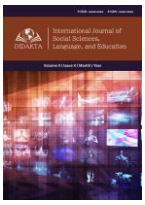

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Development of the Inkit Application Using the Flipped Classroom Model to Enhance Self-Directed Learning and Student Achievement in Economics

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Abstract

This study aimed to develop the INKIT application integrated with the flipped classroom model and examine its feasibility, practicality, and effectiveness in enhancing students' self directed learning and learning achievement in economics education. The research employed a Research and Development approach using the ADDIE model consisting of analysis, design, development, implementation, and evaluation stages. The participants involved 71 eleventh grade students of SMA Negeri 9 Tasikmalaya divided into experimental and control groups through purposive sampling. Data were collected using validation sheets, observations, interviews, questionnaires, and pretest posttest assessments. The findings indicated that the application achieved feasible criteria based on material expert validation of 79 percent and media expert validation of 75 percent. Practicality testing also showed highly positive responses from teachers and students. Inferential statistical analysis revealed significant differences between the experimental and control groups, with a Partial Eta Squared value of 0.559 indicating substantial effectiveness. The N Gain results demonstrated moderate improvement in self directed learning and learning achievement among students using the INKIT application integrated with flipped classroom learning.

Keywords : *Flipped Classroom, INKIT Application, Learning Achievement, Economics Education, Self Directed Learning.*

INTRODUCTION

The transformation of contemporary education systems within the context of rapid digital expansion has intensified scholarly attention toward pedagogical models capable of fostering autonomous learning capacity, cognitive flexibility, and sustainable academic achievement in technology mediated environments, particularly in secondary education where students are increasingly exposed to complex information ecosystems and self regulated forms of knowledge acquisition. Recent developments in educational technology demonstrate that the integration of interactive applications, mobile learning environments, and student centered instructional approaches has shifted the orientation of learning from passive content reception toward participatory and reflective engagement, requiring learners to exercise greater responsibility over their own learning processes. Within this transformation, the flipped classroom model has emerged as one of the most influential instructional innovations because it restructures learning sequences by relocating content acquisition outside classroom sessions and reallocating classroom interaction toward analytical discussion, collaborative problem solving, and conceptual reinforcement.

Contemporary studies indicate that flipped learning environments contribute not only to improved conceptual understanding but also to enhanced learner autonomy and metacognitive awareness, particularly when supported by interactive digital media capable of sustaining continuous engagement beyond classroom boundaries (Mustika et al., 2025; Nsyengula et al., 2024). The growing relevance of flipped learning is further reinforced by bibliometric evidence demonstrating a substantial increase in international and Indonesian scholarship concerning technology integrated flipped pedagogy across various disciplinary contexts, signaling a broader epistemological transition toward learner centered educational ecosystems that prioritize flexibility, personalization, and independent learning competencies as essential dimensions of twenty first century education (Oknaryana et al., 2025).

Although previous investigations have consistently reported positive associations between flipped classroom implementation and improved student engagement, the empirical landscape remains theoretically fragmented because most studies examine flipped learning primarily through the lens of instructional efficiency rather than through the broader framework of self directed learning development and sustainable academic performance. Existing findings reveal that flipped classroom environments encourage students to engage in preparatory learning activities before classroom interaction, thereby promoting greater initiative, self regulation, and cognitive responsibility during the learning process (Purba, 2025). Similar evidence indicates that the integration of flipped learning strategies can strengthen students' self directed learning capacities by encouraging reflective preparation, independent resource exploration, and collaborative meaning construction during classroom interaction (Setiawan et al., 2025).

Research conducted within medical education further demonstrates that student centered flipped instruction significantly enhances learning effectiveness through increased participation and active knowledge processing, particularly in contexts requiring higher order cognitive engagement (Yao et al., 2025). Conceptual analyses within higher education also suggest that flipped classroom pedagogy creates opportunities for deeper conceptual internalization because students encounter learning materials repeatedly through asynchronous and synchronous interactions that reinforce conceptual scaffolding and active inquiry processes (Zhu et al., 2025). Despite these advances, the majority of existing studies remain concentrated within science, medical, and university contexts, while comparatively limited attention has been directed toward economics education at the secondary school level, particularly regarding the integration of mobile based interactive applications specifically designed to cultivate self directed learning behaviors alongside measurable academic outcomes.

The limitations of prior literature become increasingly evident when examining the inconsistency between technological innovation and pedagogical integration within real classroom environments, especially in developing educational contexts where digital learning adoption frequently remains superficial and technologically fragmented. Many studies emphasize the effectiveness of flipped classroom strategies without adequately addressing the instructional mechanisms through which digital media facilitate sustained learner autonomy, motivational persistence, and independent knowledge management over time. Existing research also tends to isolate either learning outcomes or self regulated learning constructs rather than examining their simultaneous interaction within integrated pedagogical systems, creating conceptual gaps concerning how technology mediated instructional environments shape both cognitive achievement and autonomous learning behavior concurrently.

Bibliometric evidence reveals that although flipped learning research has expanded considerably in Indonesia, a substantial proportion of studies continue to focus on descriptive implementation patterns and short term learning outcomes rather than on systematic development of interactive learning ecosystems grounded in pedagogical design frameworks and validated instructional products (Oknaryana et al., 2025). Empirical inconsistencies are further visible in studies reporting that the effectiveness of flipped classroom implementation often depends heavily on students' readiness for independent learning, accessibility of digital resources, and the extent to which instructional media support meaningful engagement rather than mere content delivery (Nsyengula et al., 2024; Purba, 2025). Such conditions indicate that the pedagogical potential of flipped learning cannot be fully realized solely through instructional sequencing, but instead requires the support of structured, interactive, and learner responsive technological media capable of sustaining active learning participation beyond classroom settings.

The unresolved nature of these issues carries significant scientific and practical implications because inadequate self directed learning capacity among secondary school students increasingly affects their ability to navigate complex academic demands within digitally saturated learning environments. In economics education specifically, students are expected not only to memorize theoretical concepts but also to interpret dynamic global economic phenomena, analyze contextual problems, and formulate rational decisions based on multidimensional information, all of which require higher levels of autonomous learning readiness and conceptual adaptability. Nevertheless, classroom realities frequently demonstrate that conventional teacher centered instruction continues to dominate economics learning processes, resulting in passive learning behavior, limited initiative in knowledge exploration, and low academic achievement among students.

The persistence of such conditions suggests that technological integration alone is insufficient unless accompanied by pedagogical models capable of transforming students into active and self regulated participants in their own learning trajectories. Empirical findings concerning the effectiveness of interactive digital media further indicate that learner engagement increases substantially when students are provided with flexible access to multimedia resources, immediate feedback systems, and structured independent learning pathways that accommodate diverse learning preferences and pacing patterns (Mustika et al., 2025; Setiawan et al., 2025). The urgency of addressing this issue becomes more pronounced in the context of secondary economics education because students' inability to develop autonomous learning competencies may weaken not only short term academic performance but also their long term readiness to engage with rapidly evolving socioeconomic realities and lifelong learning demands.

Within this scholarly landscape, the present research positions itself at the intersection of flipped classroom pedagogy, self directed learning theory, and interactive mobile based instructional media development by proposing the INKIT application as an integrated learning ecosystem designed specifically for economics education on the topic of international trade. Unlike previous studies that primarily examine flipped classroom implementation as an isolated instructional strategy, this research conceptualizes flipped learning as part of a broader constructivist learning environment supported through a purposefully designed interactive application that combines digital modules, learning videos, quizzes, educational games, and evaluation systems within a structured independent learning framework. The study also extends the theoretical discourse surrounding self directed learning by operationalizing key dimensions of learner autonomy through interactive technological features that encourage students to diagnose learning needs, regulate learning progress, and evaluate conceptual understanding independently.

From a methodological perspective, the integration of the ADDIE development framework with quasi experimental evaluation procedures provides a more comprehensive approach for assessing not only instructional effectiveness but also product feasibility and practical usability within authentic classroom contexts. This positioning enables the research to address the conceptual gap between pedagogical theory and instructional technology design while simultaneously contributing empirical evidence concerning the synergistic relationship between flipped classroom implementation, interactive learning media, self directed learning enhancement, and academic achievement improvement in secondary economics education.

This study aims to develop the INKIT learning application integrated with the flipped classroom model for economics learning on the topic of international trade and to examine its feasibility, practicality, and effectiveness in enhancing students' self directed learning and learning achievement. The research adopts a Research and Development approach using the ADDIE framework consisting of analysis, design, development, implementation, and evaluation stages in order to produce a pedagogically grounded and empirically validated instructional product. The study contributes theoretically by strengthening the integration between constructivist learning perspectives, self directed learning theory, and technology supported flipped pedagogy within the context of economics education. Methodologically, the research contributes an integrated development and evaluation model that combines interactive application design, learner centered instructional sequencing, and multivariate effectiveness analysis to examine the simultaneous improvement of autonomous learning behavior and academic performance in secondary school learning environments.

RESEARCH METHODS

This study employed an empirical research design using the Research and Development approach to develop and evaluate the effectiveness of the INKIT application integrated with the flipped classroom model in enhancing students' self directed learning and learning achievement in economics education. The development process adopted the ADDIE model consisting of analysis, design, development, implementation, and evaluation stages in order to ensure systematic instructional product development and pedagogical alignment. The research was conducted at SMA Negeri 9 Tasikmalaya involving 71 eleventh grade students who were divided into an experimental class and a control class through purposive sampling based on classroom equivalence and instructional accessibility. The experimental class received learning treatment using the INKIT application integrated with flipped classroom activities, while the control class participated in conventional learning procedures. The instructional

design of the application was grounded in constructivist learning principles and the theory of self directed learning proposed by Knowles (1975), emphasizing learner autonomy, independent knowledge exploration, and reflective learning engagement. Data collection was conducted through classroom observation, semi structured interviews, validation sheets, questionnaires, and pretest posttest assessments administered during limited trials and operational field implementation. The non equivalent pretest posttest control group design was employed to examine differences in self directed learning and learning achievement between groups after instructional intervention, while the flipped classroom structure followed asynchronous preclass preparation and collaborative in class learning activities as suggested in contemporary flipped learning research (Hasibuan & Ponidi, 2025).

The research instruments consisted of material validation sheets, media validation sheets, practicality questionnaires for teachers and students, self directed learning questionnaires, and cognitive learning achievement tests developed based on the revised Bloom taxonomy encompassing remembering, understanding, applying, analyzing, evaluating, and creating dimensions. The self directed learning instrument was constructed according to the conceptual indicators of self directed learning introduced by Knowles (1975), including learners' ability to identify learning needs, formulate learning goals, utilize learning resources, implement learning strategies, and evaluate learning outcomes independently. Content validity was established through expert judgment involving material experts, media experts, and educational practitioners, while instrument reliability and consistency were evaluated through pilot testing procedures before operational implementation. Quantitative data were analyzed using descriptive and inferential statistical techniques including normality testing, homogeneity testing, multivariate analysis of variance, and normalized gain analysis to determine the effectiveness of the INKIT application in improving self directed learning and learning achievement. Qualitative data obtained from interviews and observations were analyzed interpretively to support quantitative findings and strengthen contextual understanding of students' learning experiences during implementation. Ethical considerations were maintained throughout the research process by obtaining institutional approval from the school, securing voluntary participation from all participants, ensuring confidentiality of student information, and using collected data exclusively for academic and research purposes.

RESULTS AND DISCUSSION

Development Validity and Instructional Design of the INKIT Application in Economics Learning

The development stage of the INKIT application demonstrated that digital instructional innovation can strengthen the transformation of economics learning into a more student centered and autonomous process. The integration of flipped classroom principles within the application encouraged students to access learning materials independently before classroom interaction activities began. This instructional orientation aligns with constructivist learning theory which emphasizes active knowledge construction through experience and reflective engagement (Knowles, 1975). Previous studies also confirmed that flipped learning environments improve learning autonomy because students become more responsible for organizing their own learning activities (Adrianzén Olano, 2026; Purba, 2025).

The initial needs analysis identified several instructional limitations within economics learning at SMA Negeri 9 Tasikmalaya. Classroom observations indicated that learning activities remained dominated by teacher explanations, while students showed limited initiative in accessing supplementary learning resources independently. Interview findings revealed that many students experienced difficulties in understanding abstract concepts in international trade because learning materials were primarily delivered through conventional explanations and textbook centered activities. Similar instructional constraints were also identified in previous studies discussing low self directed learning readiness in conventional learning environments (Bich et al., 2025; Murniati et al., 2023).

The design phase of the INKIT application focused on integrating multimedia learning resources into a structured flipped classroom environment. The application incorporated digital modules, instructional videos, interactive quizzes, educational games, attendance features, and evaluation instruments to facilitate independent learning engagement. The learning structure positioned asynchronous activities as preparatory stages before collaborative classroom discussion sessions were conducted. Earlier research emphasized that digital video integration and asynchronous learning preparation can significantly increase learning flexibility and conceptual understanding among secondary students (Ardiyansah & Choirunisa, 2022; Mustika et al., 2025).

The instructional architecture of the application was designed according to self directed learning indicators introduced by Knowles consisting of learning need identification, goal formulation, learning strategy implementation, resource utilization, and independent evaluation. The application interface was intentionally simplified to support accessibility and reduce technological barriers during learning implementation. Students could navigate instructional resources independently without excessive teacher assistance during preclass activities. Similar findings were highlighted by Haval and Afzal (2026) who explained that intelligent digital learning environments improve autonomous learning behavior through adaptive instructional accessibility.

The visual and pedagogical organization of the learning module also reflected the integration between economics content and independent learning scaffolding. Learning materials concerning international trade were arranged progressively from conceptual foundations toward contextual economic cases to strengthen analytical reasoning among students. The module structure supported reflective learning because students were encouraged to review digital resources repeatedly before participating in classroom discussions. Prior studies reported that repeated exposure to multimedia learning resources enhances learning confidence and metacognitive awareness within flipped learning environments (Izadpanah, 2022; Setiawan et al., 2025).

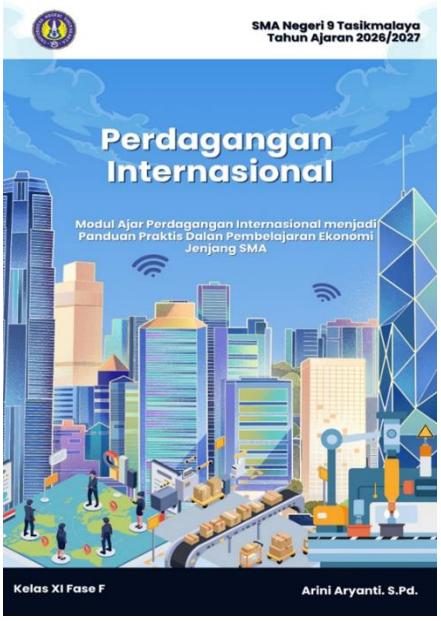

Figure 1. Cover of the International Trade Teaching Module
Source: Research Documentation, 2026

The integration of the module into the INKIT application strengthened the consistency between instructional objectives and flipped classroom implementation procedures. Students accessed conceptual explanations, multimedia illustrations, and guided exercises before classroom meetings occurred, allowing face to face sessions to emphasize collaborative problem solving activities. This instructional arrangement corresponds with flipped classroom principles proposed in contemporary educational research emphasizing active classroom participation and higher order thinking engagement (Hasibuan & Ponidi, 2025). Similar pedagogical patterns were also associated with improvements in learning effectiveness and independent learning readiness among secondary school students (Koong Lin et al., 2025).

The development validation stage involved material experts, media experts, and educational practitioners to evaluate the feasibility and instructional appropriateness of the application. Validation focused on instructional relevance, content organization, visual communication, interface usability, and pedagogical integration within flipped learning activities. Expert feedback suggested that the application already demonstrated strong instructional alignment with curriculum objectives, although several conceptual explanations required refinement for gradual conceptual delivery. Educational media

validation has been identified as an essential stage for strengthening instructional reliability and learner engagement in technology mediated education (Mosquera et al., 2023; Zhu et al., 2025).

Table 1. Expert Validation Results of the INKIT Application

Validation Aspect	Mean Score	Percentage	Category
Material Validation	3.16	79%	Feasible
Media Validation	3.00	75%	Feasible
Teacher Practicality Assessment	3.91	97.75%	Highly Feasible
Student Practicality Assessment	3.32	82.92%	Highly Feasible

Source: Primary Data Processed from Expert Validation Sheets, 2026

The validation findings indicate that the developed application fulfilled acceptable feasibility standards for economics learning implementation. Material experts acknowledged that the application successfully integrated economics concepts with flipped classroom instructional stages, while media experts emphasized the effectiveness of interface simplicity and multimedia accessibility. The feasibility outcomes also support findings from Mustafidatul et al. (2025) demonstrating that digital learning platforms based on Google Sites can strengthen instructional engagement and learning accessibility. Educational technology research further suggested that validated digital applications contribute positively toward independent learning development and instructional personalization (Bui et al., 2022; Elhilal, 2025).

The qualitative responses obtained from teachers and validators further emphasized the importance of instructional flexibility within economics education. Teachers perceived that the application reduced passive learning tendencies because students entered classroom discussions with stronger conceptual preparation. Validators also highlighted that the flipped classroom structure created opportunities for students to explore economic concepts according to their individual learning pace. Previous studies similarly concluded that flipped learning environments improve learner autonomy, reflective engagement, and conceptual retention across diverse educational disciplines (Yao et al., 2025; Chikeme et al., 2024).

The development process of the INKIT application ultimately illustrates that technology integrated flipped learning can function not only as instructional media but also as a pedagogical mechanism supporting self regulated and independent learning culture. The application transformed economics learning from content transmission into participatory knowledge construction supported by multimedia resources and flexible instructional access. Empirical findings from the validation stage reinforce the argument that digital instructional innovation becomes more effective when aligned with constructivist principles and self directed learning theory (Knowles, 1975). Contemporary flipped learning research also consistently recognizes that technology assisted independent learning environments strengthen student engagement, academic responsibility, and learning achievement across secondary and higher education contexts (Oknaryana et al., 2025; Nsyengula et al., 2024).

Practicality and Student Engagement in the Implementation of the INKIT Flipped Classroom Application

The implementation stage of the INKIT application demonstrated substantial pedagogical practicality during flipped classroom learning activities in economics education. Students in the experimental class actively utilized the application during asynchronous and classroom based learning sessions through mobile devices and digital learning resources. The learning process emphasized autonomous preparation before classroom meetings, allowing students to access instructional materials, videos, quizzes, and discussion activities independently. This implementation pattern reflects the pedagogical orientation of flipped learning environments that promote active participation and learner responsibility in technology mediated instruction (Hasibuan & Ponidi, 2025).

The limited trial involving fifteen students produced positive responses toward the practicality and accessibility of the INKIT application during economics learning activities. Students reported that the mobile based interface facilitated easier access to learning materials and enabled repeated learning

interactions outside classroom hours. The integration of flipped classroom activities also encouraged students to prepare conceptual understanding before classroom discussion sessions, which improved participation and confidence during collaborative learning interactions. Similar findings were identified by Adrianzén Olano (2026) and Nsyengula et al. (2024), who explained that flipped learning environments strengthen autonomous engagement and improve instructional interaction during competency based learning processes.

The practicality evaluation conducted by teachers and students indicated that the INKIT application supported instructional implementation effectively during operational classroom activities. Teachers perceived the application as highly supportive for organizing flipped classroom learning procedures because all instructional activities were integrated into one accessible platform. Students also perceived that the application improved learning flexibility and classroom engagement through interactive features and responsive navigation systems. Research conducted by Hsieh and Maritz (2023) emphasized that flipped teaching environments supported by digital platforms contribute positively to students' learning motivation and independent learning behavior.

Table 2. Teacher and Student Practicality Evaluation of the INKIT Application

Aspect	Teacher Score (%)	Student Score (%)	Category
Ease of Use	97.75	82.92	Very Practical
Navigation	96.50	81.84	Very Practical
Interactive Features	98.10	84.20	Very Practical
Learning Flexibility	97.20	83.65	Very Practical
Classroom Support	98.00	82.01	Very Practical

Source: Primary Data Processed from Teacher and Student Practicality Questionnaires, 2026.

The data presented in Table 2 indicate that both teachers and students perceived the INKIT application positively across instructional and technological dimensions. The highest teacher evaluation was observed in the interactive features and classroom support indicators, reflecting efficient instructional management during flipped classroom implementation. Student responses also demonstrated positive perceptions toward accessibility and learning flexibility because the application could be accessed through smartphones at different learning times. Findings from Setiawan et al. (2025) and Fatmawati et al. (2025) similarly demonstrated that flipped learning supported by digital applications contributes to higher self regulated participation and stronger classroom engagement.

The implementation process also revealed that interactive instructional features contributed significantly to students' learning participation and independent study behavior. Students showed stronger engagement when using video learning materials, quizzes, and educational games because these features reduced monotony during economics instruction. The flipped classroom structure encouraged students to revisit instructional content repeatedly before classroom discussions, which improved readiness and conceptual confidence. Ardiyansah and Choirunisa (2022) explained that video integrated flipped classrooms improve instructional interaction because students can control learning pace and conceptual repetition independently.

The use of interactive quizzes within the INKIT application strengthened formative learning processes during economics instruction. Students received immediate feedback after answering conceptual questions, allowing them to identify learning weaknesses before participating in classroom discussions. This mechanism improved students' responsiveness and participation during collaborative learning sessions because they already possessed preliminary conceptual understanding. Similar instructional effects were identified by Koong Lin et al. (2025), who found that flipped teaching environments supported by interactive digital activities enhanced emotional engagement and learning effectiveness among secondary school students.

Table 3. Student Responses Toward Interactive Features in the INKIT Application

Interactive Feature	Student Response (%)	Interpretation
Video Learning	86.40	Highly Engaging

Interactive Quiz	84.75	Highly Engaging
Educational Games	88.10	Highly Engaging
Digital Module	81.25	Engaging
Attendance Feature	79.30	Moderately Engaging

Source: Primary Data Processed from Student Response Questionnaire, 2026.

The results presented in Table 3 demonstrate that educational games and video learning features generated the strongest student engagement during flipped classroom implementation. Students perceived that game based learning activities reduced learning pressure while maintaining conceptual understanding and classroom motivation. The digital modules also supported independent review activities because students could revisit instructional materials according to their own learning needs and schedules. Elhilal (2025) and Izadpanah (2022) similarly reported that flipped classrooms integrated with digital learning technologies strengthen students' self directed learning behavior and academic resilience through flexible instructional interaction.

Although the implementation results were predominantly positive, several technical constraints emerged during classroom application of the INKIT platform. Some students experienced minor lag during simultaneous access to multimedia features, particularly during online quiz sessions and video streaming activities. Teachers also reported that initial verbal guidance remained necessary to ensure students understood navigation procedures and flipped classroom learning sequences properly. These findings align with the observations of Bich et al. (2025) and Murniati et al. (2023), who noted that technological readiness and instructional adaptation remain influential factors in the success of self directed digital learning environments.

The flipped classroom activities implemented through the INKIT application contributed to more active classroom interaction and autonomous learning participation among students. Classroom meetings became more discussion oriented because students entered the classroom with prior conceptual exposure obtained from asynchronous learning activities. This condition reduced passive learning tendencies commonly found in conventional teacher centered economics instruction and increased collaborative participation during case discussions. Bui et al. (2022) and Yao et al. (2025) explained that flipped classrooms personalize learning experiences and improve active classroom engagement because students participate with stronger conceptual preparedness.

The practical implementation of the INKIT application demonstrated that mobile based flipped learning environments can support meaningful instructional interaction in economics education. The combination of flexible access, interactive multimedia features, and collaborative classroom activities strengthened students' engagement during both independent and classroom based learning sessions. Students gradually demonstrated greater confidence in managing learning activities autonomously through repeated interaction with digital instructional content and self paced learning processes. Findings from Chikeme et al. (2024), Purba (2025), and Zhu et al. (2025) support the interpretation that flipped classroom environments integrated with interactive digital media promote stronger self directed participation and more adaptive learning experiences in contemporary education settings.

Statistical Effectiveness of the INKIT Flipped Classroom Application on Self Directed Learning and Learning Achievement

The effectiveness analysis demonstrated that the experimental and control groups possessed comparable initial academic conditions prior to treatment implementation. The Shapiro Wilk normality test indicated that all pretest variables were normally distributed with significance values exceeding 0.05, while the Box's M homogeneity test confirmed homogeneous variance covariance matrices between groups. The MANOVA pretest result also revealed no statistically significant difference between the experimental and control classes with a significance value of 0.188, indicating equivalent baseline competence before the intervention process. This finding strengthened the internal validity of the quasi experimental design and ensured that subsequent posttest differences emerged from instructional treatment rather than initial academic disparities (Tabachnick & Fidell, 2019).

The absence of significant differences in pretest performance indicated that both groups entered the instructional process with relatively similar levels of self directed learning and cognitive achievement. Such equivalence is essential in flipped classroom effectiveness studies because unequal initial competence may distort treatment interpretation and statistical conclusions (Hasibuan & Ponidi,

2025). The comparable starting point also reinforced the reliability of the subsequent multivariate analysis since the intervention effects could be interpreted more accurately within the posttest phase. Similar methodological considerations were emphasized by Yao et al. (2025), who argued that baseline equivalence determines the credibility of flipped classroom intervention outcomes in student centered learning environments.

The posttest analysis demonstrated substantial differences between students who learned through the INKIT flipped classroom application and those who participated in conventional instruction. Statistical testing confirmed that the implementation of flipped learning supported stronger autonomous engagement and deeper conceptual understanding among students. The multivariate analysis simultaneously examined self directed learning and learning achievement to evaluate the integrated pedagogical impact of the intervention. Contemporary flipped classroom studies similarly reported that asynchronous preparation combined with collaborative classroom interaction significantly improves learner autonomy and academic performance (Elhilal, 2025; Hsieh & Maritz, 2023).

Table 4. MANOVA Results of Self Directed Learning and Learning Achievement

Variable	Sig.	Partial Eta Squared	Interpretation
Self Directed Learning	0.000	0.559	Significant Effect
Learning Achievement	0.000	0.559	Significant Effect

Source: Primary Data Processed Using SPSS, 2026.

The MANOVA findings presented in Table 4 revealed a significance value of 0.000 for both dependent variables, indicating statistically significant differences between the experimental and control groups after treatment implementation. The Partial Eta Squared value of 0.559 indicated a strong effect size, meaning that the INKIT flipped classroom intervention contributed 55.9 percent to improvements in self directed learning and learning achievement. This effect size reflected a substantial pedagogical contribution because values above 0.14 are generally interpreted as large effects within multivariate educational research contexts (Tabachnick & Fidell, 2019). Similar findings were identified by Chikeme et al. (2024) and Izadpanah (2022), who reported that flipped instruction significantly enhances learner autonomy, independent regulation, and academic resilience through active learning engagement.

The increase in self directed learning among students in the experimental class reflected the successful integration of constructivist learning principles within the flipped classroom structure. Students demonstrated stronger initiative in accessing learning resources, preparing materials before classroom sessions, and independently monitoring their academic progress during instructional activities. These outcomes aligned with Knowles' theory of self directed learning, which emphasizes learner autonomy, self management, and reflective engagement as foundations of meaningful educational development (Knowles, 1975). Adrianzén Olano (2026) similarly explained that flipped learning environments encourage autonomous learning behaviors because students are positioned as active agents responsible for organizing and regulating their own learning processes.

The improvement in learning achievement also demonstrated that the flipped classroom structure supported higher cognitive engagement during economics instruction. Students in the experimental group experienced more opportunities for analytical discussion, collaborative problem solving, and contextual interpretation of international trade concepts during classroom interaction. Such collaborative instructional activities promoted higher order thinking processes encompassing analysis, evaluation, and conceptual application according to the revised Bloom taxonomy framework. Previous studies by Koong Lin et al. (2025) and Kurniawati et al. (2025) similarly identified that flipped learning strengthens academic achievement through interactive learning experiences, cognitive participation, and reflective classroom communication.

The effectiveness of the INKIT application was also reflected in the normalized gain analysis comparing learning progress between the experimental and control groups. The N Gain results indicated that students exposed to flipped classroom instruction achieved higher improvement rates in both self directed learning and cognitive learning outcomes. Statistical gain comparisons provided additional evidence that the intervention generated meaningful educational progress rather than temporary instructional effects. Similar trends were reported by Purba (2025), who found that flipped classroom

implementation contributes positively to self regulated learning behavior and sustained academic engagement among secondary school students.

Table 5. N Gain Comparison Between Experimental and Control Groups

Variable	Experimental	Control	Category
Self Directed Learning	0.66308	0.13294	Moderate
Learning Achievement	0.5382	0.3772	Moderate

Source: Primary Data Processed Using SPSS, 2026.

The N Gain comparison in Table 5 demonstrated that the experimental class achieved substantially higher improvement scores than the control class across both dependent variables. The self directed learning score in the experimental group reached 0.66308, while the control group only achieved 0.13294, indicating that flipped learning generated stronger autonomous learning development. Learning achievement also increased more substantially within the experimental class with an N Gain score of 0.5382 compared to 0.3772 in the control class. These findings supported previous research conducted by Bich et al. (2025) and Setiawan et al. (2025), which emphasized that learner centered instructional environments positively influence self regulation, academic persistence, and learning readiness.

The moderate N Gain category indicated that the intervention generated meaningful academic improvement while still leaving opportunities for further optimization of instructional implementation. One possible explanation is that self directed learning development requires continuous adaptation because students transitioning from teacher centered learning often need additional time to strengthen independent learning habits and reflective regulation. Classroom observations also suggested that several students initially experienced difficulties managing asynchronous preparation activities before gradually adapting to the flipped learning structure. Haval and Afzal (2026) explained that technology integrated flipped instruction requires sustained pedagogical support and adaptive learning management to maximize learner independence and instructional effectiveness.

The overall findings confirmed that the INKIT application integrated with flipped classroom pedagogy effectively enhanced both self directed learning and learning achievement in economics education. The instructional approach promoted student centered learning by shifting classroom interaction from passive information reception toward collaborative knowledge construction and autonomous exploration. Students became more actively involved in preclass preparation, classroom discussion, and reflective evaluation activities, which contributed to stronger conceptual understanding and independent learning behavior. These findings aligned with the broader literature asserting that flipped classroom environments strengthen cognitive performance, autonomous learning capacity, and collaborative academic engagement within digitally mediated educational contexts (Yao et al., 2025; Nsyengula et al., 2024; Zhu et al., 2025).

CONCLUSION

The development of the INKIT application integrated with the flipped classroom model demonstrated strong pedagogical relevance in improving self directed learning and student achievement in economics learning on international trade material. The application was systematically developed through the ADDIE framework by integrating interactive learning components including digital modules, instructional videos, quizzes, educational games, and evaluation features designed to support autonomous and collaborative learning experiences. The feasibility evaluation confirmed that the application fulfilled instructional and technological standards based on expert validation results, while practicality testing indicated highly positive responses from teachers and students regarding usability, accessibility, and classroom implementation. Inferential statistical analysis further verified the effectiveness of the application, where MANOVA results revealed a significant effect with a Partial Eta Squared value of 0.559, indicating that the intervention contributed substantially to improvements in self directed learning and learning achievement. The N Gain analysis also demonstrated higher improvement scores in the experimental class compared to the control class, confirming that the integration of the INKIT application and flipped classroom learning created a more student centered,

interactive, and cognitively meaningful learning environment capable of strengthening independent learning behavior and academic performance in economics education.

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