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The Moderating Role of Self-Efficacy in the Relationship Between ICT Literacy and Students' Self-Concept in Inquiry-Based Learning

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Abstract: This study focuses on inquiry-based teaching and learning (IN), emphasizing the development of students' self-efficacy (SEDU), self-concept (PP), and information and communication technology literacy (TIK). Students are encouraged to prioritize the learning process over grades or competition, to develop a sense of competence and autonomy, and to focus on broader skill development rather than purely technical objectives. The purpose of this research was to evaluate the performance of SEDU, PP, and TIK within an IN framework. A quantitative approach with a cross-sectional survey design was employed to collect and analyze data. This study investigates the relationships among SEDU, PP, TIK, and IN. Data were collected using a structured questionnaire, and the relationships between these variables were analyzed using structural equation modeling (SEM). The sample consisted of 631 elementary school teachers and 224 mathematics education students from the University of Muhammadiyah Purwokerto, Indonesia. The analysis revealed statistically significant interactions among SEDU, PP, TIK, and IN. Additionally, SEDU was identified as a moderating factor in the interaction between PP, TIK, and IN. These findings suggest that SEDU has the potential to enhance classroom enrichment in IN settings for students with high levels of PP and TIK. This study contributes to the existing literature on instructional feedback and inquiry-based learning by providing recommendations for fostering effective IN classrooms. Specifically, it highlights the importance of enhancing students' technological competencies and personal growth to maximize the benefits of inquiry-based education.

INTRODUCTION

The educational context of this study is inquiry-based teaching and learning, commonly referred to as inquiry. Inquiry encompasses diverse pedagogical approaches characterized by curricula that actively incorporate students' interests, engage students in the classroom through questioning and extended investigations—either in small groups or individually—and expand the roles assumed by both students and teachers (Fahlevi & Maghfiroh, 2023). In Indonesia, inquiry-based curricular frameworks, similar to the Common Core Standards, have faced opposition from certain political groups (Li et al., 2024). International comparisons of mathematics achievement consistently demonstrate superior performance in regions implementing inquiry-based curricula (Latifah & Siti Hasanah, 2021),

reinforcing the global recognition of inquiry as an effective pedagogical approach (Hakim et al., 2023).

However, evaluations of inquiry-based learning often focus primarily on students' cognitive progress. This study aims to expand the discussion to include students' self-efficacy, technology-based skills, and their conceptual understanding of inquiry within technology-enhanced learning environments. Although previous studies on inquiry have examined the impact of ICT (information and communication technology) on learning (Moreno & Bartolomé, 2021), research on the affective outcomes of inquiry-based education remains limited. This gap may stem from the predominant focus of both local and international evaluation frameworks on cognitive, affective, and technological outcomes (Akcaoglu, 2021).

Zheng and Xiao (2023) identified 23 potential outcomes of inquiry-based learning related to students' self-efficacy, of which self-concept, task dedication, ICT literacy, technology awareness, and activity were the only factors demonstrating significant effects. Rahmadani et al. (2023) conducted a study involving 181 students in grades 9–12, spanning classes with low, medium, and high levels of inquiry. Students were asked to evaluate their experiences with the 23 possible inquiry outcomes. A principal component analysis revealed personal efficacy as a critical component, encompassing self-efficacy, self-concept, and ICT literacy. Students in the highest inquiry group outperformed those in lower groups on all three measures. Teachers identified this group as actively promoting self-efficacy learning, self-concept dialogue, ICT literacy development, and student-led investigations.

Notably, Jaya and Nurqamarani (2023) found that integrating reading with inquiry-based mathematics improved reading efficacy in grades 3 and 5, compared to teacher-centered approaches. Inquiry-based learning is widely regarded as promoting qualities such as high levels of self-efficacy, self-concept, ICT literacy, an emphasis on learning processes over grades or outcomes, a sense of competence and autonomy, and goal orientations that prioritize mass-versus-individual ICT literacy skills (Richter et al., 2022).

High self-efficacy not only facilitates effective learning but also enhances knowledge retention in optimal learning environments. Wilski et al. (2024) emphasized that self-efficacy improves conceptual understanding, subsequent learning, and ICT literacy. Beyond intelligence, self-efficacy is a strong predictor of academic success (Kao et al., 2021). Students with higher self-efficacy are more likely to engage in class discussions, fostering flexible ICT literacy skills (Hortelano et al., 2021). Furthermore, self-efficacy theory, as proposed by Bandalos et al. (1995), is highly applicable to technology education, with studies by Nzomo et al. (2023) and Zheng and Xiao (2023) confirming its relevance. Self-efficacy extends beyond academic achievement to encompass lifelong learning and broad self-concept development, with its integration into ICT literacy providing a novel perspective within mainstream self-efficacy theory.

Despite these findings, limited research has explored self-efficacy among high-achieving students with significant subject-matter disparities. While inquiry-based learning and self-concept emphasize challenges, task commitment, and persistence, questions remain unanswered. For example, do self-efficacy and ICT literacy contribute to inquiry-based learning by enhancing self-concept? A theoretical framework is needed to explore the roles of self-efficacy and ICT literacy within inquiry-based education. This study addresses these questions through a cross-sectional

design, investigating the relationships among self-efficacy, self-concept, and ICT literacy in the context of inquiry-based learning. This approach is particularly relevant given the limited prior research on this topic.

LITERATURE REVIEW

Inquiry-Based Learning (IBL)

Inquiry refers to the process of seeking answers or knowledge through the formulation of questions, a concept applicable in both educational and everyday contexts (Oktaviah et al., 2021). Inquiry-Based Learning (IBL) positions students as the central figures in the learning process, encouraging them to actively pose, research, and answer questions, thus taking responsibility for their learning (Sumantri, 2023). Additionally, IBL is recognized as a self-directed learning approach where students take accountability for their education (Durucu & Başaran, 2022). Djihadah et al. (2023) define the active learning process in IBL as requiring students to utilize data analysis and information exchange to address research problems.

Inquiry is acknowledged as an educational approach that supports the development of students' self-efficacy and self-concept (Nisfah & Purwaningsih, 2018). Akcaoglu (2021) identifies several key components of inquiry, including analysis, self-efficacy, ICT literacy, and self-concept. Although inquiry predominantly centers on students, Hasan et al. (2019) note that teachers may intervene to guide novice learners in developing their inquiry skills. Burbage et al. (2023) explore inquiry from both student and teacher perspectives, highlighting that from the student's viewpoint, inquiry emphasizes exploring unresolved questions, while from the teacher's perspective, it focuses on guiding students to build self-efficacy and deeper understanding.

Richter et al. (2022) emphasize that IBL not only facilitates knowledge acquisition but also enhances self-efficacy, ICT literacy, and self-concept skills. Su et al. (2022) found that students engaged in IBL exhibited elevated academic self-efficacy, improved conflict resolution skills, reduced fear of taking risks, and greater persistence despite challenges. Similarly, Hortelano et al. (2021) report that students participating in inquiry develop both knowledge and self-efficacy skills. Getenet et al. (2024) highlight the advantages of IBL, such as fostering curiosity, encouraging students to explore their interests, and developing advanced reasoning and conceptual understanding through discovery.

Students' Self-Concept in Inquiry-Based Learning

Modern education embraces constructivist teaching approaches that emphasize active student engagement and the development of essential competencies (Mihalca et al., 2021). Constructivist principles posit that students are active participants in constructing knowledge, and this understanding evolves over time through the learning process (Duong, 2023). In inquiry, students reconstruct knowledge through exploration and critical thinking, assuming the role of explorers in their educational activities (Desianti et al., 2023).

Latifah and Hasanah (2021) note the increasing adoption of IBL in Indonesia and globally as an approach that supports the development of skills in mathematics, science, and technology. IBL integrates constructivist principles, emphasizing independent learning and fostering self-concept skills, including the ability to conduct research. Various educational strategies can implement IBL, employing diverse instructional techniques such as project-based methodologies to enhance self-concept.

Ze et al. (2018) argue that in IBL, teachers shift from being mere transmitters of knowledge to facilitators

and coordinators of the learning process. Djihadah et al. (2023) add that teachers play a pivotal role in establishing conditions that inspire and support students' self-concept development. Technical education further challenges students to apply their knowledge, skills, and beliefs to solve theoretical and practical problems, fostering self-concept growth. This study, therefore, proposes: Hypothesis 1. Self-concept will be positively correlated with inquiry.

ICT Literacy in Inquiry-Based Learning

Traditional teaching approaches often render knowledge disconnected from real-world applications, limiting students' ability to engage meaningfully (Indana et al., 2020). ICT literacy in IBL helps bridge this gap by enabling students to conduct experiments, collect data, and engage in analysis with greater ease and accuracy (Azari et al., 2023). Tools like LabQuest facilitate these activities, improving scientific literacy by making abstract concepts more tangible and accessible.

Incorporating ICT literacy in IBL supports students in addressing real-world problems through virtual laboratories and ICT-based experiments (Fatahillah et al., 2020). Such approaches enhance critical thinking and problem-solving skills, fostering active engagement and better learning outcomes (Avcı & Deniz, 2022). This study hypothesizes: Hypothesis 2. ICT literacy will be positively correlated with inquiry.

Self-Efficacy as a Moderator Between Self-Concept and Inquiry-Based Learning

Self-efficacy, defined as the belief in one's ability to achieve desired outcomes, is integral to IBL (Fahlevi & Maghfiroh, 2023). It plays a vital role in fostering persistence and resilience in inquiry processes (Burbage et al., 2023). Rahmadani et al. (2023) emphasize that students with high self-efficacy are more likely to apply creative solutions and actively engage in inquiry activities. Ingram et al. (2024) further highlight that self-efficacy enhances motivation and enables students to perceive supportive information positively.

For postgraduate students, self-efficacy strengthens the relationship between self-concept and engagement in inquiry activities (Widuroyekti et al., 2023). Conversely, those with low self-efficacy may lack confidence in their abilities, reducing their active participation (Hakim et al., 2023). This study proposes: Hypothesis 3. Self-efficacy will moderate the relationship between self-concept and inquiry.

Self-Efficacy as a Moderator Between ICT Literacy and Inquiry-Based Learning

ICT literacy often motivates students to engage in technological activities for personal interest or enjoyment (Elmy & Jizat, 2019; Mahmud et al., 2018). According to Markauskaite (2019), ICT literacy enhances autonomy and competence, while Fatahillah et al. (2020) highlight its role in improving engagement and critical thinking in IBL. High self-efficacy further amplifies these effects, enabling students to creatively and effectively utilize ICT tools (Getenet et al., 2024).

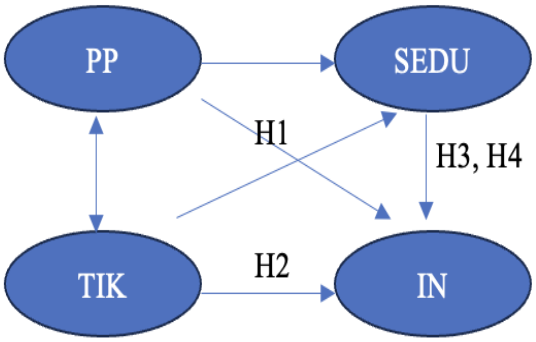
Avcı and Deniz (2022) note that ICT literacy correlates with critical thinking and problem-solving, which drive student engagement in inquiry activities. Prior research underscores the significant moderating role of self-efficacy in the relationship between ICT literacy and inquiry (Burbage et al., 2023; Kao et al., 2021; Sumantri, 2023). Thus, this study hypothesizes: Hypothesis 4. Self-efficacy will moderate the relationship between ICT literacy and inquiry.

METHOD

Research Design

This study employs a quantitative approach utilizing a cross-sectional survey design for data collection and analysis (Ishtiaq, 2019). This approach provides a comprehensive understanding of the research problem, which constitutes the primary focus of the study (Byrne, 2019). The use of a cross-sectional survey in quantitative research offers several advantages, including the ability to gather data efficiently and produce reliable and generalizable findings (Cabrera et al., 2023).

The study focuses on four main constructs: self-efficacy, self-concept, ICT literacy, and inquiry. Each construct encompasses variables that contribute to the overall framework of inquiry-based teaching and learning. A structured questionnaire was developed to measure these variables effectively, ensuring that all constructs were adequately represented. Figure 1 illustrates the conceptual framework, highlighting the interactions among self-efficacy, self-concept, ICT literacy, and inquiry within the context of inquiry-based education.



Note: SEDU= self-efficacy, IN= inquiry, TIK= ICT literacy, PP= self-concept, H1= hypotheses 1, H2= hypotheses 2, H3= hypotheses 3, H4= hypotheses 4

Figure 1. The Conceptual Framework of the Study.

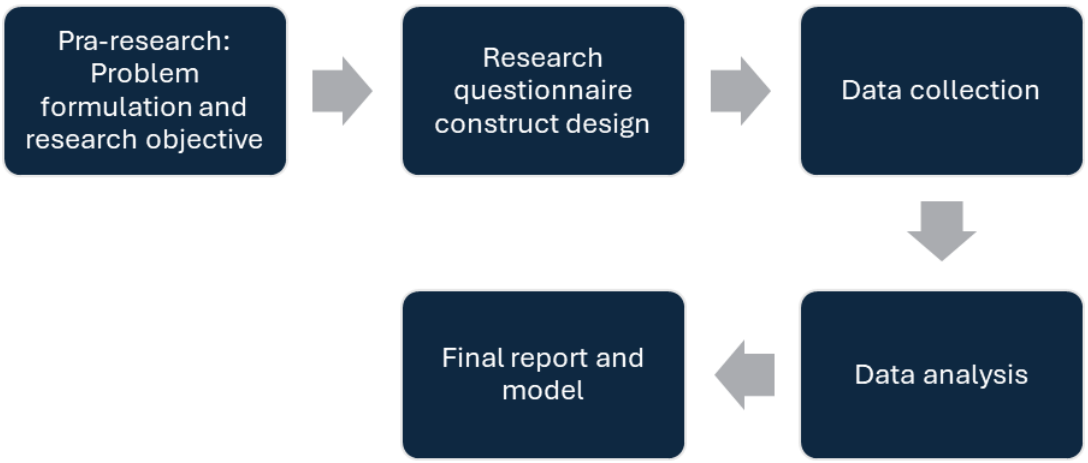


Figure 2. The Research Design Procedures.

These competencies are assessed using four main components: self-efficacy, self-concept, ICT literacy, and inquiry. Structural Equation Modeling (SEM) will be utilized to evaluate the reliability and validity of the estimated

values derived from the current data collection and analysis procedures, ensuring that these four components consistently and accurately achieve the intended outcomes (Kline, 2017). The research design and procedures are visually represented in Figure 2, which provides a comprehensive illustration of the methodological framework employed in this study.

Sample Information

The study involved two departments at the University Muhammadiyah Purwokerto (UMP), Indonesia, namely the Mathematics Education and Primary Education Departments. These departments were selected because their student populations represent the target demographic for this research (Mills, 2012). The final sample consisted of 224 students from the Mathematics Education Department and 631 students from the Primary Education Department.

Data Analysis

Structural Equation Modeling (SEM) was used to analyze the relationships between variables. SEM is particularly suitable for examining correlations rather than causation (Helmericks et al., 2017). This approach incorporates both measurement models, such as factor analysis, and confirmatory factor analysis models, which together are often referred to as the "whole model" (Kline, 2017). SEM is advantageous because it allows researchers to explore complex structures and interrelations despite the challenges in achieving precise model accuracy, which often arise from potential errors (Romeo & Elleine, 2022). Given these complexities, the study emphasized the inclusion of a moderating variable—self-efficacy—which is hypothesized to influence the relationship between self-concept and inquiry, as well as between ICT literacy and inquiry.

Measurement and Data Collection

The study utilized Confirmatory Factor Analyses (CFAs) through AMOS 24.0 software to evaluate the discriminant validity of the constructs. Commonly reported model fit indices, including the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA), were used. According to Strajhar et al. (2019), CFI and TLI values of 0.90 or higher indicate acceptable fit, while an RMSEA value below 0.08 is also considered adequate (Byrne, 2019).

The inquiry instrument, based on the 5E Instructional Model (Fahlevi & Maghfiroh, 2023) and prior research (Nzomo et al., 2023), consisted of ten items rated on a 5-point Likert scale. The scale originally included labels such as "Very Frequently" and "Frequently," but these were replaced with quantifiable terms to avoid ambiguity. For instance, "Very Frequently" was changed to "Every Lesson (EL)," while "Frequently" became "Once a Week (OW)." The reliability of this instrument was supported by a Cronbach's alpha of 0.873. A peer evaluation further refined the items, achieving an interrater reliability coefficient of 0.946. Lesson observations were conducted in 10-minute intervals to document inquiry use, with reliability confirmed at 0.846. Scores were categorized as follows: 1.0–1.4 indicated no use of inquiry, 1.5–2.4 indicated infrequent use, 2.5–3.4 represented occasional use, 3.5–4.4 indicated regular use, and 4.5–5.0 represented very frequent use.

The self-efficacy instrument, adapted from Widuroyekti et al. (2023), consisted of 26 positively worded items assessed on a 5-point Likert scale. Scores were categorized as follows: 1.0–2.4 indicated low self-efficacy, 2.5–3.4 represented neutral self-efficacy, and 3.5–5.0 indicated high self-efficacy. Peer evaluation was conducted to ensure the accuracy of items, and lesson

observations documented their frequency during classroom activities.

Table 1. The Sample of Instruments.

Construct	Sub-construct	Items	Indicators
ICT literacy	collaboration	PTIKS4	I want to be sure that throughout our conversation, I understand both sides of an issue and can clearly state my position.
	Critical thinking	KTBJ2	When we speak, I try my best to support my positions with specific examples from real life.
Self-efficacy	Experience	SEDUP5	When I'm curious about anything, I'll try to find out for sure.
	Social Persuasion	SEDUPS3	I try my hardest to apply what I've learnt every day.
Self-concept	Dynamic self-concept	PPB1	I always verify important things again after reading it, no matter how accurate they appear to be.
	Exact Self-Concept	PPT2	I like to explore previously undiscovered literature to uncover its deeper meanings.

The items were tested on a sample of 855 students from the Mathematics Education and Primary Education Departments at UMP. The reliability of the self-efficacy scores was assessed using the Cronbach alpha coefficient, which yielded a value of 0.758, indicating acceptable reliability. Self-concept was measured using a three-item scale adapted from the role ambiguity scale developed by Zheng and Xiao (2023). This scale has been widely validated for its reliability and discriminant validity in previous studies (Awofala et al., 2017; Rahmadani et al., 2023), with a Cronbach alpha coefficient of 0.842 for the self-concept scores. Self-concept (PP) was further divided into two components: dynamic self-concept (PPB) and exact self-concept (PPT). General ICT literacy was assessed using an eight-item New General ICT Literacy scale created by Avcı and Deniz (2022). The Cronbach alpha coefficient for this scale was 0.793, confirming its reliability. ICT literacy was further categorized into four components: working collaboratively (KKS), critical thinking (KBK), problem-solving (KPM), and creativity (KKRE).

RESULT AND DISCUSSION

Data Respondents

The study involved a total sample of 855 students from the Mathematics Education and Primary Education Departments. Of the participants, 11% identified as female, while 88% identified as male. The distribution of students across semesters included 316 students (36.96%) in their fifth semester, 294 students (34.41%) in their seventh semester, and 245 students (28.67%) in their third semester. Geographically, 401 students (46.90%) resided in suburban areas, whereas 454 students (53.01%) lived in urban areas. This disparity suggests a preference among students for residing in metropolitan regions compared to rural locations.

In terms of internet access, 453 students (52.98%) reported having less than three hours of daily internet access, 87 students (10.18%) had access for three to five hours, and 315 students (36.84%) had access for more than five hours daily. This distribution highlights differences in students' connectivity, which may influence their academic and digital engagement.

Reliability and Validity

A reliability analysis was conducted using SPSS 24.0 to ensure the consistency and stability of the measurement instruments. The Cronbach alpha coefficient for the total scale was 0.946, significantly exceeding the threshold of 0.7, indicating excellent internal

consistency. Structural validity was evaluated through a confirmatory factor analysis (CFA) using AMOS 24.0, where 21 parameters were estimated. The standardized factor loading coefficients ranged from 0.5 to 0.95, all significant at the 0.001 level, except for five reference indicators that were fixed as parameters. The analysis showed no negative deviations in the non-standardized factor loadings, and the standard errors were negligible.

The critical ratio (CR) and average variance extracted (AVE) further confirmed the reliability and validity of the constructs. The CR and AVE values for each construct were as follows: network ties (CR = 0.942, AVE = 0.647), boundary-spanning search (CR = 0.847, AVE = 0.545), absorptive capacity (CR = 0.857, AVE = 0.658), and innovation capability (CR = 0.942, AVE = 0.684). All constructs demonstrated composite reliability above 0.6 and AVE values above 0.5, indicating strong construct validity. The one-dimensional CFA model for the four latent variables aligned well with the sample data, confirming that the model's goodness of fit was optimal for further analysis.

Table 2. The Correlation Coefficients.

	SD	SE	SEDU	PP	TIK	IN
SEDU	1.944	0.893				
PP	2.521	0.855	0.041**			
TIK	4.914	0.742	0.415**	0.381		
IN	4.255	0.755	0.561**	0.000*	0.401**	

Note: n = 350; ** p < 0.01, * p < 0.05. Data in parentheses are square roots of AVE. SD: Standard Deviation; SE: Standard Error; SEDU: Self-efficacy; PP: Self-concept; TIK: ICT literacy; IN: Inquiry-based teaching and learning.

Table 2 presents the descriptive statistics and validity measures for the variables, including the average value, standard deviation, correlation coefficients, and square root of the average variance extracted (AVE). The correlation coefficients between variables were all below 0.70, indicating that multicollinearity was not an issue. Additionally, the square roots of the AVE for each variable exceeded the correlation coefficients with other variables, demonstrating strong discriminant validity among the latent constructs.

Measurement Model

The reliability of the measurement model was assessed using Cronbach's alpha, composite reliability (CR), and AVE criteria. For a construct to be considered reliable, the Cronbach's alpha value should exceed 0.7 ($\alpha > 0.7$), the CR should be 0.6 or higher (CR > 0.6), and the AVE should exceed 0.5 (AVE > 0.5). These thresholds ensure the reliability and validity of the constructs included in the study.

As shown in Figure 3, self-efficacy (SEDU) consists of three components: SEDUP, SEDUFE, and SEDUPS. Similarly, ICT literacy comprises two components: PPT and PPB, while inquiry is represented by INR and INI. Items with factor loadings below 0.50 were removed to improve model fit. The final measurement model demonstrated a good fit with the following indices: Chi-square/df = 9.347, p = .000, CFI = 0.956, PGFI = 0.421, GFI = 0.902, TLI = 0.924, and RMSEA = 0.152. This procedure was applied to all variables in the study, ensuring consistency across the measurement model.

The final values for the Cronbach's alpha, CR, and AVE for each component are reported in Table 3. These values confirm the reliability and validity of the constructs, further supporting the robustness of the measurement model used in the study.

Table 3. The Decision of CR, AVE, and Alpha Cronbach.

Components	Factor Loading	CR > 0.6	AVE > 0.5	Alpha Cronbach > 0.70	Decision
Experience (SEDUP)	0.79	0.783	0.742	0.845	Achieved
Emotional and Physical (SEDUFE)	0.73	0.714	0.583	0.831	Achieved
Social Persuasion (SEDUPS)	0.83	0.744	0.655	0.793	Achieved
Exact Self-Concept (PPT)	0.93	0.682	0.783	0.845	Achieved
Dymanic Self-Concept (PPB)	0.90	0.831	0.633	0.983	Achieved
Collaboration (PTIKS)	0.90	0.783	0.734	0.914	Achieved
Critical Thinking (KTBJ)	0.89	0.673	0.673	0.844	Achieved
Reflection (INR)	0.95	0.733	0.598	0.842	Achieved
Implementation (INI)	0.94	0.735	0.734	0.793	Achieved

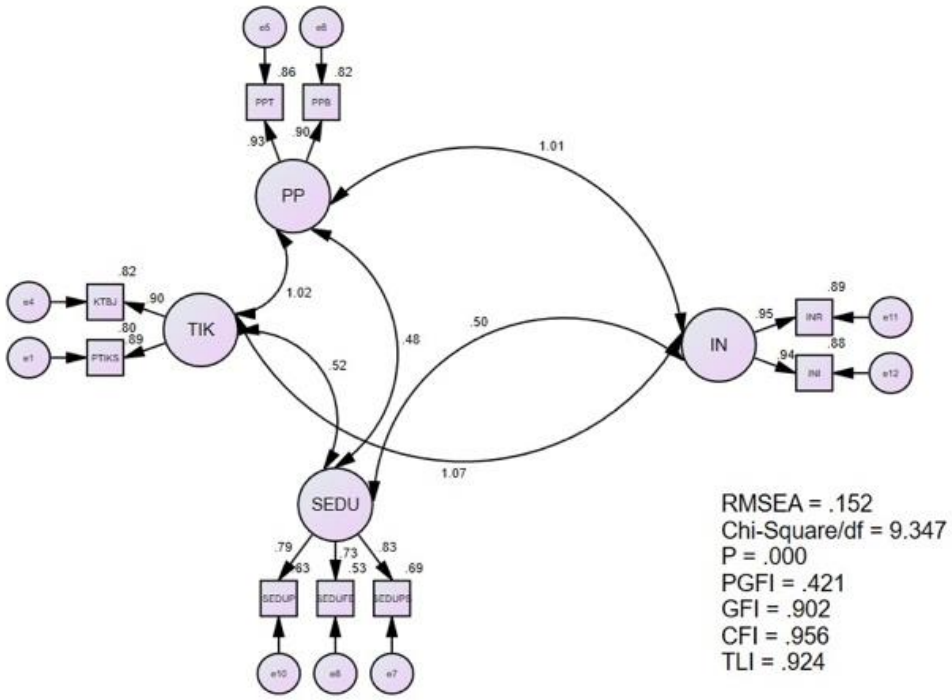


Figure 3. The Measurement Model of The Study.

Structural Model

Building upon the findings of the first study, a second study was conducted to identify the most suitable Structural Equation Modeling (SEM) configuration. The interaction effects between variables were categorized into four levels based on their values: weak interaction stages (values < 0.10), basic interaction stages (values between 0.10 and 0.50), and solid interaction sets (values > 0.50). The results revealed several significant positive correlations between the constructs under investigation.

Specifically, self-concept was found to positively correlate with inquiry (β = 0.101, solid) and ICT literacy (β = 1.02, solid). Additionally, self-concept showed a positive correlation with self-efficacy (β = 0.48, basic interaction). ICT literacy was positively correlated with self-efficacy (β = 0.52, solid) and inquiry (β = 1.07, solid). Finally, self-efficacy also demonstrated a positive correlation with inquiry (β = 0.50, basic interaction). These findings provide robust support for the relationships between self-concept, ICT literacy, self-efficacy, and inquiry.

Figure 4 illustrates the SEM model developed to represent the inquiry classroom framework utilized in this investigation. This model integrates the observed interactions and highlights the pathways through which these constructs influence inquiry-based learning environments.

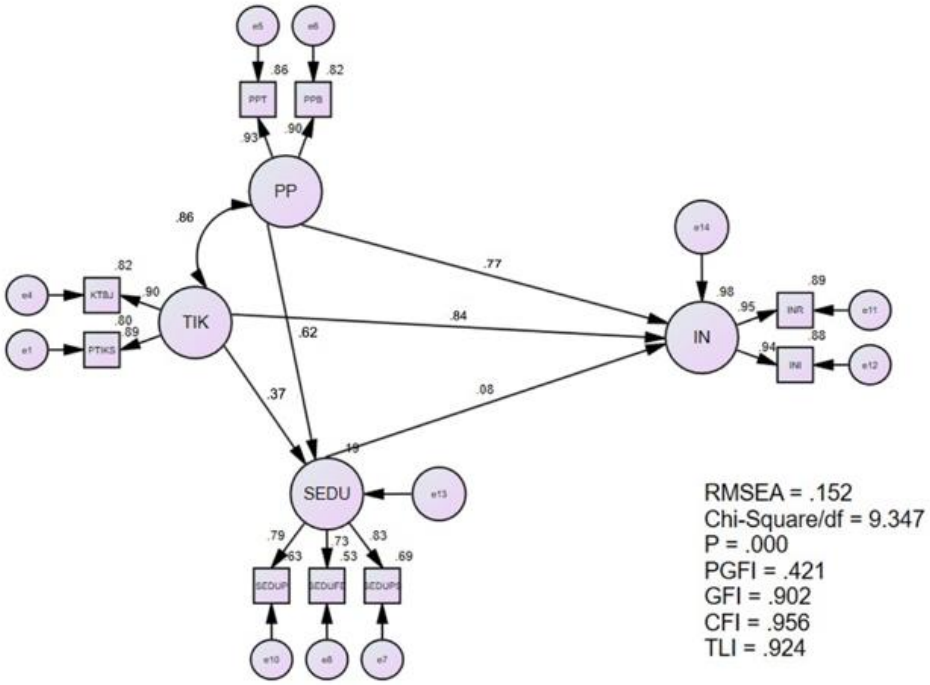


Figure 4. The Structural Model of The Study.

Hypothesis Test

The first hypothesis posits that inquiry is positively influenced by self-concept. As shown in Table 4, self-concept has a significant positive effect on inquiry (β = 0.773), confirming Hypothesis 1. Similarly, Hypothesis 2 states that ICT literacy positively impacts inquiry, which is supported by the findings (β = 0.841). Furthermore, under Hypotheses 3 and 4, self-concept (β = 0.622) and ICT literacy (β = 0.373) both influence inquiry through self-efficacy. These results demonstrate that self-efficacy links self-concept and inquiry as well as ICT literacy and inquiry relationships. Self-efficacy is considered essential in addressing challenges encountered in everyday life, particularly within the global context of inquiry classrooms. Students' self-efficacy is strongly related to their procedural abilities in inquiry-based learning, as shown by Hakim et al. (2023). Practical exercises and learning activities designed to enhance self-efficacy help students better understand the material, ultimately improving their skills in inquiry classrooms (Kao et al., 2021). Teachers often express concerns that students lacking self-efficacy may struggle to gather sufficient evidence to support their answers. However, students can enhance their self-efficacy and inquiry performance by participating in instructional activities that challenge them to solve real-world problems, as suggested by Nzomo et al. (2023).

Developing students' capacity to synthesize knowledge in the inquiry classroom is crucial. Hortelano et al. (2021) observed that the inquiry technique enhances students' self-efficacy and conceptual knowledge by allowing them to make observations, plan experiments, and understand the

practical implementation of concepts. This process significantly improved students' self-concept and inquiry-related abilities. Furthermore, results show a significant relationship between students' self-concept and their inquiry classroom performance, with all indicators of this skill type receiving passing grades during the evaluation phases. According to Sumantri (2023), inquiry classrooms offer various techniques, media, and evaluation instruments that help students develop these abilities. Burbage et al. (2023) highlight the importance of self-concept as a foundational component of the learning process, which can be explicitly taught to students. Durucu and Başaran (2022) recommend that teachers encourage students to adopt a learner's mindset and engage in self-concept-building activities. Additionally, the inquiry technique has proven effective in fostering self-concept, with students showing significant improvement when taught using this method (Wilski et al., 2024). Teachers are encouraged to repeat experimental practices to achieve substantial improvements in their students' self-concept and inquiry skills.

Research over the past decades has extensively examined the role of self-concept in inquiry classrooms. Rost and Feng (2024) investigated the inquiry development process and the application of self-concept in learning, emphasizing the need for professional development opportunities for teachers. According to Widuroyekti et al. (2023), educational institutions should address current challenges in the learning process by offering seminars that enhance teachers' understanding of effective learning strategies. This study highlights self-concept as a crucial factor for students' success in inquiry-based learning. However, while the inquiry classroom has been implemented in schools, one significant barrier remains: time constraints.

Additionally, technological advancements must accompany educational reforms to align with the needs of inquiry classrooms. Elmy and Jizat (2019) argue that ICT literacy plays a pivotal role in influencing self-concept and the progress of inquiry in education. As Oral and Desianti et al. (2023) suggest, ICT literacy is one of the most critical components of modern education, serving as an indispensable tool for enhancing self-concept and inquiry-based learning. Markauskaite (2019) further emphasizes the importance of integrating ICT literacy into educational practices to meet the demands of contemporary academic disciplines.

Table 4. The Hypothesis Review.

Hypothesis	The Association	Value (β)	Conclusion
H1	PP → IN	0.773	Significant
H2	TIK → IN	0.841	Significant
H3	PP → SEDU → IN	0.622	Significant
H4	TIK → SEDU → IN	0.373	Significant

The education profession is undergoing rapid and unprecedented change. In today's information society, where knowledge is constantly evolving and expanding, it is neither feasible nor necessary for students to commit vast amounts of information to memory. According to Azari et al. (2023), students living in information-based communities are expected to possess the skills required to acquire relevant information, utilize their existing ICT literacy, and independently develop self-concept.

One effective strategy to address the challenges of inquiry-based learning

is to integrate the technological capabilities of ICT literacy and self-efficacy with proven teaching approaches. This combination can enhance inquiry activities, thereby enabling more comprehensive and impactful instruction for students (Zheng & Xiao, 2023). It is critical to emphasize that self-efficacy has become a fundamental requirement in modern education. While it is not a universal solution to every educational challenge, the importance of self-efficacy in fostering effective learning environments remains evident. Prior professional development focused on self-efficacy for experienced educators is essential for optimizing the integration of ICT literacy into classrooms (Rahmadani et al., 2023).

The benefits of self-efficacy to educational institutions are undeniable, making it imperative for teachers to incorporate self-efficacy into inquiry classrooms and ICT literacy environments (Duong, 2023). In the digital era, where vast amounts of information are readily accessible, the inability to effectively utilize ICT literacy is akin to neglecting self-efficacy (Mihalca et al., 2021). Furthermore, computer literacy has become an indispensable skill for aspiring educators (Hakim et al., 2023). This requirement ensures that teachers are equipped with the necessary competencies to use computers effectively for classroom instruction and professional resource sharing in ICT literacy (Getenet et al., 2024).

CONCLUSION

This study highlights the significant influence of the examined variables on research design and conceptual theories, enabling the development of new frameworks or adjustments to existing ones, particularly through the integration of moderating variables like self-efficacy. These insights contribute to a deeper understanding of the interaction effects in educational research and provide opportunities to address real-world technological challenges with practical, well-grounded solutions. The study validates the conceptual model of inquiry-based learning (IN) competencies and demonstrates the importance of moderating variables in improving structural models. However, several limitations must be acknowledged. The reliance on single-source and self-reported data introduces a potential for common method bias, though this was not found to be an issue in this study. To enhance the robustness of future research, dual-source and time-lagged designs are recommended to minimize bias and test hypotheses more comprehensively. Additionally, as a cross-sectional study, this research cannot establish causal relationships, underscoring the need for longitudinal designs to capture temporal changes. Lastly, the findings are based on a sample limited to specific student departments, restricting generalizability. Future studies should broaden the scope by including data from multiple departments and faculties across different contexts to confirm and extend these results.

REFERENCES

Akcaoglu, M. (2021). Understanding the relationship among self-efficacy, utility value, and the community of inquiry framework in preservice teacher education. *International Review of Research in Open and Distributed Learning*, *23*(2), 1–13.

Avcı, C., & Deniz, M. N. (2022). Computational thinking: early childhood teachers' and prospective teachers' preconceptions and self-efficacy. *Education and Information Technologies*, *27*(8), 11689–11713. https://doi.org/10.1007/s10639-022-11078-5

Awofala, A. O. A., Akinoso, S. O., & Fatade, A. O. (2017). Attitudes

towards computer and computer self-efficacy. *Acta Didactica Napocensia*, *10*(3), 91–108.

Azari, A. M., Wilujeng, I., & Nurohman, S. (2023). Development of web-based science learning to improve ICT literacy and conceptual understanding skills. *JSER Journal of Science Education Research Journal*, *22*(1), 1–13.

Bandalos, D. L., Yates, K., & Thorndike-Christ, T. (1995). Effects of math self-concept, perceived self-efficacy, and attributions for failure and success on test anxiety. *Journal of Educational Psychology*, *87*(4), 611–623. https://doi.org/10.1037/0022-0663.87.4.611

Burbage, A. K., Jia, Y., & Hoang, T. (2023). The impact of community of inquiry and self-efficacy on student attitudes in sustained remote health professions learning environments. *BMC Medical Education*, *23*(1), 1–10. https://doi.org/10.1186/s12909-023-04382-2

Byrne, B. M. (2019). Structural equation modeling with Amos: Basic concepts, applications and programming. *Journal of Applied Quantitative Methods*, *5*(2), 365–367.

Cabrera, L., Ketelhut, D. J., Mills, K., Killen, H., Coenraad, M., Byrne, V. L., & Plane, J. D. (2023). Designing a framework for teachers' integration of computational thinking into elementary science. *Journal of Research in Science Teaching*. https://doi.org/10.1002/tea.21888

Desianti, L. C., Hardhienata, S., & Setyaningsih, S. (2023). The modelling of ICT literacy, work engagement, and personal knowledge management to enhance teacher creativity. *Asian Journal of Management Entrepreneurship and Social Science*, *03*(3), 164–192. https://ajmesc.com/index.php/ajmesc

Djihadah, N., Wasliman, I., Mulyanto, A., & Fatkhullah, F. K. (2023). Literary teaching based on information and communication technology (ICT): An inquiry approach. *Theory and Practice in Language Studies*, *13*(6), 1556–1563. https://doi.org/10.17507/tpls.1306.25

Duong, C. D. (2023). A moderated mediation model of perceived barriers, entrepreneurial self-efficacy, intentions, and behaviors: A social cognitive career theory perspective. *Oeconomia Copernicana*, *14*(1), 355–388. https://doi.org/10.24136/oc.2023.010

Durucu, A. S., & Başaran, M. (2022). Investigation of the relationship between teachers' self-efficacy in Inquiry-based teaching for STEM+S and teaching 21st-century skills. *Journal of Innovative Research in Teacher Education*, *3*(3), 339–362. https://doi.org/10.29329/jirte.2022.479.6

Elmy, J., & Jizat, M. (2019). Investigating ICT-literacy assessment tools : Developing and validating a new assessment instrument for trainee teachers in Malaysia. *Journal for Research in Mathematics Education*, *3*(August), 325–336.

Fahlevi, A., & Maghfiroh, S. (2023). Development of guided inquiry-based science electronic teaching materials to increase student learning motivation. *Jurnal Penelitian Pembelajaran Fisika*, *9*(1), 1. https://doi.org/10.24036/jppf.v9i1.120947

Fatahillah, A., Puspitasari, I. D., & Hussen, S. (2020). The development of Schoology web-based learning media with GeoGebra to improve

the ICT literacy on quadratic functions. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *5*(3), 304–316. https://doi.org/10.23917/jramathedu.v5i3.10692

Getenet, S., Cantle, R., Redmond, P., & Albion, P. (2024). Students' digital technology attitude, literacy and self-efficacy and their effect on online learning engagement. *International Journal of Educational Technology in Higher Education*, *21*(1), 1–15. https://doi.org/10.1186/s41239-023-00437-y

Hakim, H., Hasmyati, H., Zulfikar, M., Anwar, N. I. A., Dos Santos, H. A., & Hamzah, A. (2023). Improving student's self-efficacy through inquiry learning model and modeling in physical education. *Cakrawala Pendidikan*, *42*(2), 483–492. https://doi.org/10.21831/cp.v42i2.57759

Hasan, R., Lukitasari, M., Utami, S., & Anizar, A. (2019). The activeness, critical, and creative thinking skills of students in the Lesson Study-based inquiry and cooperative learning. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *5*(1), 77–84. https://doi.org/10.22219/jpbi.v5i1.7328

Helmericks, S. G., Nelsen, R. L., & Unnithan, N. P. (2017). The researcher, the topic, and the literature: A procedure for systematizing literature searches. *The Journal of Applied Behavioral Science*, *27*(3), 285–294. https://doi.org/10.1177/0021886391273004

Hortelano, J. T., Ramos, R. A., Gutierrez, M. C., & Catapang, H. A. (2021). Mediating role of self-efficacy to use ict on the relationship between digital profile and competence. *Journal of Applied Structural Equation Modeling*, *5*(1), 19–39. https://doi.org/10.47263/JASEM.5(1)04

Indana, S., Agustini, R., & Rahayu, Y. S. (2020). Effectiveness of learning material by ICT-based guided inquiry model to train critical thinking skill and science literacy. *Proceedings of the 7th Mathematics, Science, and Computer Science Education International Seminar, MSCEIS 2019*. https://doi.org/10.4108/eai.12-10-2019.2296311

Ingram, E., Hill, T. W., Harshbarger, D., & Keshwani, J. (2024). Improving elementary pre-service teachers' science teaching self-efficacy through garden-based technology integration. *Education Sciences*, *14*(1), 1–15. https://doi.org/10.3390/educsci14010065

Ishtiaq, M. (2019). Book Review Creswell, J. W. (2014). Research design: qualitative, quantitative and mixed methods approaches (4th ed.). Thousand Oaks, CA: Sage. *English Language Teaching*, *12*(5), 40–51. https://doi.org/10.5539/elt.v12n5p40

Jaya, F., & Nurqamarani, A. S. (2023). Understanding student engagement in hybrid learning : An analysis impact digital literacy and academic self-efficacy. *Jurnal Kependidikan: Jurnal Hasil Penelitian Dan Kajian Kepustakaan Di Bidang Pendidikan, Pengajaran Dan Pembelajaran*, *9*(3), 833. https://doi.org/10.33394/jk.v9i3.7947

Kao, K. Y., Lee, H. T., Rogers, A., Hsu, H. H., & Lin, M. T. (2021). Mentoring and job search behaviors: A moderated mediation model of job search self-efficacy. *Journal of Career Development*, *48*(1), 44–59.

https://doi.org/10.1177/0894845319832971

Kline, R. B. (2017). Principles and practice of structural equation modeling. *Journal Basic of Education*, *3*(21), 445–458.

Latifah, S., & Siti Hasanah, D. (2021). The Influence of inquiry-based learning model on self-efficacy and scientific literacy of high school students. *Asian Journal of Science Education*, *3*(2), 113–119.

Li, X., Zhang, Y., Yu, F., Zhang, X., Zhao, X., & Pi, Z. (2024). Do science teachers' believes related to inquiry-based teaching affect students' science process skills? Evidence from a multilevel model analysis. *Disciplinary and Interdisciplinary Science Education Research*, *6*(1). https://doi.org/10.1186/s43031-023-00089-y

Mahmud, R., Arif, M., & Ismail, H. (2018). Impact of training and experience in using ICT on in-service teachers ' basic ICT literacy. *Malaysian Online Journal of Instructional Technology (MOJIT)*, *10*(2), 5–12.

Markauskaite, L. (2019). Exploring differences in trainee teachers ' ICT literacy : Does gender matter? *Journal for Research in Math Education*, *4*(3), 445–455.

Mihalca, L., Rațiu, L., Brendea, G., Metz, D., Dragan, M., & Dobre, F. (2021). A moderated-mediation model of role clarity, self-efficacy, and task interdependence Exhaustion while teleworking during COVID-19. *Eoconomia Copernicana*, *12*(2), 269–306. https://doi.org/10.24136/oc

Mills, P. W. A. (2012). *Educational research: Competencies for analysis and applications*. New York: Routledge

Moreno, A., & Bartolomé, E. (2021). Study and research paths to improve web-based inquiry learning: Study case of an ICT course in engineering. *Education Sciences*, *11*(12), 1–11. https://doi.org/10.3390/educsci11120772

Nisfah, N. L., & Purwaningsih, E. (2018). Collaborative inquiry integrated technological pedagogical content knowledge to improve higher-order thinking skills. *Jurnal Kependidikan*, *6*(1), 25–39.

Nzomo, C., Rugano, P., Njoroge Mungai, J., & Gitonga Muriithi, C. (2023). Inquiry-based learning and students' self-efficacy in Chemistry among secondary schools in Kenya. *Heliyon*, *9*(1), 1–10. https://doi.org/10.1016/j.heliyon.2022.e12672

Oktaviah, R., Mawarda Rokhman, N., & Reza Maulana, A. (2021). Inquiry-based teaching to develop EFL students' critical thinking in reading comprehension. *Education of English as Foreign Language*, *4*(1), 49–56. https://doi.org/10.21776/ub.educafl.2021.004.01.05

Rahmadani, A., Jumadi, J., Wilujeng, I., Suyanta, S., & Afikah, A. (2023). Students' self-efficacy in science learning based on gender. *Jurnal Penelitian Pendidikan IPA*, *9*(6), 4143–4150. https://doi.org/10.29303/jppipa.v9i6.2873

Richter, J., Lachner, A., Jacob, L., Bilgenroth, F., & Scheiter, K. (2022). Self-concept but not prior knowledge moderates effects of different implementations of computer-assisted inquiry learning activities on students' learning. *Journal of Computer Assisted Learning*, *38*(4), 1141–1159. https://doi.org/10.1111/jcal.12673

Romeo S. Berba, & Elleine Rose A. Oliva. (2022). a Structural equation model on research skills. *EPRA International Journal of*

Multidisciplinary Research (IJMR), *7*(January), 212–218. https://doi.org/10.36713/epra9388

Rost, D. H., & Feng, X. (2024). Academic self-concept wins the race: The prediction of achievements in three major school subjects by five subject-specific self-related variables. *Behavioral Sciences*, *14*(1), 1–12. https://doi.org/10.3390/bs14010040

Saefudin, W., Sriwiyanti, & Yusoff, M. (2021). Role of social support toward student academic self-efficacy in online learning. *Jurnal Tatsqif*, *19*(2), 133–154. https://doi.org/10.20414/jtq.v19i2.4221

Safaruddin, S., Ibrahim, N., Juhaeni, J., Harmilawati, H., & Qadrianti, L. (2020). The effect of project-based learning assisted by electronic media on learning motivation and science process skills. *Journal of Innovation in Educational and Cultural Research*, *1*(1), 22–29. https://doi.org/10.46843/jiecr.v1i1.5

Strajhar, P., Schmid, Y., Liakoni, E., Dolder, P. C., Rentsch, K. M., Kratschmar, D. V., Odermatt, A., Liechti, M. E., Ac, R., No, N., No, C., Oramas, C. V., Langford, D. J., Bailey, A. L., Chanda, M. L., Clarke, S. E., Drummond, T. E., Echols, S., Glick, S. Mogil, J. S. (2019). Structural equation modeling basic assumtions and concepts: a Novices guide. *Nature Methods*, *7*(6), 20–35.

Su, W., Qi, Q., & Yuan, S. (2022). A Moderated Mediation Model of Academic Supervisor Developmental Feedback and Postgraduate Student Creativity: Evidence from China. *Behavioral Sciences*, *12*(12), 1–14. https://doi.org/10.3390/bs12120484

Sumantri, M. S. (2023). The influencing of Inquiry-Based Learning on Science Conceptual Understanding in Terms of Primary School's Self-Efficacy. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *7*(3), 3627–3638. https://doi.org/10.31004/obsesi.v7i3.4618

Widuroyekti, B., Widyani, I. P., Hartanti, J., & Bergsma, L. N. (2023). Contribution of self-concept and learning independence to the resilience of students in Open University. *IJORER : International Journal of Recent Educational Research*, *4*(2), 213–222. https://doi.org/10.46245/ijorer.v4i2.335

Wilski, M., Brola, W., Koper, M., Gabryelski, J., Łuniewska, M., Fudala, M., & Tomczak, M. (2024). Relationship between physical activity and coping with stress in people with multiple sclerosis: A moderated mediation model with self-efficacy and disability level as variables. *International Journal of Clinical and Health Psychology*, *24*(1), 1–8. https://doi.org/10.1016/j.ijchp.2023.100415

Ze, R., Kun, Z., Boadu, F., & Yu, L. (2018). The effects of boundary-spanning search, network ties, and absorptive capacity for innovation: A moderated mediation examination. *Sustainability (Switzerland)*, *10*(11), 1–18. https://doi.org/10.3390/su10113980

Zheng, Y., & Xiao, A. (2023). A structural equation model of online learning: investigating self-efficacy, informal digital learning, self-regulated learning, and course satisfaction. *Frontiers in Psychology*, *14*, 1–18. https://doi.org/10.3389/fpsyg.2023.1276266