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Enhancing High School Students' Investment Skills and Risk Management Through Capital Market Simulation with Virtual Trading

Mauliana Wayudi[1]*, Rizki Aria[2], Aidil Akbar[3], Raisah[4], Sarah Adilla[5]
[1,5]Economic Education, Universitas Almuslim Aceh, Indonesia
[2]Elementary School Teacher Education Program, Universitas Almuslim Aceh, Indonesia
[3]Economic Education, Universitas Syiah Kuala Aceh, Indonesia
* maulianawayudi@umuslim.ac.id

Abstract

This study examines the effectiveness of virtual trading–based capital market simulations in improving high school students' investment and risk management skills, addressing the persistently low level of financial literacy among Indonesian adolescents. Using a quantitative approach with a quasi-experimental nonequivalent control group design, this research involved an experimental group that learned through virtual trading simulations and a control group that received conventional instruction. Data were collected through pretests and posttests and analyzed using normality and homogeneity tests, paired sample *t*-tests, and ANCOVA ($\alpha = 0.05$). The results indicate that students who participated in virtual trading simulations experienced a significantly greater improvement in investment and risk management skills than those in the conventional learning group. These findings suggest that simulation-based learning enhances students' critical and practical thinking by providing experiential exposure to real-world investment decision-making. Accordingly, integrating virtual trading simulations into economic education can serve as an effective instructional strategy to better prepare students for real-life financial challenges. However, this study has limitations in terms of contextual scope, as it was conducted in only one school, which may affect the generalizability of the findings to broader educational settings.

Keywords: Investment Skill, Quasi-Experimental, Risk Management, Simulation-Based Learning, Virtual Trading.

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INTRODUCTION

In education, particularly in the fields of science and economics, the development of critical and analytical thinking skills is a crucial aspect of learning. The ability of students to identify complex problems, choose the appropriate solution methods, and formulate effective and measurable outcomes is a highly valued competency, both in academic and professional contexts (Ahdika, 2017). This is also emphasized by Brous (2017), who states that analytical skills are among the most sought-after competencies by the employers.

As more applied learning approaches continue to develop, the use of stock market simulators has become an innovative method to support financial education. These simulators provide hands-on experience in managing investments within the capital market without real financial risks, enabling students to understand market dynamics more effectively (Marriot et al., 2015). In addition to introducing fundamental investment concepts, this approach also trains students to manage risks through portfolio diversification (Patil et al., 2024). Pierce (2021) further highlights that stock trading simulations can strengthen learning in management and strategy, as they encourage students to make analytical and data-driven investment decisions.

The need for this type of learning process has become increasingly urgent due to the low level of financial literacy in Indonesia. According to data from the S&P Global FinLit Survey cited by the the Financial Services Authority of Indonesia (OJK) (2024), low-income countries, including Indonesia, continue to record relatively low financial literacy scores. Indonesia's Financial Fitness Index is only 37.72, far behind Singapore's score of 61. Furthermore, public participation in investment products such as stocks and mutual funds remains limited, with only about 8% of Indonesians engaging in these instruments (OCBC NISP, 2023).

The survey revealed that individuals who perceive wealth in terms of investment tend to have higher levels of financial literacy than those who wealth as owning luxury brands. Nevertheless, the main sources of investment information are mass media and social media, while teachers' involvement in educating students about finance-related issues is relatively low, at only around 5% (Wijoyo et al., 2024).

This case indicates an urgent need for a learning strategy that bridges a gap between theory and practice, particularly in enhancing students' understanding and skills in finance from an early age. The urgency of this study grounded in Survey of Financial Literacy and Inclusion (SNLIK) results (Santosa et al., 2024), teenagers aged approximately 15 to 17, are known for their lower levels of financial literacy, while understanding of the capital market has even declined in recent years. This study is particularly important because high school students are in a transitional stage toward financial independence.

Virtual trading, an alternative learning method, has ability to integrate the theory and practice. Marriot et al. (2015) demonstrated the effectiveness of market-share simulation in financial education. Similarly, Chulkov & Wang (2020) suggested that the simulation provides greater educational value than traditional teaching methods. The findings are also aligned with Wijoyo et al. (2024), showing the use of virtual trading in senior high school significantly increases students' understanding of investment risk.

The state of the art in this study is the enhancement of high school students' investment and risk management skills through a capital market simulation based on virtual trading. Improving financial literacy and critical thinking skills has become an important focus of research in economic education. The previous study by Wayudi et al. (2023) illustrated that senior high school students' critical thinking continues to decline, highlighting the need for more practical and contextual learning strategies.

Subsequent research has concluded that problem-solving and problem-based learning markedly develop students' critical thinking skills when they are confronted with real-world problems (Wayudi et al., 2023). Furthermore, Tiara et al. (2024) utilized the Educational Gallery of Investment and found an improvement

in financial literacy, while Gunardi et al. (2020)demonstrated that the capital market literacy considerably affects the students' investment decision-making.

Additionally, Ferdiansyah et al. (2024)underscored that seminars and capital market simulations can enhance students' awareness of the importance of investing. Likewise, Nadapdap & Helmi (2023) affirmed that trading applications play a meaningful role in senior high schools by strengthening students' understanding of the capital market through direct engagement. However, few studies have integrated virtual trading supported by digital technology as the primary learning medium. Therefore, applying virtual trading-based learning in capital market education offers an innovative way to improve students' critical thinking, analytical skills, and risk management.

The objectives of this study are to examine: (1) the effect of using a capital market simulation based on virtual trading on investment skills; and (2) the effect of using a capital market simulation based on virtual trading on risk management skills.

RESEARCH METHOD

Research Design

This study employed a quasi-experimental quantitative design with a nonequivalent control group. See the followings:

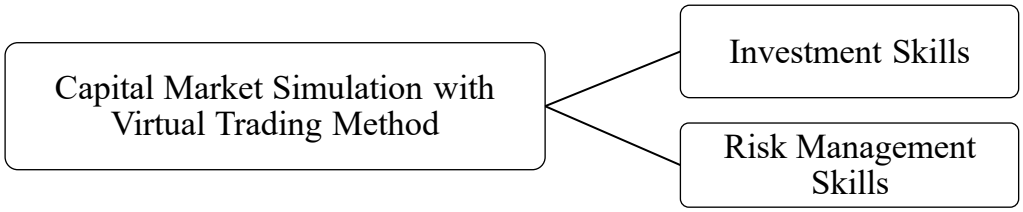

Figure 1. Research Design

Figure 1 illustrated the the design examining the effect of the Capital Market Simulation with Virtual Trading Method on students' Investment Skills and Risk Management Skills. The nonequivalent control group design was selected because it allows for a comparison of learning outcomes between the experimental and control groups, making it well aligned with the objectives of this study.

Data Collection

The participants were assigned to two groups, experimental and control, selected through purposive sampling based on comparable characteristics. Prior to the treatment, both groups completed a pretest to assess their initial skills in investment and risk management. The experimental group then received instruction through a capital market simulation using virtual trading, which involved activities such as virtual stock trading, risk analysis, and investment decision-making. The virtual trading platforms used in this study were Stockbit and Trading View. In contrast, the control group received conventional instruction without simulation. After the

intervention, both groups completed a posttest using an instrument equivalent to the pretest. The research design is presented as follows:

Table 1. Participants' Group

Group	Pretest	Treatement	Posttest
Experiment	0_1	X_1	0_1
Control	0_3	X_2	0_2

Descriptions:

0_1 = Initial measurement (pretest) for the experimental class

0_2 = Final measurement (posttest) for the eksperimental class

0_3 = Initial measurement (pretest) for the control class

0_4 = Final measurement (posttest) for the control class

X_1 = Capital market virtual trading simulation

X_2 = Conventional learning method

Analisis Data

The research data were collected through tests, observations, and documentation, and subsequently analyzed using SPSS. The analysis was conducted in several stages. First, prerequisite tests were performed, including a normality test (Kolmogorov–Smirnov, $p > 0.05$) and a homogeneity test (Levene's Test, $p > 0.05$), to ensure that the data met the assumptions for parametric analysis. Second, a paired-sample t-test was used to examine differences between pretest and posttest scores within each group. Third, ANCOVA was employed to assess the effect of the treatment while controlling for students' initial abilities (pretest), allowing the impact of the virtual trading simulation to be interpreted accurately.

RESULTS AND DISCUSSION

Result

The findings of this study directly address the research objectives by demonstrating the impact of capital market simulation-based learning through virtual trading on high school students' investment skills and risk management abilities. Specifically, the results show a significant improvement in students' investment skills in the experimental group after participating in virtual trading activities, compared to their performance prior to the intervention. In addition, when compared with the control group that received conventional instruction, students exposed to virtual trading exhibited superior risk management skills. These findings indicate that virtual trading-based learning is more effective than conventional learning in enhancing students' investment-related competencies, thereby answering the research questions regarding differences in learning outcomes between the two instructional approaches.

Description of Data

The data description is presented to provide an initial overview of the pretest and posttest results for investment and risk management skills in both the experimental and control classes.

Investment Skills

Students' investment skills are measured through pretests and posttests to evaluate the effectiveness of the learning intervention in the experimental and control groups. The analysis of minimum, maximum, and average scores from both groups gives a clear picture of how students' investment skills improve before and after the learning treatment. The following data show a detailed comparison of the pretest and posttest results for investment skills.

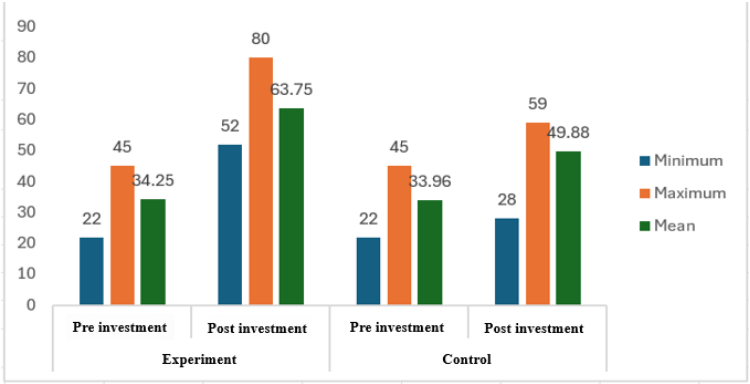

Figure 2. Investment Skill Data Descriptions

Based on the data in the figure, the average investment skill score of the experimental group increases from 34.25 in the pretest to 63.75 in the posttest. The control group also shows an improvement, but to a lesser extent, rising from 33.96 in the pretest to 49.88 in the posttest. These findings indicate that the treatment given to the experimental group has a greater impact on improving investment skills compared to the control group.

Risks Management Skills

The data description of risk management skills in this study is presented to show the minimum, maximum, and average (mean) scores for both the experimental and control groups. The data are displayed for the initial conditions (pretest) and after treatment (posttest), providing an initial picture of the differences in risk management skill achievement between the groups. A summary of these descriptive results is presented in Figure 3 below.

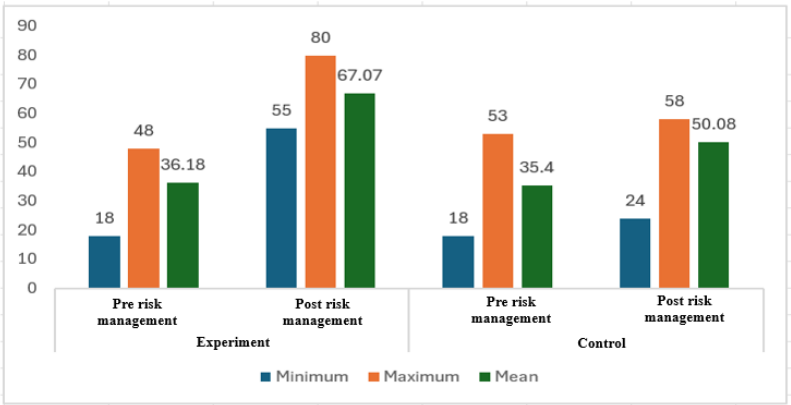

Figure 3. Risk Management Skills Data Descriptions

As shown in the figure 3, the average risk management skill score of the experimental group increases significantly from 36.18 in the pretest to 67.07 in the posttest. Meanwhile, the control group also shows an improvement, but to a lesser extent, rising from 35.4 in the pretest to 50.08 in the posttest. This indicates that the treatment given to the experimental group contributes more substantially to the improvement of risk management skills compared to the control group.

Normality Test

Before further analysis is conducted, a normality test is performed to determine whether the data are normally distributed and meet the assumptions required for the statistical tests used. The results of the normality test are presented as follows.

Table 2. Normality Test

	Kelas	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Pre-investment	Experimental Class	.113	28	.200*	.977	28	.766
	Controlled Class	.142	25	.200*	.980	25	.883
Post-investment	Experimental Class	.162	28	.056	.955	28	.261
	Controlled Class	.181	25	.035	.901	25	.019
Pre-risk management	Experimental Class	.169	28	.039	.940	28	.111
	Controlled Class	.110	25	.200*	.967	25	.558
Post-risk management	Experimental Class	.103	28	.200*	.973	28	.676
	Controlled Class	.232	25	.001	.829	25	.001

The Kolmogorov-Smirnov and Shapiro-Wilk normality tests show that most of the data have a significance value (Sig.) > 0.05, indicating normal distribution. This includes Pre-Investment (experimental and control groups), post-investment (experimental group), and both Pre- and Post-Risk Management (experimental and control groups in certain tests). However, some data groups show a significance value < 0.05, namely post-investment in the control group, Pre-Risk Management in the experimental group, and Post-Risk Management in the control group, indicating they are not normally distributed. Overall, the data distribution in this study tends to be normal, although deviations in some groups should be considered when selecting subsequent statistical tests.

Homogeneity Test

Homogeneity test is conducted to ensure the equality of variances between groups as a prerequisite for parametric analysis, thereby making the test results more valid and reliable.

Tabel 3. Homogeneity Test

	Levene's Test of Equality of Error Variances[a]			
	F	**df1**	**df2**	**Sig.**
Post Investment	1.054	1	51	.309
Post Risk Management	3.391	1	51	.071

The results of the homogeneity test, presented in Table 2, show that the significance values for both variables are greater than 0.05. This indicates that the data for both variables have homogeneous variances. Therefore, the assumption of homogeneity of variance is met, allowing parametric statistical analysis to be conducted in the subsequent stage.

Description of the Improvement in Investment Skills

This study involves two classes: a control class using conventional learning and an experimental class using capital market virtual trading simulations. Improvement in investment skills is analyzed using a paired sample t-test to examine the differences between pretest and posttest scores within each class, and ANCOVA to test the differences in improvement between the classes while controlling for initial scores. The results of the analysis are presented in the following table.

Table 4. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Eks	Pre Investasi - Post Investasi	-29.500	7.923	1.497	-32.572	-26.428	-19.701	27	.000
Kontrol	Pre Investasi - Post Investasi	-15.920	8.660	1.732	-19.495	-12.345	-9.192	24	.000

The results of the paired sample t-test show that both the experimental and control classes exhibit significant differences between pretest and posttest investment skill scores ($p < 0.001$). In the experimental class, the average increase reaches 29.50 points ($t = -19.701$; $p = 0.000$), while in the control class it is 15.92 points ($t = -9.192$; $p = 0.000$). This indicates that both learning models improve students' investment skills, but the improvement in the experimental class is greater than in the control class.

Table 5. Paired Samples Effect Sizes

			Standardizer[a]	Point Estimate	95% Confidence Interval Lower	Upper
Eks	Pre Investasi - Post Investasi	Cohen's d	7.923	-3.723	-4.773	-2.664
		Hedges' correction	8.035	-3.671	-4.706	-2.627
Kontrol	Pre Investasi - Post Investasi	Cohen's d	8.660	-1.838	-2.480	-1.182
		Hedges' correction	8.798	-1.809	-2.441	-1.164

The experimental class achieves a Cohen's d value of -3.723, which is categorized as a very large effect, while the control class has a Cohen's d of -1.838, also considered large but comparatively lower. Thus, learning through capital market virtual trading simulations not only results in significant improvement but also exerts a greater practical effect compared to conventional learning.

Table 6. Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	2546.618[a]	2	1273.309	26.593	.000	.515	53.185	1.000
Intercept	3169.140	1	3169.140	66.186	.000	.570	66.186	1.000
Kelas	2531.426	1	2531.426	52.868	.000	.514	52.868	1.000
Pre_Investasi	5.791	1	5.791	.121	.729	.002	.121	.063
Error	2394.099	50	47.882					
Total	178394.000	53						
Corrected Total	4940.717	52						

a. R Squared = .515 (Adjusted R Squared = .496)

The results of the ANCOVA show a significant effect of the treatment on students' investment skills after controlling for pretest scores (F = 52.868; p = 0.000). The Partial Eta Squared value of 0.514 indicates that the treatment accounts for approximately 51.4% of the variance in students' investment skills. Therefore, it can be concluded that learning through capital market virtual trading simulations is significantly more effective in improving investment skills compared to conventional learning.

Description of the Improvement in Risk Management Skills

The improvement in students' risk management skills was measured by comparing their initial and final scores after the treatments were administered to both the experimental and control classes. The measurement results are presented in the Paired Samples Test table, Effect Sizes, and Between-Subjects Effect to illustrate the effectiveness of the simulation in enhancing students' risk management skills.

Table 7. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Exp.	Pre and Post Risk Management	-30.893	7.666	1.449	-33.865	-27.920	-21.324	27	.000
Control	Pre and Post Risk Management	-14.680	9.793	1.959	-18.722	-10.638	-7.496	24	.000

Based on the results of the Paired Samples Test, there was a significant improvement in risk management skills in both classes. In the experimental class, the mean score increased by 30.89 ($t = 21.324$; $df = 27$; $p < .001$), while in the control class, it increased by 14.68 ($t = 7.496$; $df = 24$; $p < .001$). These results indicate that the capital market simulation learning based on virtual trading in the experimental class was more effective in enhancing students' risk management skills compared to conventional learning in the control class.

Table 8. Paired Samples Effect Sizes

					95% Confidence Interval	
			Standardizer[a]	Point Estimate	Lower	Upper
Exp.	Pre and Post Risk Management	Cohen's d	7.666	-4.030	-5.156	-2.894
		Hedges' correction	7.774	-3.974	-5.084	-2.854
Control	Pre and Post Risk Management	Cohen's d	9.793	-1.499	-2.067	-.916
		Hedges' correction	9.949	-1.476	-2.035	-.902

The effect size analysis revealed that the improvement in risk management skills in the experimental class had a very large effect, with Cohen's d = 7.666 and Hedges' correction = 7.774, indicating a strong treatment effect. In contrast, the control class showed a moderate effect, with Cohen's d = 0.793 and Hedges' correction = 0.949. These findings reaffirm that the simulation-based learning in the experimental class was more effective in enhancing students' risk management skills compared to conventional learning.

Table 9. Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	4088.738[a]	2	2044.369	38.456	.000	.606	76.911	1.000
Intercept	4444.690	1	4444.690	83.607	.000	.626	83.607	1.000
Kelas	3690.625	1	3690.625	69.422	.000	.581	69.422	1.000
Pre_M.Risiko	275.605	1	275.605	5.184	.027	.094	5.184	.608
Error	2658.092	50	53.162					
Total	191594.000	53						
Corrected Total	6746.830	52						

a. R Squared = .606 (Adjusted R Squared = .590)

The results of the Tests of Between-Subjects Effects showed a significant difference in post-test scores of risk management skills between the experimental and control classes after controlling for pre-test scores ($F(1,50) = 69.422$; $p < .001$; Partial $\eta^2 = 0.581$). The overall regression model was significant ($F(2,50) = 38.456$; $p < .001$), with a substantial contribution of variables to the variability of post-test

scores (R^2 = 0.606; Adjusted R^2 = 0.590). These findings confirm that the simulation-based learning in the experimental class was more effective in enhancing students' risk management skills than conventional learning in the control class, although the students' initial scores (pre-test) also had a significant effect ($F(1,50) = 5.184$; $p = .027$; Partial $\eta^2 = 0.094$).

Discussion

The results of this study indicate that capital market simulation learning based on virtual trading significantly improved students' investment and risk management skills compared to conventional instruction. In investment skills, the experimental class showed a mean increase of 29.50 ($t = 19.701$; $df = 27$; $p < .001$) with a very large effect size (Cohen's d = 7.923; Hedges' correction = 8.035), while the control class improved by 15.92 ($t = 9.192$; $df = 24$; $p < .001$) with a moderate effect (Cohen's d = 0.660; Hedges' correction = 0.798). These findings confirm that simulation-based learning was more effective in enhancing students' technical competence in investment.

Similarly, students' risk management skills in the experimental class increased more substantially than those in the control class, with Cohen's d values of 7.666 and 0.793, respectively. The Between-Subjects Effects analysis also revealed a significant difference in post-test scores between the experimental and control groups, even though students' pre-test scores had a smaller influence. This suggests that the observed improvements in students' skills were largely attributable to the learning method applied.

Previous studies also support these findings. Kosasih & Juhana (2025)found that game-based learning enhanced students' investment skills through safe interaction and practical experience. Likewise, Lukman et al. (2023) reported that simulation-based instruction improved students' learning outcomes in disaster mitigation topics, aligning with the observed improvement in risk management skills in this study. Furthermore, Musadat et al. (2024) demonstrated that financial literacy education and stock investment simulations increased students' understanding and interest in personal financial management and investment, reinforcing the present finding of improved investment competence. Collectively, these studies strengthen the evidence that simulation is an effective medium for developing analytical skills and decision-making abilities in economic contexts.

Moreover, the significant improvement observed in the experimental class suggests that simulation provides a more practical and contextual learning experience. This method allows students to encounter risk scenarios resembling real-world conditions, thereby fostering their ability to evaluate risks and make informed decisions simultaneously. Such a learning approach aligns with Kolb's (2015) experiential learning theory, which emphasizes the importance of hands-on practice in acquiring complex skills.

The pedagogical implications of these findings highlight that the teaching of economics and investment should not rely solely on theoretical instruction but also integrate simulation methods that stimulate students' practical skills and critical thinking. Simulation-based learning can enhance student engagement, motivation, and their ability to apply investment and risk management concepts in real-world contexts, ultimately improving the overall quality of economic education.

In conclusion, this study provides empirical evidence that simulation-based learning is an effective method for improving students' investment and risk management skills. It can serve as an alternative pedagogical approach for educators to strengthen students' conceptual understanding and practical competence, better preparing them to face real-world economic and financial challenges.

CONCLUSION

This study confirms that capital market simulation learning based on virtual trading makes a significant contribution to improving senior high school students' investment and risk management skills. Through the implementation of this method, students not only gain theoretical understanding but also acquire practical and applicable experiences in navigating capital market dynamics. The findings show that students who engaged in virtual trading simulations demonstrated substantially greater improvement in their skills compared to those who participated in conventional learning. These results indicate that the integration of digital technology and simulation in economics education can effectively bridge the gap between theory and practice, an ongoing challenge in enhancing financial literacy among adolescents. In addition to providing a deeper understanding of investment and risk management concepts, simulation-based learning also fosters the development of students' critical and analytical thinking skills. This experiential learning approach enables students to engage in direct decision-making within scenarios that closely resemble real-world conditions, thereby enhancing their preparedness to face contemporary economic challenges. The practical implication of this study underscores the importance of integrating innovative learning methods such as virtual trading into the curriculum to prepare young generations to become intelligent investors capable of managing risks effectively. Consequently, the implementation of technology-based capital market simulations not only enriches the learning process but also holds the potential to improve the overall quality of human resources in the financial sector more broadly.

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