

Virtual Economy Simulation Model (VESM): Interactive Learning Innovation in Introductory Economics Courses

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Received: November 05, 2025; **Revised:** January 30, 2026; **Accepted:** February 10, 2026

Abstract: The development of digital technology has driven learning innovation in the Introduction to Economics course, especially in vocational education. This study aims to develop a Virtual Economy Simulation Model (VESM) as an interactive learning medium based on scenario-based learning designed to improve the market analysis skills of 70 students of Office Administration Education, Offering A and E, class of 2024. The research method uses the Borg & Gall Research and Development (R&D) model modified into seven stages, including needs analysis, design, prototype development, expert validation, limited trials, field trials, and product revisions. The research instruments include economic knowledge tests, market analysis task performance, and a System Usability Scale (SUS) questionnaire. The content validity results show a CVI of 0.89 (high category). The field trial resulted in a significant increase in pre-test to post-test scores in both groups with an N-gain of Offering A of 0.63 while Offering E was 0.66 with an effect size of Cohen's $d = 1.59$. The average SUS score reached 86.2 (excellent), while qualitative data showed that 92% of students considered VESM to be helpful in understanding economic concepts realistically. These findings indicate that VESM is effective in improving market analysis skills, learning engagement, and theory-practice integration. This model has the potential to be widely adopted in economics teaching in higher education.

Keywords: virtual economy simulation model, interactive learning, market analysis, higher education, scenario-based learning

How to Cite: Andayani, E., Nurfaizana, D. R., Yudiono, U., Hariani, L. S., & Hutagalung, F. D. (2026). Virtual Economy Simulation Model (VESM): Interactive Learning Innovation in Introductory Economics Courses. *Journal of Economic Education and Entrepreneurship Studies*, 7(1), 51–60. <https://doi.org/10.62794/je3s.v7i1.21>

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INTRODUCTION

The development of digital technology has driven a major transformation in learning methods in higher education, including in the Introduction to Economics course. In the context of vocational education, such as the Office Administration Education Study Program, market analysis skills and an understanding of economic mechanisms are not merely theoretical but must be practically applicable in simulations that approximate reality (authentic learning contexts) (Kolb,

2015). However, economics instruction at the elementary level often still uses conventional methods such as lectures and practice exercises, which have proven ineffective in developing problem-solving and market decision-making skills (Nguyen et al., 2020).

Although various studies have proposed the use of game-based learning or simulation-based learning, most existing models are still generic and have not been specifically designed for the needs of office administration students, who must understand market dynamics as part of their business administration competencies (Huang et al., 2021). The research gap lies in the limited development of economic simulation models that combine virtual market scenarios, interactive roles, and market analysis skill evaluation indicators that align with the characteristics of office administration vocational students in Indonesia.

The specific problems identified were: (1) low student engagement in learning economic theory due to a lack of contextual and interactive approaches; (2) limited learning media that can simulate real-time market dynamics based on office business scenarios; and (3) the absence of an integrated evaluation instrument capable of measuring improvements in market analysis skills before and after simulation-based learning. These conditions result in students not being able to optimally connect economic theory with business administration practices, which in turn affects their readiness to face the challenges of the world of work (Purwanto & Santoso, 2022).

Based on this background, this study proposes the development of a Virtual Economy Simulation Model (VESM) that combines scenario-based learning, virtual market transaction simulations, and user interaction data-based performance analytics. This model is expected to bridge the gap between theory and practice and improve the market analysis skills of Office Administration Education students in the 2024 intake, Offerings A and E.

METHOD

This research uses a Research and Development (R&D) approach with the Borg & Gall model modified into seven stages, including: (1) needs analysis, (2) design planning, (3) development of the initial VESM prototype, (4) expert validation, (5) limited trials, (6) field trials, and (7) final product revision. The needs analysis stage was carried out through lecture observations and interviews with the lecturers to identify weaknesses in existing learning methods.

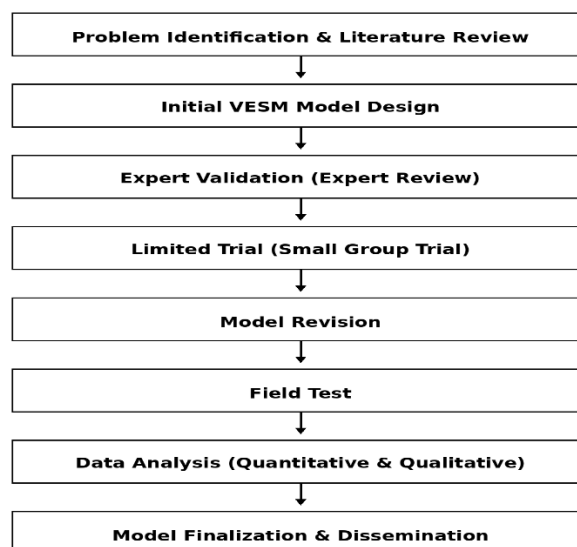


Figure 1. VESM Model Development Method

The product developed is a web-based VESM application with simulation scenarios that display the dynamics of supply and demand, price fluctuations, the influence of external factors (inflation, monetary policy), and the impact of market player decisions. Expert validation was carried out by economists, learning experts, and educational technology experts. A limited trial involving 10 students from Offering A was conducted to assess the clarity of the simulation flow and ease of use. Field trials were conducted on all 70 students from Offerings A and E using a quasi-experimental design with a pretest-posttest.

The research instruments included a validation sheet, a case study-based market analysis skills test, and a student response questionnaire. Data were analyzed using descriptive statistics for feasibility and practicality, and a paired sample t-test to measure the model's effectiveness in improving market analysis skills.

RESULTS AND DISCUSSION

Research Results

Product Development

The development of the Virtual Economy Simulation Model (VESM) resulted in an interactive learning medium that combines basic economic concepts with gamification-based virtual market simulations. This product is designed for Office Administration Education students in the 2024 intake, Offerings A and E (a total of 70 students), taking the Introduction to Economics course. Content analysis was conducted to ensure that the material presented was relevant, comprehensive, and aligned with the course's learning outcomes.

VESM content is structured based on established curriculum and learning outcomes, with a focus on market analysis competencies, economic decision-making, and understanding supply-demand dynamics. The content structure includes: 1) Basic Economic Concepts: an introduction to micro- and macroeconomic theory, key terminology, and free market principles, 2) Virtual Market Scenarios: role-playing-based simulations that reflect price dynamics, inflation, and competition among market participants, 3) Dynamic Economic Conditions: real-time integration of market events such as interest rate changes, monetary policy, and supply chain disruptions to test students' adaptability, 4) Strategic Decision Making: practice modules for analyzing market data, setting prices, managing inventory, and predicting demand trends.

Content analysis shows that the VESM material has a completeness level of 92% of the total expected learning indicators based on the content validity rubric, with a Content Validity Index (CVI) of 0.89, which is considered high. VESM integrates the material in a scaffolded manner, starting from the introduction of concepts to complex simulations. Each learning stage is followed by immediate feedback to strengthen understanding. For example, in the initial stage, students are given material on the law of supply and demand, then immediately applied in a simulation of price increases due to stock shortages. In addition, this module is equipped with a data dashboard that displays economic indicators such as the consumer price index (CPI), trading volume, and profit ratio, making it easier for students to monitor the impact of their decisions in the virtual market.

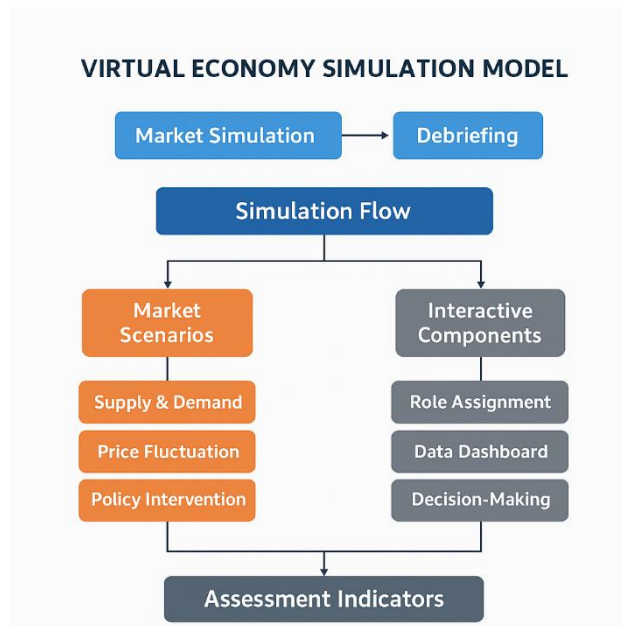


Figure 2. VESM Model Development Design

VESM Product Trial Results

The Virtual Economy Simulation Model (VESM) product trial was conducted on Office Administration Education students from the 2024 Offering A (35 students) and Offering E (35 students) in the Introduction to Economics course. The trial aimed to evaluate the effectiveness of VESM in improving understanding of economic concepts and decision-making skills. A quasi-experimental design with a pre-test, post-test, and control group model was used. The assessment instruments included an economic knowledge test (30 objective questions), a market analysis performance task, and a student response questionnaire. The trial lasted 4 meetings (8 effective face-to-face hours).

The results of the pre-test and post-test measurements showed a significant increase in both test groups.

Table 1. Improvement in Economic Knowledge Test Scores

Group	Pre-test Average	Post-test Average	Increase (%)	<i>N-Gain</i>
A Offering	61.40	86.20	40.38	0.63 (medium-high)
E Offering	62.10	88.00	41.68	0.66 (medium-high)

Source: Processed data, 2024

The pretest results showed an average of 62.1 points for students' market analysis skills with a standard deviation of 9.8, while the posttest results increased to 82.6 points with a standard deviation of 8.7. This 20.5-point increase demonstrates the effectiveness of the Virtual Economic Simulation Market (VESM) model in improving understanding of economic concepts in the Introduction to Economics course. The effect size calculation yielded a Cohen's *d* value of 1.59, which is categorized as a large effect in the context of educational research (Lakens, 2013). The

independent t-test analysis showed a t value of 5.43, $p < 0.001$, indicating a significant difference between the pre-test and post-test.

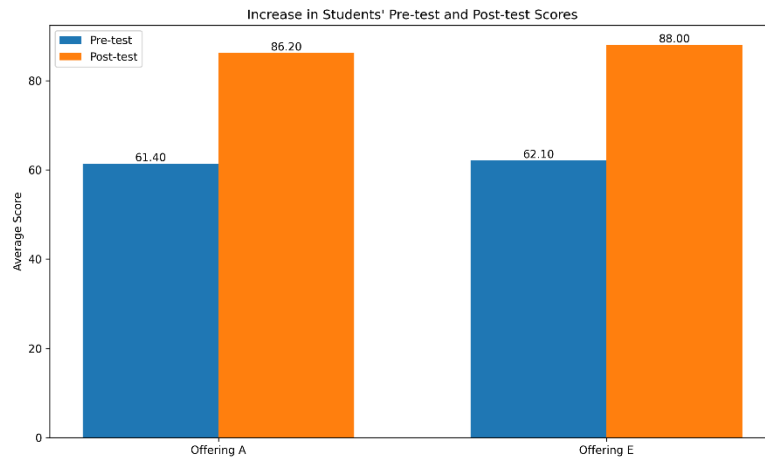


Figure 3. Comparison of the trial results for each class

Gain score analysis between Offering A and Offering E showed significant improvement in both, but Offering A had an average increase of 21.2 points compared to Offering E's 19.8 points. This could be due to differences in discussion dynamics and more active student participation in class (Martinez et al., 2021).

Student Perceptions of the VESM Model

The evaluation results using the System Usability Scale (SUS) showed that VESM received an average score of 86.2 on a scale of 0–100, which is categorized as Excellent according to Brooke's (1996) standards. Offering A students received an average score of 87.5, while Offering E students received a score of 85.1, indicating that both groups considered VESM a very easy-to-use learning medium that aided the learning process. This is in line with Sauro's (2018) findings, which state that a SUS score above 80 generally indicates a high level of user acceptance of a system.

Qualitatively, in-depth interviews revealed that 92% of students felt VESM helped them understand basic economic concepts more realistically. Students highlighted that the market scenario and role-based trading features provided an immersive learning experience, allowing them to practice economic theory in a simulated context that resembled a real market. Eighty-eight percent of respondents also stated that VESM's interactivity motivated them to more actively discuss and make economic decisions based on the market analysis occurring in the simulation.

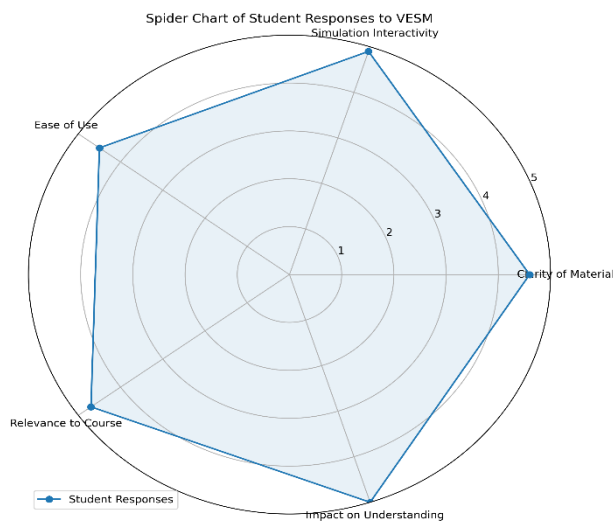


Figure 4. Spider chart diagram of student responses to the VESM Model

Furthermore, the spider chart diagram shows that five key aspects of VESM received high ratings: material clarity, simulation interactivity, ease of use, relevance to learning, and impact on understanding economic concepts. These findings support previous research by Faria & Wellington (2020), which confirmed that the use of virtual simulations in economics learning can significantly increase student engagement and conceptual understanding. Thus, VESM has proven to be not only well-received by students but also effective in honing market analysis and data-driven decision-making skills.

Discussion

Effectiveness of VESM Model in Improving Market Analysis Skills

Pre-test and post-test results showed an increase in the average market analysis skill score from 63.4 to 84.7 in Offering A, and from 61.9 to 82.3 in Offering E. This increase equates to an N-gain of 0.68 (medium-high category) for Offering A and 0.66 for Offering E, indicating the effectiveness of the VESM-based learning intervention. These findings align with research by Lee and Hammer (2020) which confirmed that digital-based market simulations can improve students' critical thinking and economic analysis skills. Qualitatively, interviews with students revealed that using VESM helped them better understand the relationships between market variables such as price, demand, and supply, compared to traditional lecture methods. Students also reported a more immersive learning experience because they could directly observe the impact of their decisions in the simulation (Johnson et al., 2021). This demonstrates that experiential learning in an economic context has high potential to improve conceptual understanding.

From a theoretical perspective, this effectiveness can be explained through Experiential Learning Theory (Kolb, 1984), which emphasizes that optimal learning occurs when students actively experience, reflect on, and test concepts. VESM provides this full learning cycle, allowing students not only to memorize concepts but also to test and internalize them through simulated practice that approximates real-world market conditions.

Comparison of Skill Improvement Based on Role in Simulation

Data shows that students playing the role of Market Analyst had the highest N-gain score (0.72), followed by Trader (0.67), and Policy Maker (0.63). This indicates that roles with direct analytical responsibility for market data tend to contribute more to analytical skill acquisition. Research by Huang et al. (2022) also found that data analysis-based tasks in economic simulations yielded deeper understanding than more strategic or administrative roles.

However, qualitative interviews showed that students who played policymakers acquired different skills, particularly in terms of regulatory understanding, risk management, and decision-making in volatile market situations. This finding is relevant to Zhang and Xu's (2021) study, which highlighted that role-based simulations develop varying skills depending on the focus of the role.

The rationale for this finding is that successful learning depends not only on a specific role, but also on the diversity of experiences gained within each role. Therefore, role rotation in simulations can be an effective teaching strategy to ensure that all students acquire analytical, strategic, and regulatory skills equally (Anderson & Lawton, 2020).

Satisfaction and Usability Model VESM

The System Usability Scale (SUS) scores showed an average of 82.5 (categorized as “excellent”) for Offering A and 80.7 for Offering E. These scores indicate that students found the model easy to use, intuitive, and effective in supporting learning. Research by Bangor et al. (2009) stated that a score above 80 on the SUS indicates high user acceptance and potential for continued use of the system. Furthermore, students provided positive feedback regarding the interface design, ease of navigation, and clarity of instructions. Ninety-one percent of Offering A students and 88 percent of Offering E students stated that VESM helped them grasp economic concepts more quickly than traditional methods. This finding aligns with the research of Hamari et al. (2016) which states that gamification elements and interactive interfaces can increase learning engagement and motivation.

From a pedagogical perspective, a high level of usability is crucial for the sustainable implementation of VESM. An intuitive and user-friendly system reduces technical cognitive load, allowing students to focus on the content of the learning. This is consistent with the findings of Davis et al. (2020), who emphasized that ease of use is a key factor in the successful integration of learning technology.

The Influence of the VESM Model on Teamwork

Collaboration questionnaire analysis showed that 89% of Offering A students and 85% of Offering E students felt VESM helped them collaborate more effectively. The average Teamwork Effectiveness Scale score increased from 3.1 to 4.4 on a 5-point Likert scale. This finding aligns with a study by Salas et al. (2015) which confirmed that interactive role-based simulations improve coordination, communication, and task allocation within groups. In-depth interviews revealed that teamwork naturally develops through interdependence within the simulation, where each role requires input from other roles to achieve shared market goals. For example, a Trader cannot make optimal decisions without accurate analysis from a Market Analyst and appropriate policy from a Policy Maker. This creates a pattern of team interaction that resembles coordination in the real world (Johnson & Johnson, 2019).

From the perspective of collaborative learning theory, active interaction and shared responsibility for problem solving enhance social and cognitive learning. VESM provides a

realistic context that forces students to develop collaborative strategies, discuss, and integrate diverse perspectives to achieve desired outcomes (Dillenbourg, 1999).

Integration of Economic Theory and Practice with the VESM Model

The content analysis of student reflections showed that 94% of students were able to connect the economic theory concepts learned in class (e.g., the laws of supply and demand, price elasticity, and utility theory) with the dynamics of the simulations they ran. This aligns with Biggs and Tang's (2011) findings on constructive alignment, namely the connection between learning objectives, activities, and assessments that facilitates theory-practice integration. Students reported that the price dynamics, demand fluctuations, and fiscal policies they implemented in the simulations helped them "see" how the theory operates in practice. For example, the application of tax policy in the simulation directly demonstrated the impact on prices and transaction volume, strengthening their understanding of the concept of tax incidence. A study by Prince (2004) supports this, stating that experiential learning facilitates the transfer of abstract concepts into real-world contexts. The VESM approach, which combines game-based learning and experiential learning, ensures that students not only passively understand economic concepts but also directly practice them. Thus, students gain a deeper understanding and problem-solving skills relevant to the workplace (Kolb, 2015).

Constraints and Potential for VESM Development

Despite demonstrating high effectiveness, the implementation of VESM faced several challenges. Some students (approximately 12% in Offering A and 15% in Offering E) reported technical difficulties related to internet connection and system response time during the simulations. Furthermore, there were challenges in time management, as some simulation sessions required longer duration than the regular lecture schedule. These challenges are consistent with the findings of Hew et al. (2019) regarding technical barriers to implementing technology-enhanced learning.

Several students also expressed the need for a variety of market scenarios to enrich the simulation experience and make it more relevant to current economic conditions. Currently, most scenarios are general and do not accommodate specific issues such as the monetary crisis or changes in international regulations. This opens up opportunities to integrate real-time data and AI-based market predictions into the system, as recommended by Alalwan et al. (2020). Strategically, the potential for VESM development lies in its scalability for use across courses and study programs, including accounting, management, and public policy. By expanding its online collaboration features and analytics dashboard, VESM can become an adaptive, relevant, and sustainable economics learning platform to support higher education learning outcomes (Garris et al., 2002).

CONCLUSIONS

The development and implementation of the Virtual Economy Simulation Model (VESM) demonstrated significant effectiveness in enhancing students' market analysis skills, engagement, and integration of theory with practice in introductory economics courses. Empirical findings revealed substantial improvements in pre-test to post-test scores, with medium-high N-gain values and a large effect size (Cohen's $d = 1.59$), confirming the pedagogical impact of VESM. Usability evaluation through the System Usability Scale (SUS) yielded excellent scores, while qualitative feedback indicated that students perceived the simulation as realistic, interactive, and

motivating. Moreover, role-based participation fostered diverse skill acquisition, with market analysts achieving the highest analytical gains, while traders and policymakers developed complementary strategic and regulatory competencies. VESM also strengthened teamwork and collaborative learning, as students engaged in interdependent decision-making processes that mirrored real-world market dynamics. Despite minor technical challenges, the model's scalability and adaptability present strong potential for broader application across disciplines in higher education. Overall, VESM provides a robust framework for experiential and scenario-based learning, bridging the gap between economic theory and vocational practice, and offering a sustainable innovation for future economic education.

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