



## **Modeling Economics Learning Outcomes in the Digital Era: The interplay of Digital Literacy, Peer Collaboration, and Self-Regulated Learning**

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**Abstract:** This study aims to analyze the effects of digital literacy, peer collaboration, and self-regulated learning on the Economics learning outcomes of senior high school students. The study employed a quantitative explanatory approach using a cross-sectional survey design. The population consisted of 180 students, from which a sample of 124 students was selected through simple random sampling. Data on digital literacy, peer collaboration, and self-regulated learning were collected using questionnaires, while data on Economics learning outcomes were obtained from school academic records. The data were analyzed using partial least squares structural equation modeling (PLS-SEM) with the assistance of SmartPLS. The results showed that digital literacy had a positive and significant effect on Economics learning outcomes ( $\beta = 0.443$ ,  $p < .001$ ). Peer collaboration also demonstrated a positive and significant effect on Economics learning outcomes ( $\beta = 0.406$ ,  $p < .001$ ). In addition, self-regulated learning had a positive and significant effect on Economics learning outcomes ( $\beta = 0.122$ ,  $p = .033$ ). The model explained 62.8% of the variance in Economics learning outcomes ( $R^2 = 0.628$ ), indicating moderate explanatory power. These findings suggest that students' Economics learning outcomes are influenced by their ability to utilize digital learning resources effectively, engage in meaningful academic interaction with peers, and regulate their learning processes independently. Based on these findings, Economics instruction should be designed to emphasize the effective use of digital learning resources, strengthen collaborative learning activities among students, and promote the development of self-regulated learning practices throughout the learning process.

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## **Introduction**

Twenty first century learning is important because it develops the 4C skills communication, creativity, collaboration, and critical thinking that students need to adapt to change and increasingly complex learning demands (Tohani & Aulia, 2022). In line with this, developments in educational technology require students not only to be able to use devices, but also to access, evaluate, and utilize digital information effectively for learning purposes (Q. Pan et al., 2025). These demands emphasize that students are not merely expected to receive information, but also to process it, test their understanding, and connect it to real-life situations so that learning becomes meaningful (Uus et al., 2022). Academic achievement is an important indicator of both the learning process and assessment. Therefore, low achievement may indicate problems in the learning process rather than merely problems in the final outcome (Levy, 2025).

In the context of Economics learning, this issue becomes more important because Economics requires students to understand concepts, interpret data, analyze socio-economic

phenomena, and make logical decisions based on available information (Kolstø et al., 2024; Lieb & Pickhardt, 2025). If the learning process is not meaningful, students may only memorize concepts without being able to apply them to real economic problems (Bhardwaj et al., 2025; Mystakidis, 2021). This condition is reflected in the preliminary data on the Economics learning outcomes of Grade XI students at SMAN 5 Kota Jambi. Out of five classes with a total of 180 students, 83 students (46.11%) had achieved the minimum mastery criterion, while 97 students (53.89%) had not. In other words, more than half of the students were still categorized as not yet achieving mastery. Data obtained from the Economics teacher at SMAN 5 Kota Jambi indicate students' learning outcomes need to be examined seriously because they may reflect weaknesses in the learning process, particularly in the way students access learning resources, interact with peers, and regulate their learning activities.

Based on this condition, one important factor that needs to be examined is digital literacy, since this skill increasingly determines learning success in the digital era. Digital literacy has become increasingly important in education along with the growing role of educational digitalization and digital skills in supporting successful learning (Vodā et al., 2022). In its development, digital literacy is understood as a core competence that goes beyond basic technical skills and includes the ability to use digital resources effectively for learning (Yuan et al., 2025).

In addition, digital literacy is also defined as the capacity to understand, apply, and manage digital devices effectively and appropriately (F. Li et al., 2025). Adequate digital literacy skills, supported by proper planning and technology-integrated learning implementation, can make learning more engaging, interactive, and relevant to students' lives (Yahya, 2023). Digital competence includes the skills to use devices, applications, and networks to access, manage, evaluate, and communicate information (Acosta et al., 2024). While, digital literacy also involves responsible and safe participation in digital environments, including attention to privacy and ethical navigation (Buchan et al., 2024).

In Economics learning, digital literacy is particularly relevant because students need to access current economic information, evaluate digital sources, interpret economic data, and relate economic concepts to real socio-economic phenomena. This relevance is supported by Syamiya et al. (2022), who examined digital literacy in relation to online learning outcomes in Macroeconomics. In addition, Supriyadi & Amalia (2026), found that students' digital literacy had a positive and significant effect on learning outcomes in an Economics Learning Evaluation course. Therefore, students with good digital literacy are more likely to use digital learning resources effectively, understand economic issues critically, and support their learning with relevant information.

However, the ability to use digital resources is not always sufficient to produce deep understanding, because learning outcomes are also influenced by the social interaction that accompanies students learning activities (Loh et al., 2024). Therefore, the information students obtain needs to be clarified, discussed, and tested through academic interaction so that it develops into more meaningful understanding (Shao et al., 2024). In this context, peer collaboration becomes relevant because peer relationships and cooperation have been shown to contribute to learning engagement, group academic functioning, and students' academic achievement (Tang & Shen, 2026).

Peer collaboration refers to a form of academic cooperation among students that takes place through active interaction, mutual support, and the joint completion of tasks or problems in order to achieve shared learning goals (Gürbüz et al., 2026; Huang et al., 2024; H. Li, 2025). In practice, peer collaboration functions as socio-academic support that can enhance learning engagement and students' academic achievement (Bach & Thiel, 2024).

When interaction with peers is positive and meaningful, students are more likely to build confidence and psychological readiness in learning, which in turn contributes to improved learning outcomes (F. Pan et al., 2024).

In Economics learning, peer collaboration may help students discuss economic issues, compare perspectives, clarify concepts, and construct arguments through academic interaction. This is in line with Cagliesi & Ghanei (2022), who showed that team-based learning in Economics can enrich students' learning experience by helping them contextualize and apply Economics to various issues and policies. Therefore, peer collaboration is relevant in Economics learning because it supports students not only in understanding concepts, but also in applying economic reasoning through discussion and group-based problem solving.

Nevertheless, the effectiveness of learning is not determined solely by external support, but also by students' ability to regulate their own learning. In this context, self-regulated learning is relevant because it includes the ability to plan, monitor, and evaluate the learning process independently (Pansri et al., 2024). Self-regulated learning is students' ability to plan, monitor, and evaluate their own learning process independently so as to support academic success (Tinajero et al., 2024; Xu & Yu, 2025). *Through this ability, students can manage study time, adjust learning strategies, monitor their progress, and improve the quality of their learning* (Barz & Dörrenbächer-ulrich, 2024; Lourenco & Pavia, 2024).

In the context of Economics education, self-regulated learning helps students manage their learning strategies when dealing with abstract concepts, data-based tasks, and problem-solving activities related to economic issues, as self-regulated learning empowers students to control cognitive processes and apply adaptive strategies for deeper understanding and effective application of economic concepts across contexts (Arthur et al., 2025).

The explanation above shows that digital literacy, peer collaboration, and self-regulated learning are important factors in explaining the quality of students' learning processes and outcomes. However, although these variables have been widely examined in previous educational studies, most studies have investigated them separately. Limited research has examined digital literacy, peer collaboration, and self-regulated learning simultaneously as digital, social, and personal dimensions of learning in explaining Economics learning outcomes. This gap is particularly important in the context of senior high school students in developing countries, where access to digital learning resources, collaborative learning practices, and independent learning habits may develop unevenly.

Therefore, this study aims to analyze the effects of digital literacy, peer collaboration, and self-regulated learning on the Economics learning outcomes of eleventh-grade students at SMAN 5 Kota Jambi. This study is expected to provide empirical evidence on how digital, social, and personal learning factors contribute to students' achievement in Economics. The findings are also expected to support the development of Economics instruction that is more relevant, collaborative, and aligned with the demands of learning in the digital era.

## Research Method

This study employed a quantitative explanatory approach with a cross-sectional survey design to examine the relationship between digital literacy, peer collaboration, self-regulated learning, and students' Economics learning outcomes (Kurniawan, 2022). The research population consisted of all 180 eleventh-grade students at SMAN 5 Kota Jambi, with a sample of 124 students selected using simple random sampling and the Yamane formula at a 5% precision level (Johnson & Larry, 2014; Kurniawan, 2022).

Primary data were collected through questionnaires to measure digital literacy, peer collaboration, and self-regulated learning, while secondary data were obtained from the documentation of students' final semester assessment scores in Economics provided by the teacher or school. The instruments were developed based on the research variable indicators and measured using a five-point Likert scale (Kurniawan, 2022). Digital literacy was measured using seven indicators, namely fundamentals of hardware and software, information and data literacy, communication and collaboration, digital content creation, safety, problem solving, and career-related competences (UNESCO, 2018). Peer collaboration was measured using five indicators, namely communication skills, shared goals, collaborative products, knowledge exchange, and collaborative prosocial skills (Burns et al., 2024). Self-regulated learning was measured using three indicators, namely forethought, performance, and self-reflection (Zimmerman & Schunk, 2013).

Before being used in the main study, the instruments were piloted on 34 students from Class XI F3 at SMAN 1 Kota Jambi and analyzed using partial least squares structural equation modeling through outer loading assessment. The results of the first-stage pilot test showed that, out of 75 statement items, 33 were declared valid, while 42 were eliminated because they had outer loading values below 0.70. The digital literacy indicators of Safety and Problem Solving, as well as the Shared Goals indicator in peer collaboration, were also excluded because, after the elimination process only one valid item remained for each, which was insufficient to adequately represent the constructs (Hair Jr et al., 2021). In the second stage, all remaining 30 items met the criteria for convergent validity and were therefore considered appropriate for use in the main study.

The data were analyzed using partial least squares structural equation modeling (PLS-SEM) with the assistance of SmartPLS 4.0 software. The analytical procedure consisted of descriptive analysis, measurement model evaluation, and structural model evaluation. Descriptive analysis was based on the respondent achievement level, with the following criteria: 81%–100% very good, 61%–80% good, 41%–60% fair, 21%–40% poor, and 0%–20% very poor (Johnson & Larry, 2014).

The measurement model was evaluated through convergent validity, construct reliability, and discriminant validity testing. Convergent validity was assessed based on outer loading values greater than 0.70 and Average Variance Extracted (AVE) values greater than 0.50. Construct reliability was assessed using Cronbach's Alpha and Composite Reliability values greater than 0.70. Discriminant validity was evaluated using the Fornell–Larcker criterion. Furthermore, the structural model was evaluated using R-square ( $R^2$ ), predictive relevance ( $Q^2$ ), effect size ( $f^2$ ), and hypothesis testing.  $R^2$  was used to assess the explanatory power of the model, with values of 0.25, 0.50, and 0.75 indicating weak, moderate, and strong explanatory power, respectively. Predictive relevance was assessed using  $Q^2$ , with values greater than 0 indicating predictive relevance. Effect size was evaluated using  $f^2$ , with values of 0.02, 0.15, and 0.35 indicating small, medium, and large effects, respectively. Hypothesis testing was conducted through the bootstrapping procedure to assess the direct effects among variables, with the criteria of t-values greater than 1.96 and p-values below 0.05 (Hair Jr et al., 2021; Haryono, 2016).

## **Results and Discussion**

### **Descriptive Analysis**

The descriptive analysis was conducted using the respondent achievement level (TCR) to determine the achievement category of each research variable. The results show that all variables fall into the good category. Self-regulated learning had the highest TCR value at

77.04%, followed by digital literacy at 74.74%, peer collaboration at 73.87%, and Economics learning outcomes at 71.08%. These findings indicate that students generally showed good levels of self-regulated learning, digital literacy, peer collaboration, and Economics learning outcomes. However, Economics learning outcomes showed the lowest achievement level compared to the other variables, suggesting that students' academic achievement still needs to be strengthened despite relatively good learning conditions

**Table 1. Descriptive Analysis**

| Variable                          | Total Score | Ideal Maximum Score | Standard Deviation | Mean  | Respondent Achievement Level (%) | Category |
|-----------------------------------|-------------|---------------------|--------------------|-------|----------------------------------|----------|
| Economics Learning Outcomes (ELO) | 8814        | 12400               | 11.29              | 71.08 | 71.08                            | Good     |
| Digital Literacy (DL)             | 2317        | 3100                | 2.94               | 18.69 | 74.74                            | Good     |
| Peer Collaboration (PC)           | 1832        | 2480                | 2.48               | 14.77 | 73.87                            | Good     |
| Self-Regulated Learning (SRL)     | 1433        | 1860                | 1.78               | 11.56 | 77.04                            | Good     |

#### Measurement Model (Outer Model)

The initial stage of partial least squares structural equation modeling involves evaluating the measurement model, which aims to ensure that each construct in the study meets the criteria of validity and reliability. This evaluation is essential to ensure that each indicator measures the construct consistently and accurately, so that the results of the structural model analysis can be interpreted validly.

#### Convergent Validity

The convergent validity test results showed that, in the first stage, several indicators were still considered invalid because their outer loading values were below 0.70, namely the information and data literacy indicator in digital literacy, the knowledge exchange indicator in peer collaboration, and the forethought (goal setting/planning) indicator in self-regulated learning. After these indicators were eliminated, all indicators in the second stage had outer loading values greater than 0.70, and each construct had an Average Variance Extracted (AVE) value greater than 0.50. Therefore, all constructs in the final model were considered to have met the criteria for convergent validity. The validity results are presented in Table 2.

#### Discriminant Validity

Discriminant validity was assessed using the Fornell-Larcker criterion by comparing the square root of the Average Variance Extracted of each construct with its correlations with other constructs. The results show that the square root of the Average Variance Extracted for Economics learning outcomes, peer collaboration, digital literacy, and self-regulated learning are 1.000, 0.793, 0.759, and 0.848, respectively, all of which are higher than the correlations among constructs, as shown in Table 3. Thus, all constructs are considered to have met discriminant validity based on the Fornell-Larcker criterion.

#### Reliability Test

Reliability testing was conducted to assess the internal consistency of the indicators in measuring each research construct. The results show that all constructs had Composite Reliability values above 0.70, namely 0.845 for digital literacy, 0.835 for peer collaboration, and 0.836 for self-regulated learning. Therefore, all constructs were considered reliable, as presented in Table 2.



**Table 2. Results of Convergent Validity and Reliability Test**

| Variable                            | Indicator | Outer Loading | AVE   | Composite Reliability | Decision           |
|-------------------------------------|-----------|---------------|-------|-----------------------|--------------------|
| <b>Digital Literacy (DL)</b>        | DL1       | 0.769         | 0.628 | 0.845                 | Valid and reliable |
|                                     | DL3       | 0.744         |       |                       |                    |
|                                     | DL6       | 0.785         |       |                       |                    |
|                                     | DL7       | 0.739         |       |                       |                    |
| <b>Peer Collaboration (PC)</b>      | PC1       | 0.830         | 0.576 | 0.835                 | Valid and reliable |
|                                     | PC2       | 0.770         |       |                       |                    |
|                                     | PC5       | 0.776         |       |                       |                    |
| <b>Self-Regulated Learning (P2)</b> | SRL2      | 0.760         | 0.72  | 0.836                 | Valid dan reliable |
|                                     | SRL3      | 0.928         | 7     | -                     |                    |

**Table 3. Discriminant Validity (Fornell-Larcker Criterion)**

| Variabel   | ELO          | PC           | DL           | SRL          |
|------------|--------------|--------------|--------------|--------------|
| <b>ELO</b> | <b>1.000</b> |              |              |              |
| <b>PC</b>  | 0.692        | <b>0.793</b> |              |              |
| <b>DL</b>  | 0.713        | 0.608        | <b>0.759</b> |              |
| <b>SRL</b> | 0.257        | 0.125        | 0.184        | <b>0.848</b> |

### Structural Model (Inner Model)

After the measurement model met the required criteria, the next step was structural model evaluation. The structural model analysis was conducted to examine the model's ability to explain the relationships among latent constructs in accordance with the research hypotheses. This evaluation includes the assessment of R Square, Effect Size, Predictive Relevance, and the results of hypothesis testing, in order to determine the extent to which the exogenous variables explain the endogenous variable in the developed model.

### R Square (R<sup>2</sup>)

The coefficient of determination results shows that the R-square value for Economics learning outcomes is 0.628, meaning that 62.8% of the variance in Economics learning outcomes can be explained by digital literacy, peer collaboration, and self-regulated learning.

**Table 4. R-Square Results**

| Endogenous Variable | R-square | R-square Adjusted | Remark   |
|---------------------|----------|-------------------|----------|
| <b>ELO</b>          | 0.628    | 0.619             | Moderate |

### Effect Size (F<sup>2</sup>)

The effect size analysis indicates that digital literacy has a moderate effect on Economics learning outcomes, with a value of 0.328, while peer collaboration also has a moderate effect, with a value of 0.279. Meanwhile, self-regulated learning has a small effect on Economics learning outcomes, with a value of 0.039. These findings indicate that the largest contributions in the model come from digital literacy and peer collaboration in explaining Economics learning outcomes.

**Table 5. Effect Size Results F<sup>2</sup>**

| Variable   | ELO   | Decision               |
|------------|-------|------------------------|
| <b>ELO</b> | 0.000 | No effect              |
| <b>PC</b>  | 0.279 | Moderate effect on ELO |
| <b>DL</b>  | 0.328 | Moderate effect on ELO |
| <b>SRL</b> | 0.039 | Small effect on ELO    |

### Predictive Relevance ( $Q^2$ )

The  $Q^2$  analysis shows that the model has good predictive capability for Economics learning outcomes, as indicated by a value of 0.593. In addition, the prediction error values of the partial least squares structural equation modeling approach are smaller than those of the linear model, indicating that the predictive power of the model for Economics learning outcomes is good.

**Table 6.  $Q^2$  Result**

| Variable | $Q^2$ predict | PLS-SEM<br>RMSE | PLS-SEM<br>MAE | LM<br>RMSE | LM<br>MAE | Decision                       |
|----------|---------------|-----------------|----------------|------------|-----------|--------------------------------|
| ELO      | 0.593         | 7.243           | 5.987          | 7.422      | 6.052     | Has<br>predictive<br>relevance |

### Hypothesis Testing

The hypothesis testing results show that digital literacy had a positive and significant effect on Economics learning outcomes ( $\beta = 0.443$ ,  $t = 6.162$ ,  $p < .001$ ). Peer collaboration also had a positive and significant effect on Economics learning outcomes ( $\beta = 0.406$ ,  $t = 5.748$ ,  $p < .001$ ), while self-regulated learning had a positive and significant effect on Economics learning outcomes ( $\beta = 0.122$ ,  $t = 2.127$ ,  $p = .033$ ). These results indicate that all three hypotheses were supported. Therefore, students with better digital literacy, peer collaboration, and self-regulated learning tended to achieve higher Economics learning outcomes.

**Table 7. Hypothesis Testing Results**

|            | Original<br>sample<br>(O)/ $\beta$ | Sample<br>mean<br>(M) | Standard<br>deviation<br>(STDEV) | T statistics<br>( O/STDEV ) | P<br>values | Decision                 |
|------------|------------------------------------|-----------------------|----------------------------------|-----------------------------|-------------|--------------------------|
| PC-> ELO   | 0.406                              | 0.408                 | 0.071                            | 5.748                       | 0.000       | Positive and significant |
| DL-> ELO   | 0.443                              | 0.442                 | 0.072                            | 6.162                       | 0.000       | Positive and significant |
| SRL -> ELO | 0.122                              | 0.120                 | 0.058                            | 2.127                       | 0.033       | Positive and significant |

### Discussion

The findings of this study show that digital literacy, peer collaboration, and self-regulated learning influence students' Economics learning outcomes. However, these three variables did not contribute equally. Digital literacy and peer collaboration had more dominant effects, whereas self-regulated learning had a smaller effect. This pattern indicates that the Economics learning outcomes of eleventh-grade students at SMAN 5 Kota Jambi were more strongly explained by direct and contextual learning support, such as the use of digital resources and academic interaction with peers, than by students' independent learning ability that relies on self-regulation.

Digital literacy became the most dominant factor because Economics learning in the digital era is strongly related to students' ability to access, select, understand, and use information from various digital sources. Economics materials do not only consist of theoretical concepts, but are also related to current socio-economic phenomena, data, market issues, consumption, production, inflation, and economic problems commonly found in everyday life. Therefore, students with better digital literacy tend to find additional learning resources more easily, understand current economic issues, and compare information from various sources. The dominance of digital literacy can also be explained by the fact that digital literacy supports digital learning, self-efficacy, digital competence, and students' academic achievement (Holm, 2025; Zakir et al., 2025). In the context of Economics



learning, this finding is reinforced by Adha (2022), who showed that students' ability to use digital technology is associated with improved Economics learning outcomes.

In the context of SMAN 5 Kota Jambi, the dominance of digital literacy can be understood from the condition of students' Economics learning outcomes, which had not yet reached an optimal level. Since more than half of the students had not achieved the minimum mastery criterion based on the preliminary data, the ability to use digital learning resources becomes important because it can help students obtain additional explanations, actual examples, and more diverse sources of information. In other words, digital literacy not only helps students access learning materials, but also helps them build a more contextual understanding of economic phenomena. This makes digital literacy the strongest factor in explaining Economics learning outcomes.

Peer collaboration also made a strong contribution because Economics learning often requires students to discuss, compare opinions, test arguments, and solve problems together. In the learning process, students do not always understand Economics concepts only through teacher explanations or teaching materials. They often need interaction with peers to clarify concepts, correct misunderstandings, and build understanding through language that is closer to their way of thinking. Asri et al. (2025), showed that the quality of interaction in collaborative learning is related to student outcomes and satisfaction among senior high school students in Indonesia. In addition, peer support, peer networks, and students' social relationships are associated with academic adjustment, learning engagement, satisfaction, and academic achievement (Tian & Lin, 2025).

The strong effect of peer collaboration at SMAN 5 Kota Jambi can also be related to the characteristics of learning that encourage discussion, group work, and joint task completion. In the context of the Merdeka Curriculum, learning is directed to be more student-centered and contextual, while also providing space for character development and more active learning activities. A more focused scope of learning materials gives teachers more room to use student-centered learning methods and allocate specific time for character development (Wahyudin et al., 2024). Therefore, when Economics learning in the classroom involves group discussions, projects, or context-based problem solving, peer collaboration becomes more visible in its influence than learning factors that are purely individual.

However, collaboration does not automatically produce good learning outcomes if it is not clearly guided. Peer effects in collaborative tasks may vary and can even be influenced by mechanisms such as free-riding and discouragement. Therefore, group work needs to be designed with clear role distribution, individual responsibility, and academic goals so that collaboration truly supports students' understanding (Hidalgo-hidalgo & López, 2026). In the context of this study, the strong effect of peer collaboration indicates that interaction among students has great potential to support Economics learning outcomes, but it still requires teacher guidance so that group activities do not merely become task distribution, but rather a process of mutual learning.

In contrast, self-regulated learning had the smallest effect compared to digital literacy and peer collaboration. Empirically, this indicates that students' ability to regulate their own learning process did not contribute as strongly as digital and social support in explaining Economics learning outcomes. This does not mean that self-regulated learning is unimportant. Rather, it suggests that students' ability to plan, monitor, and evaluate their learning process has not yet fully become a strong and consistent learning habit. Students may still tend to depend on teacher guidance, task structures, school schedules, and peer assistance. Thus, although students may have self-regulation abilities, these abilities are not necessarily applied independently in their daily learning activities.





The smaller effect of self-regulated learning can also be explained by the nature of SRL, which requires practice and support. SRL does not automatically emerge simply because students are given assignments or access to learning resources. Aksela et al. (2025), emphasized the importance of examining the SRL strategies that students actually apply while completing tasks, rather than relying only on general perceptions of independent learning ability. This finding is also supported by Faza & Lestari, (2025), who showed that self-regulated learning, self-regulation strategies, and volitional control are positively related to academic success, competence gain, and academic achievement across different educational levels. Therefore, the low contribution of SRL in this study can be understood as an indication that students' independent learning ability may not yet be fully internalized in their actual learning behavior. Although its contribution was the smallest, self-regulated learning remains an important internal factor in explaining students' academic success.

## Conclusion

This study concludes that digital literacy, peer collaboration, and self-regulated learning are significant predictors of students' Economics learning outcomes. Among these three variables, digital literacy makes the strongest contribution, followed by peer collaboration, while self-regulated learning also contributes positively, although with a smaller effect. These findings indicate that students' learning outcomes are not shaped by a single factor, but rather by the combination of digital competence, academic interaction with peers, and the ability to manage the learning process independently. Therefore, improving Economics learning outcomes requires strengthening students' ability to use digital resources effectively, collaborate meaningfully with peers, and regulate their learning process in a more focused and strategic manner.

## Recommendation

Based on the research findings, several recommendations can be proposed. Since digital literacy had the strongest influence on Economics learning outcomes, Economics teachers should design learning activities that train students to search, evaluate, and use digital information critically, such as comparing economic information from different digital sources, analyzing current economic issues, and relating digital information to concepts learned in class. Peer collaboration should also be strengthened through structured group discussions, contextual problem-solving tasks, and peer explanation activities with clear roles, shared goals, and individual accountability.

In addition, self-regulated learning needs to be developed more systematically through learning targets, study plans, progress checklists, reflection sheets, and short self-evaluation activities so that students can gradually build independent learning habits. For schools, it is important to provide access to digital learning resources, internet-supported learning spaces, and teacher support for implementing digital, collaborative, and reflective Economics learning. Future researchers are encouraged to examine other variables, such as learning motivation, self-efficacy, teacher support, learning engagement, or family environment, and to involve broader samples or different educational contexts to obtain a more comprehensive understanding of factors affecting Economics learning outcomes.

## References

- Acosta, A. M., Regnault, M. D. A., Vargas-cano, E., & Cárdenas-cobo, J. (2024). Assessment of digital competencies in higher education students: Development and validation of a measurement scale. *Frontiers in Education*, 9, 01–09. <https://doi.org/10.3389/feduc.2024.1497376>

- Adha, A. M. (2022). The effect of self-regulated learning and digital literacy on the learning outcomes of economics subjects in students with self-efficacy as an intervening variable. *Jurnal Of Economic Education, Office And Accounting(JPEPA)*, 3(3), 3–17. <https://doi.org/https://doi.org/10.21009/jpepa.0303.20>
- Aksela, O., Lämsä, J., & Järvelä, S. (2025). Secondary school students' enacted self-regulated learning strategies in a computer-based writing task-insights from digital trace data and interviews. *Technology, Knowledge and Learning*, 30, 1727–1756. <https://doi.org/10.1007/s10758-024-09789-4>
- Arthur, F., Yidana, M. B., & Acquah, B. Y. S. (2025). Self-regulated learning among higher education economics students: Does gender and academic level matter? *Cogent Education Taylor & Francis*, 12(1), 1–22. <https://doi.org/10.1080/2331186X.2025.2579351>
- Asri, A., Badaruddin, B., & Idris, M. (2025). Relational and cognitive dynamics in collaborative learning: Lessons from Pancasila integration in Indonesia. *Frontiers in Education*, 10, 1–10. <https://doi.org/10.3389/feduc.2025.1572715>
- Bach, A., & Thiel, F. (2024). Collaborative online learning in higher education-quality of digital interaction and associations with individual and group-related factors. *Frontiers in Education*, 9, 1–12. <https://doi.org/10.3389/feduc.2024.1356271>
- Barz, N., & Dörrenbächer-ulrich, L. (2024). Fostering self-regulated learning using synchronous or asynchronous digital learning environments: A latent profile analysis of pre-service teachers' individual differences. *Frontiers in Education*, 9, 1–14. <https://doi.org/10.3389/feduc.2024.1445182>
- Bhardwaj, V., Zhang, S., Tan, Y. Q., & Pandey, V. (2025). Redefining learning: Student-centered strategies for academic and personal growth. *Frontiers in Education*, 10, 1–15. <https://doi.org/10.3389/feduc.2025.1518602>
- Burns, S., Yu, E., Brathwaite, L., Masum, M., White, L., Dhuey, E., & Perlman, M. (2024). Improving young children's peer collaboration in early educational settings: A systematic review. *Review of Education BERA*, 12(2), 1–34. <https://doi.org/10.1002/rev3.3484>
- Cagliesi, G., & Ghanei, M. (2022). Team-based learning in economics: Promoting group collaboration, diversity and inclusion. *The Journal of Economic Education*, 53(1), 11–30. <https://doi.org/10.1080/00220485.2021.2004276>
- Faza, A., & Lestari, I. A. (2025). Self-Regulated Learning in the Digital Age : A Systematic Review of Strategies , Technologies , Benefits , and Challenges. *International Review of Research in Open and Distributed Learning*, 26(2). <https://doi.org/https://doi.org/10.19173/irrodl.v26i2.8119>
- Gürbüz, M. Ç., Ozkul, R., & Sen, S. (2026). The relationship between peer learning and self-directed learning: The mediating role of collaborative leadership among pre-service mathematics teachers. *Frontiers in Psychology*, 17, 1–13. <https://doi.org/10.3389/fpsyg.2025.1724725>
- Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Springer. <https://doi.org/https://doi.org/10.1007/978-3-030-80519-7>
- Haryono, S. (2016). *Metode SEM Untuk Penelitian Manajemen AMOS LISREL PLS*. PT. Intermedia Personalia Utama.
- Hidalgo-hidalgo, M., & López, P. D. (2026). Partner effects and collaborative learning. *Labour Economics*, 98(December 2025), 102842. <https://doi.org/10.1016/j.labeco.2025.102842>
- Holm, P. (2025). Impact of digital literacy on academic achievement : Evidence from an online anatomy and physiology course. *E-Learning and Digital Media Sage*, 22(2), 139–155. <https://doi.org/10.1177/20427530241232489>
- Huang, L., Wang, R., & Han, J. (2024). Regulation of emotions in project-based collaborative learning : an empirical study in academic English classrooms. *Frontiers in Psychology*, June, 1–11.



<https://doi.org/10.3389/fpsyg.2024.1368196>

- Johnson, R. B., & Larry, C. (2014). *Educational research: Quantitative, qualitative, and mixed approaches* (Fifth edit, Vol. 17). SAGE Publications.
- Kolstø, S. D., Paulsen, H. V., & Mestad, I. (2024). Critical thinking in the making: Students' critical thinking practices in a multifaceted SSI project. *Cultural Studies of Science Education*, 19, 499–530. <https://doi.org/10.1007/s11422-024-10217-3>
- Kurniawan, A. (2022). *Metodologi Penelitian Pendidikan*. PT. Remaja Rosdakarya.
- Levy, feldman. I. (2025). The Role of Assessment in Improving Education and Promoting Educational Equity. *MDPI Education Series*, 15(224). <https://doi.org/https://doi.org/10.3390/educsci15020224>
- Li, F., Cheng, L., Wang, X., Shen, L., Ma, Y., & Islam, A. Y. M. A. (2025). The causal relationship between digital literacy and students' academic achievement: A meta-analysis. *Humanities and Social Sciences Communications*, 12(108), 1–12. <https://doi.org/10.1057/s41599-025-04399-6>
- Li, H. (2025). Impact of collaborative learning on student engagement in college English programs: Mediating effect of peer support and moderating role of group size. *Frontiers in Psychology*, 16, 1–11. <https://doi.org/10.3389/fpsyg.2025.1525192>
- Lieb, C., & Pickhardt, C. (2025). A didactic intervention to strengthen critical thinking in the interpretation of visualized data. *Frontiers in Education*, 10, 1–13. <https://doi.org/10.3389/feduc.2025.1680396>
- Loh, H. Sen, Jaarsveld, G. M. Van, Mesutoglu, C., & Baars, M. (2024). Supporting social interactions to improve MOOC participants' learning outcomes: A literature review. *Frontiers in Education*, 9, 1–13. <https://doi.org/10.3389/feduc.2024.1345205>
- Lourenco, A., & Pavia, M. O. (2024). Academic Performance of Excellence: The Impact of Self-Regulated Learning and Academic Time Management Planning. *Knowledge MDPI*, 4(2), 289–301. <https://doi.org/https://doi.org/10.3390/knowledge4020016>
- Mystakidis, S. (2021). Deep meaningful learning. *Encyclopedia MDPI*, 1(3), 988–997. <https://doi.org/https://doi.org/10.3390/encyclopedia1030075>
- Pan, F., Zhu, G., Sui, W., & Fu, M. (2024). The effects of peer interaction on learning outcome of college students in digital environment-The chain-mediated role of attitude and self-efficacy. *Studies in Educational Evaluation*, 83, 1–10. <https://doi.org/10.1016/j.stueduc.2024.101404>
- Pan, Q., Reichert, F., Liang, Q., & De, J. (2025). Measuring digital literacy across ages and over time: Development and validation of a performance-based assessment. *Education and Information Technologies*, 30, 22065–22100. <https://doi.org/10.1007/s10639-025-13592-8>
- Pansri, B., Sharma, S., Timilsina, S., Choonhapong, W., Kurashige, K., Watanabe, S., & Sato, K. (2024). Understanding Student Learning Behavior: Integrating the Self-Regulated Learning Approach and K-Means Clustering. *Education Series MDPI*, 14(12), 1–15. <https://doi.org/https://doi.org/10.3390/educsci14121291>
- Shao, Y., Kang, S., Lu, Q., Zhang, C., & Li, R. (2024). How peer relationships affect academic achievement among junior high school students: The chain mediating roles of learning motivation and learning engagement. *BMC Psychology*, 12(1), 1–12. <https://doi.org/10.1186/s40359-024-01780-z>
- Supriyadi, & Amalia, A. N. (2026). Artificial intelligence integration and students' digital literacy as determinants of learning outcomes in an economics education assessment course. *JURNAL PENDIDIKAN EKONOMI & BISNIS*, 13(1), 118–128. <https://doi.org/doi.org/10.21009/JPEB.013.1.8>
- Syamiya, E. N., Lestari, S., Wulandari, D., & Ekawati, D. (2022). Digital Literacy Analysis on Online Learning Outcomes for Macroeconomics with Gender-Mediated and Family Socio-Economics as Moderating Variables. *Jurnal Kependidikan: Jurnal Hasil Penelitian Dan Kajian*



- Kepustakaan Di Bidang Pendidikan, Pengajaran Dan Pembelajaran*, 8(2), 450–459.  
<https://doi.org/https://doi.org/10.33394/jk.v8i2.5065>
- Tang, H., & Shen, L. (2026). Peer collaborative learning and academic engagement in university libraries: A moderated mediation model and latent profile analysis. *Frontiers in Psychology*, 16, 1–13. <https://doi.org/10.3389/fpsyg.2025.1759026>
- Tian, J., & Lin, J. (2025). From social to academic: Associations and predictions between different types of peer relationships and academic performance among college students. *Applied Sciences*, 15(5), 1–18. <https://doi.org/https://doi.org/10.3390/app15052262>
- Tinajero, C., Mayo, M. E., Villar, E., & Martínez-lópez, Z. (2024). Classic and modern models of self-regulated learning: Integrative and componential analysis. *Frontiers in Psychology*, 15, 1–19. <https://doi.org/10.3389/fpsyg.2024.1307574>
- Tohani, E., & Aulia, I. (2022). Effects of 21st Century Learning on the Development of Critical Thinking, Creativity, Communication, and Collaboration Skills. *Journal of Nonformal Education*, 8(1), 46–53. <https://doi.org/https://doi.org/10.15294/jne.v8i1.33334>
- UNESCO. (2018). *A global framework of reference on digital literacy skills for indicator 4.4.2*. United Nations Educational, Scientific and Cultural Organization. <https://unesdoc.unesco.org/ark:/48223/pf0000265403>
- Uus, Ö., Mettis, K., & Väljataga, T. (2022). Self-directed learning: A case-study of school students scientific knowledge construction outdoors. *Cogent Education*, 9(1). <https://doi.org/10.1080/2331186X.2022.2074342>
- Vodă, A. I., Cautisanu, C., Grădinaru, C., Tănăsescu, C., & de Moraes, G. H. S. M. (2022). Exploring Digital Literacy Skills in Economics and Social Sciences and Humanities Students. *Sustainability (Switzerland)*, 14(5), 1–31. <https://doi.org/10.3390/su14052483>
- Wahyudin, D., Subkhan, E., Malik, A., Hakim, M. A., Sudiapermana, E., LeliAlhapip, M., Nur Rofika Ayu Shinta Amalia, L. S., Ali, N. B. V., & Krisna, F. N. (2024). Kajian Akademik Kurikulum Merdeka. In *Kemendikbud* (Edisi 1). Pusat Kurikulum dan Pembelajaran Badan Standar, Kurikulum, dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi (Kemendikbud).
- Xu, X., & Yu, C. (2025). Understanding self-regulated learning through Redit analysis: an in-depth study of graduate students' perceptions. *Frontiers in Education*, 10, 1–11. <https://doi.org/10.3389/educ.2025.1609448>
- Yahya, M. slamet. (2023). Transformasi Pendidikan Agama Islam di Era Digital: Implementasi Literasi Digital dalam Pembelajaran di Wilayah Banyumas. *EDUKASIA: Jurnal Pendidikan Dan Pembelajaran*, 4(1), 609–616. <https://doi.org/10.62775/edukasia.v4i1.317>
- Yuan, N., Yu, Q., & Liu, W. (2025). The impact of digital literacy on learning outcomes among college students: the mediating effect of digital atmosphere, self-efficacy for digital technology and digital learning. *Frontiers in Education*, 10(August), 1–11. <https://doi.org/10.3389/educ.2025.1641687>
- Zakir, S., Hoque, M. E., Susanto, P., Nisaa, V., Alam, K., Khatimah, H., & Mulyani, E. (2025). Digital literacy and academic performance: The mediating roles of digital informal learning, self-efficacy, and students' digital competence. *Frontiers in Education*, 10, 1–13. <https://doi.org/10.3389/educ.2025.1590274>
- Zimmerman, B. J., & Schunk, D. H. (2013). Self-Regulated Learning and Academic Achievement: Theoretical Perspectives, Second Edition. In *Self-Regulated Learning and Academic Achievement: Theoretical Perspectives, Second Edition*. <https://doi.org/10.4324/9781410601032>