of analysis, design, development, implementation, and evaluation. The research subjects were students of the Economic Education Study Program at Universitas Nusa Cendana who were enrolled in the Fundamentals of Accounting course. Data were collected through expert validation sheets, a self-directed learning questionnaire, and a student response questionnaire. Data analysis techniques included descriptive quantitative analysis, improvement testing using normalized gain, and difference testing using a paired sample t-test. The results indicate that the Smart Accounting learning media is highly feasible based on validation by media and material experts. The normalized gain test shows a score of 0.56, categorized as moderate, while the paired sample t-test reveals a significant difference in students' self-directed learning before and after the use of the learning media. Therefore, the Smart Accounting learning media is effective in improving students' self-directed learning in the service company accounting cycle material. The implementation of the research results shows that Android-based learning media can serve as an alternative to support interactive and student-centered accounting learning. In addition to improving learning effectiveness and student autonomy, these findings also contribute to the development of knowledge in the fields of accounting education and educational technology, and have the potential to be applied to other accounting courses in higher education.

Keywords: instructional media; self directed learning; service accounting cycle; smart accounting.

ABSTRAK

Perkembangan teknologi digital menuntut inovasi pembelajaran di perguruan tinggi, namun pembelajaran siklus akuntansi perusahaan jasa masih konvensional sehingga diperlukan media pembelajaran yang inovatif dan mudah diakses secara digital. Penelitian ini bertujuan untuk mengembangkan dan menguji efektivitas media pembelajaran berbasis Android Smart Accounting *pada materi siklus akuntansi perusahaan jasa dalam meningkatkan kemandirian belajar mahasiswa. Penelitian ini menggunakan pendekatan penelitian dan pengembangan dengan model ADDIE yang meliputi tahap analisis, perancangan, pengembangan, implementasi, dan evaluasi. Subjek penelitian adalah mahasiswa Program Studi Pendidikan Ekonomi Universitas Nusa Cendana yang menempuh mata kuliah Dasar-Dasar Akuntansi. Pengumpulan data dilakukan melalui lembar validasi ahli, angket kemandirian belajar, dan angket respon mahasiswa. Teknik analisis data menggunakan analisis deskriptif kuantitatif, uji peningkatan menggunakan normalized gain, serta uji perbedaan menggunakan paired sample t-test. Hasil penelitian menunjukkan bahwa media pembelajaran* Smart Accounting *dinyatakan sangat layak berdasarkan validasi ahli media dan ahli materi. Selain itu, hasil uji* normalized gain *menunjukkan nilai 0,56 dengan kategori sedang, serta hasil uji paired sample t-test menunjukkan perbedaan yang signifikan antara kemandirian belajar mahasiswa sebelum dan sesudah penggunaan media pembelajaran. Dengan demikian, media pembelajaran* Smart Accounting *efektif*

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digunakan untuk meningkatkan kemandirian belajar mahasiswa pada materi siklus akuntansi perusahaan jasa. Implementasi hasil penelitian menunjukkan bahwa media pembelajaran berbasis Android *dapat menjadi alternatif untuk mendukung pembelajaran akuntansi yang interaktif dan berpusat pada mahasiswa. Selain meningkatkan efektivitas dan kemandirian belajar, temuan ini juga berkontribusi pada pengembangan ilmu pengetahuan di bidang pendidikan akuntansi dan teknologi pembelajaran serta berpotensi diterapkan pada mata kuliah akuntansi lainnya di perguruan tinggi.*

Keywords: *kemandirian belajar; media pembelajaran; siklus akuntansi jasa*; smart accounting.

INTRODUCTION

The introduction must be at least contain *state of the art* (literature review study) short, *gap* The rapid advancement of digital technology has brought significant transformation to the implementation of higher education, particularly in the era of the Industrial Revolution 4.0 and Society 5.0. The Industrial Revolution 4.0 is characterized by the integration and utilization of advanced technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), big data analytics, and cloud computing, which drive automation, connectivity, and efficiency across various sectors, including education (Nurkhin et al., 2020). These technological developments have reshaped instructional delivery, learning management systems, and academic services, fostering more flexible, data driven, and technology enhanced learning environments (Mourtzis, 2024). Meanwhile, the concept of Society 5.0 places humans at the center of technological advancement, aiming to enhance quality of life through the harmonious integration of technology and societal needs. In this paradigm, digital innovations are not merely tools for efficiency and automation, but are strategically utilized to address social challenges, support human wellbeing, and create inclusive and sustainable development. (Carayannis & Morawska-Jancelewicz, 2022).

In the context of higher education, the digitalization of education has become an inevitability. Universities are required to integrate technology into the learning process in order to create a flexible, adaptive learning environment that is oriented toward the development of 21st-century competencies (Legi et al., 2023). In the 21st century, higher education is also required to create student-centered learning in order to produce graduates who are adaptive and competitive (Andrisyah et al., 2021). The transformation of higher education today shifts the role of students into proactive subjects of learning, where they are no longer merely passive recipients of information who depend entirely on lecturers' instructions (Chen & Tsai, 2021). The modern educational paradigm encourages students to develop intellectual independence through independent exploration of information, in order to reduce dependence on lecturers as the sole source of learning (Valtonen et al., 2021). Therefore, the integration of digital technology in higher education is essential to facilitate student-centered learning environments that foster learning independence and encourage students to actively construct knowledge through autonomous exploration (Purwanto et al., 2024).

Learning independence is an essential competency for students in facing global challenges in the 21st century. It enables students to actively and responsibly manage their own learning processes, thereby supporting the development of lifelong learning skills and enhancing the competitiveness of higher education graduates (Chang et al., 2023). Scientifically, learning independence is important for students because it directly contributes to enhancing learning effectiveness and the mastery of competencies required at the global level. Learning independence enables students to regulate their own goals, strategies, and learning evaluation, thereby promoting the development of critical thinking, problem solving, and decision making skills (Blau et al., 2020). These competencies are essential prerequisites for students to adapt to the dynamic development of

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science, technology, and the demands of the international labor market, enabling them to compete globally (Solichin et al., 2021). Moreover, the development of learning independence encourages students to become proactive learners who are capable of seeking, analyzing, and utilizing various sources of information to construct their own understanding (Finn et al., 2025). In the context of higher education, this competence supports the creation of a more student-centered learning environment, where students are not merely passive recipients of knowledge but active participants in the learning process (Roy & Gandhimathi, 2025). Consequently, strengthening learning independence becomes a strategic effort for universities to produce graduates who are adaptive, innovative, and capable of responding to the complex challenges of the global era (Churiyah et al., 2021).

Learning independence is an essential competency that must be possessed by students, particularly those of the Economic Education Program at Universitas Nusa Cendana, to support student-centered learning and enhance global competitiveness (Purba et al., 2024). However, this ideal condition has not been fully reflected in practice. Preliminary observations indicate that 62% of students rely solely on the materials delivered by lecturers without attempting to seek additional references independently. In addition, 58% of students admit that they rarely read scientific sources such as journals or electronic books relevant to the courses they take. Furthermore, the survey results show that 65% of students engage in independent study only when facing exams or assignments, while only 35% consistently allocate time for self-directed learning outside scheduled class hours. These findings suggest that students' learning independence remains relatively low and has not yet fully aligned with the demands of student-centered learning in the 21st century.

According to preliminary observations, the low level of learning independence among students of the Economic Education Program at Universitas Nusa Cendana is influenced by the use of learning media that remain conventional and are not yet integrated with digital technology. As a result, these media are less capable of facilitating students to learn independently, flexibly, and sustainably outside class hours. These observational findings are in line with the opinion that Hidajat, (2023) who state that the use of effective and interactive learning media influences students' learning independence, particularly in facilitating students to regulate and control their own learning processes. Considering the high level of smartphone ownership among students, this condition should serve as a strategic opportunity to develop more interactive and flexible learning media that can be accessed anytime and anywhere to support students' learning independence.

The development of Android-based learning media becomes a relevant and strategic solution to create more interactive, flexible, and student centered learning, considering the low level of students' learning independence and the high ownership of smartphones (Hernawati & Sasea, 2025). Android-based learning media have the characteristic of ubiquity, meaning they can be accessed anytime and anywhere, thus providing high flexibility in the learning process. In addition, these media are interactive, as they are capable of presenting multimedia content such as videos, simulations, and interactive quizzes that enhance students' learning engagement. Android based learning media also support a microlearning approach, namely the delivery of material in small, structured units, which makes it easier for students to understand the material independently (Deda et al., 2023). According to Novaliendry et al., (2020) nformation technology–based learning media have advantages in terms of flexibility and learning independence, as they enable students to regulate their own pace, strategies, and learning needs independently. In line with this perspective, Android-based learning media, which are portable and accessible anytime and anywhere, have great potential to support adaptive and student-centered learning. (Darwin et al., 2023). In line with the research findings of Saputri et al., (2020) and Adiningsih et al., (2025) which state that the development of Android-based learning media is able to enhance students' learning independence.

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Although many digitalbased learning applications have been developed, most of them still focus primarily on content delivery and practice exercises. Learning applications that are specifically designed to stimulate students' learning independence through features such as self-monitoring, progress tracking, and reflective journals remain relatively limited. Therefore, the development of an Android-based learning media that systematically integrates these features constitutes the novelty of this study in supporting student-centered learning and enhancing learning independence. This learning media is developed for the course Introduction to Accounting, particularly on the topic of the accounting cycle of service companies, as the material is both conceptual and procedural, requiring gradual understanding and continuous practice. Moreover, the accounting cycle of service companies is often perceived as difficult by students because it involves a systematic sequence of recording processes. Hence, interactive and flexible learning media are needed to help students learn independently and gain a deeper understanding of the concepts.

RESEARCH METHODS

This study employs a Research and Development (R&D) approach with the aim of developing an Android-based learning media called Smart Accounting on the topic of the accounting cycle of service companies to enhance students' learning independence. The development model used in this study is ADDIE, which consists of five stages: analysis, design, development, implementation, and evaluation. The analysis stage focuses on identifying learning needs, problems, and student characteristics. The design stage involves planning the learning media, including content structure, interface, and learning objectives. The development stage includes producing and validating the Smart Accounting media by experts. The implementation stage involves applying the media in the learning process, while the evaluation stage aims to assess the effectiveness and feasibility of the developed learning media. The research subjects were 32 students of the Economic Education Study Program at Universitas Nusa Cendana who were enrolled in the Introduction to Accounting course during the 2025/2026 academic year. The study was conducted at Universitas Nusa Cendana in Kupang, Indonesia. The object of this study was the Android-based Smart Accounting learning media on the topic of the service company accounting cycle. The sample was determined using purposive sampling, considering that the selected students had taken or were currently taking the Introduction to Accounting course and were directly involved in learning the service company accounting cycle material.

The analysis stage was conducted to identify learning needs, student characteristics, the level of learning independence, and the suitability of the material. The design stage included the formulation of learning objectives, the organization of content structure, the application flow, and the design of features that support learning independence such as self-monitoring, progress tracking, and independent practice exercises.During the development stage, the Android based learning media was developed and validated by subject matter experts and media experts. Product revisions were carried out based on the validators' feedback. The implementation stage was conducted through a limited trial involving students of the Economic Education Study Program who were enrolled in the Introduction to Accounting course. Finally, the evaluation stage aimed to assess the feasibility and effectiveness of the developed learning media.

Data were collected using expert validation sheets, a learning independence questionnaire, and a student response questionnaire. The data obtained from expert validation were analyzed using quantitative descriptive analysis in the form of feasibility percentages. The data on students' learning independence were analyzed using descriptive statistical tests and an improvement test (N-Gain test) to determine the increase in learning independence before and after the use of the learning

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media. Meanwhile, the student response data were analyzed descriptively to determine the practicality level of the developed learning media.

RESULTS AND DISCUSSION

Analysis Stage

Based on the results of the needs analysis, it was found that students still demonstrate a high level of dependence on lecturers' explanations during the classroom learning process. Static learning resources, such as textbooks, have not been able to optimally motivate students to engage in independent learning outside class hours. This condition has resulted in a low level of student initiative in exploring the material independently.

On the other hand, the profile of students in the Economic Education Study Program at Universitas Nusa Cendana indicates that all students already own Android devices. However, this potential has not been optimally utilized as a learning medium, particularly to support understanding of the accounting cycle of service companies. These findings indicate a gap between the availability of technology and its utilization in learning. Therefore, the development of systematically designed Android-based learning media is necessary to support independent and student centered learning.

Design Phase

The design phase was focused on developing the structure and features of the Android-based learning media in accordance with students' needs and the characteristics of the material. The structure of the Smart Accounting application was designed based on the principles of microlearning, in which the material on the accounting cycle of service companies is presented in small, systematic units that are easy to understand independently. In addition to the main content, the application is equipped with features specifically designed to stimulate students' learning independence, including:

1. A self monitoring feature in the form of a self-reflection sheet to help students evaluate their level of understanding of the material**.**
2. A progress tracking feature that displays visual indicators of students' learning achievements; and
3. An independent practice feature in the form of interactive quizzes equipped with immediate feedback.

The design of these features aims to encourage students to be more active, independent, and responsible for their learning process.

Development Phase

In the development phase, the Android-based Smart Accounting learning media was developed in accordance with the previously designed plan. The resulting product was then validated by subject-matter experts and media experts to assess the feasibility of its content, interface, and functionality. The results of the developed learning media are presented Figure 1.

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Figure 1. Smart Accounting Home Display

Figure 1. shows the initial interface of the Smart Accounting learning media. This page serves as the main page of the application, displaying the application title. The interface is designed to be simple and user-friendly to facilitate students in accessing the learning content. Meanwhile, the menu within the Smart Accounting application is shown in Figure 2.

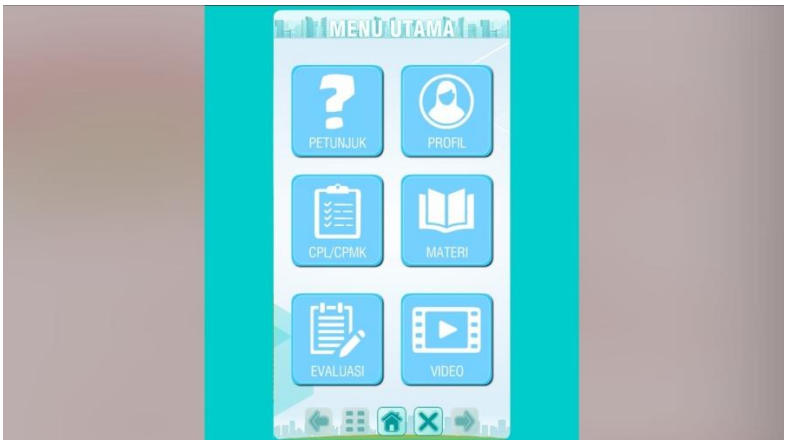

Figure 2. Smart Accounting Menu Display

Figure 2. shows the Smart Accounting menu display, This page serves as the main menu of the application, providing access to various learning materials and features available in the Smart Accounting application. Through this menu, students can navigate easily to the accounting cycle materials, practice exercises, and other supporting learning resources. The menu is designed to be clear and user-friendly to facilitate students in accessing and exploring the learning content efficiently. The material topics in the Smart Accounting application are shown in Figure 3.

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Figure 3. Smart Accounting Material Menu

Figure 3. shows Smart Accounting material menu is displays the list of learning topics available in the Smart Accounting application. It provides structured access to the service company accounting cycle materials, allowing students to select and study specific topics according to their learning needs. The menu is designed to facilitate independent learning by enabling students to explore the materials systematically and efficiently.

Following the product development phase, the next stage involves a validation test conducted by two experts: a media specialist and a subject matter expert. This testing process is carried out simultaneously by providing the media product along with a validation instrument in the form of a rating scale questionnaire to the validators to review the feasibility of the media. The validation results from both the media and subject matter experts are presented in Table 1.

Table 1. Results of Media Expert Validation

Assessment Aspects	Percentage (%)	Category
Visual Display Quality	85	Highly Feasible
Feature Comprehensiveness	84	Highly Feasible
Usability	90	Highly Feasible
Average	86,33	Highly Feasible

Based on Table 1. it can be observed that the visual display quality aspect obtained a score of 85%, feature completeness reached 84%, and ease of use achieved a score of 90%. Consequently, the overall average for the media expert validation was 86.33%. Therefore, it can be concluded that according to the established criteria, the "Smart Accounting" Android-based learning media falls into the "Highly Feasible" category. The results of the subject matter expert validation of the Smart Accounting learning media are presented in Table 2.

Table 2. Results of Subject Matter Expert Validation

Assessment Aspects	Percentage (%)	Category
Material Accuracy	82	Highly Feasible
Material Presentation	80	Feasible
Linguistic Accuracy	83	Highly Feasible
Average	81,66	Highly Feasible

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Based on Table 2. it can be identified that the content feasibility aspect obtained a score of 82%, material presentation feasibility reached 80%, and linguistic accuracy achieved a score of 83%. Consequently, the overall average for the subject matter expert validation was 81.66%. Therefore, it can be concluded that according to the established criteria, the "Smart Accounting" Android-based learning media falls into the "Highly Feasible" category.

Implementation Phase

The implementation phase was conducted through a limited trial involving students from the Economic Education Study Program at Universitas Nusa Cendana who were enrolled in the Basic Accounting course. The students utilized the Smart Accounting application during the learning process for the service company accounting cycle material. The results of the student response assessment questionnaire are presented in Table 3.

Table 3. Student Response Assessment Questionnaire

Assessment Aspects	**Percentage (%)**	**Category**
Material Accuracy	87	Highly Feasible
Visual Display Quality	90	Highly Feasible
Media Usefulness	92	Highly Feasible
Average	89,66	Highly Feasible

Based on Table 3. it can be observed that the student responses to the Smart Accounting learning media reached a score of 87% for the media suitability category, 90% for material suitability, and 92% for usefulness. Consequently, the overall average for the student response assessment was 89.66%. Therefore, it can be concluded that according to the established criteria, the "Smart Accounting" Android-based learning media falls into the "Highly Feasible" category.

Evaluation Phase

The evaluation was conducted to determine the effectiveness of the learning media in enhancing students' independent learning.

N-Gain Test Results for Independent Learning

The N-Gain test was used to determine the improvement in students' independent learning before and after using the Smart Accounting learning media. The results of the N-Gain analysis are presented in Table 4.

Table 4. N-Gain Test Results of Students' Independent Learning

Components	Average Score
Pretest	68,30
Posttest	82,45
N-Gain	0,56
N-Gain Category	Medium

Based on Table 4. the obtained N-gain value is 0.56, which falls into the "Medium" category. This indicates that the use of Smart Accounting media is capable of effectively increasing students' independent learning in the service company accounting cycle material.

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T-Test Results

A paired sample t-test was conducted to determine the difference in students' independent learning before and after using the Smart Accounting media. The t-test results are presented in Table 5.

Table 5. Paired Sample t-Test Results of Independent Learning

Variable	Mean	t-value	Sig. (p)	Description
Pretest	68,30			
Posttest	82,45	7,84	0,000	Significant (p < 0,05)

Based on Table 5. the obtained t-value is 7.84 with a significance level of 0.000 ($p < 0.05$). Consequently, it can be concluded that there is a significant difference in students' independent learning before and after the use of the Smart Accounting media. Thus, the Smart Accounting learning media is statistically proven to be capable of enhancing students' independent learning.

Self directed learning is defined as students' capacity to regulate, orient, and evaluate their learning progress autonomously, thereby reducing excessive dependence on instructors (Adigun et al., 2025). In the context of higher education, fostering this ability is essential to support students in managing their own learning processes effectively. In line with this perspective, the empirical findings of this study indicate that the integration of the Smart Accounting learning media within the service company accounting cycle module contributes significantly to enhancing students' learning autonomy.

The effectiveness of Smart Accounting in improving students' self-directed learning can be explained through several pedagogical mechanisms. First, the application provides structured and easily accessible learning materials that allow students to control their own learning process. By enabling students to determine when and how they engage with the materials, the application encourages them to take greater responsibility for their learning activities. This condition naturally promotes self-regulation, particularly when students are required to understand the sequential procedures involved in the service company accounting cycle. Second, the interactive components embedded in Smart Accounting, such as practice exercises, transaction recording simulations, and automated feedback, create opportunities for continuous self-assessment. When students receive immediate feedback on their answers, they can directly identify misconceptions and adjust their understanding. As a result, the learning process shifts from passive reception of information toward active engagement, where students repeatedly test their knowledge and reflect on their learning outcomes. Third, the availability of the application outside the classroom environment reduces students' dependence on instructor explanations. Because the materials and exercises can be accessed anytime through mobile devices, students are able to revisit difficult concepts and practice accounting procedures independently. This continuous access is particularly important in Basic Accounting courses, which require repetitive practice and procedural understanding. The improvement in self-directed learning is reflected in students' increasing ability to complete assignments and exercises with minimal guidance. Many students begin to plan their study activities, set learning targets, and utilize the application as their primary learning resource. Consequently, Smart Accounting functions not merely as a content delivery tool but also as a facilitator that supports the transition from instructor-centered learning to a more student-centered learning environment.

Overall, these findings indicate that integrating technology-based learning media such as Smart Accounting can enhance students' autonomy in learning. By providing structured materials, interactive practice, and flexible access, the application supports the development of independent, active, and responsible learners in higher education.The findings of this study are consistent with

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Putri, (2019) which posits that the integration of technology driven instructional media significantly improves both academic performance and self-directed learning among students. This study is also supported by the research findings of Hendikawati et al., (2019) This study is also supported by research findings stating that Android-based learning media is effective in enhancing students' critical thinking levels and learning autonomy. The interactive nature of the application challenges students to analyze problems more deeply. The results of this study indicate that Heryana et al., (2022) indicate that instructional media developed through Android technology empowers students to engage in self-directed learning more effectively.

CONCLUSION AND SUGGESTIONS

Based on the research findings, it can be concluded that the Smart Accounting learning media is effective in enhancing students' independent learning in the service company accounting cycle material. This is evidenced by an N-gain score of 0.56, categorized as 'Medium,' as well as the results of the paired sample t-test, which show a significant difference in students' independent learning before and after using the learning media ($p = 0.000 < 0.05$). The implementation of Smart Accounting encourages students to learn independently through systematic and interactive material presentation, thereby increasing their responsibility, initiative, and learning management. Therefore, the Smart Accounting media is highly suitable for use as an alternative accounting learning medium in higher education**.**

Based on the research findings, it is suggested that accounting lecturers utilize the Smart Accounting learning media as an instructional alternative to enhance students' independent learning, particularly in the service company accounting cycle material. Furthermore, the development of similar learning media should be extended to other accounting topics by incorporating more diverse evaluation features. For future researchers, it is recommended to examine the effectiveness of Smart Accounting by involving larger sample sizes, employing more robust experimental designs, and integrating other variables such as learning motivation or academic achievement to obtain more comprehensive findings.

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