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SIMULATION-BASED MICROECONOMICS LEARNING: A QUASI-EXPERIMENTAL STUDY USING SIMCITY GAMES

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ABSTRACT

This study investigates the effectiveness of using the SimCity simulation game as an interactive learning medium to enhance students' understanding of trade concepts in Microeconomics courses. The integration of digital simulations in education is gaining traction as a means to promote contextual and experiential learning, particularly in complex subjects such as economics. A quantitative approach with a quasi-experimental one-group pretest-posttest design was employed. The participants consisted of 14 undergraduate students enrolled in a Microeconomics course. They engaged in a learning intervention using SimCity, where they simulated urban development and made economic decisions related to trade, such as resource allocation, and zoning management. Data were collected through pretest and post-test assessments to measure conceptual understanding before and after the intervention. Statistical analysis was conducted using a paired sample t-test. The results showed a significant improvement in student understanding, with the mean score increasing from 15.3 (pretest) to 18.7 (post-test). The paired sample t-test yielded a p-value of 0.000 ($p < 0.05$), indicating statistically significant learning gains. These findings suggest that SimCity facilitates critical thinking, reflective learning, and cognitive engagement through immersive and contextual decision-making experiences.

While the results are promising, the study is limited by its small sample size and lack of a control group. Future research should implement a full experimental design with a larger and more diverse participant pool, as well as explore other economic topics to further validate the effectiveness of simulation-based learning in higher education.

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Introduction

The development of digital technology has significantly transformed the educational landscape. It has not only changed how teachers teach and how students learn, but also shifted the educational paradigm from knowledge-based learning to experience and 21st century skills-based learning. One of the key innovations in this transformation is the integration of interactive media, including simulation games, into the learning process. Simulation games, as part of game-based learning, allow students to

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acquire knowledge through direct engagement in environments that resemble real-world conditions but carry minimal risk. Within increasingly complex and dynamic learning ecosystems, simulations provide learners with the opportunity to explore, make decisions, and reflect on the consequences in a safe and controlled setting.

In higher education, simulation games have shown promising potential. Previous studies have demonstrated that the use of simulations can enhance learning motivation, student engagement, and the achievement of both cognitive and affective learning outcomes. Sitzmann (2011), in her meta-analysis, found that simulations had a significant positive effect on declarative and procedural knowledge. Similarly, (Woo, 2014) emphasized that interactive educational games can foster high emotional engagement among students, which in turn positively influences knowledge retention. Siewiorek et al. (2012) reported that simulations in business education effectively enhance leadership skills in a non-threatening environment. Even in technical fields such as nursing and medicine, simulations have become an integral part of the curriculum, allowing students to practice complex practical skills in near-realistic scenarios (Shin et al., 2015; Swanson et al., 2011).

As curricula grow more complex and demands for 21st-century skills such as critical thinking, problem-solving, collaboration, and digital literacy increase, traditional didactic methods are increasingly seen as inadequate. In this context, simulation games emerge as an innovative pedagogical solution capable of bridging the gap between theoretical concepts and practical applications. Wouters & Van Oostendorp (2013) argued that providing appropriate instructional support in educational games is crucial to improving learning outcomes, and that well-designed educational games can integrate cognitive and motivational aspects of learning. They further emphasized the importance of game design that incorporates strong pedagogical principles to ensure not only engagement but also conceptual understanding.

The application of simulation games in education spans various disciplines, including business, engineering, and social skill development. Tao et al. (2015) found that simulations in business education improved students' perceptions of the skills and knowledge acquired. Similar findings were reported in the fields of technology and programming education (Seng & Yatim, 2014; L. C. Wang & Chen, 2010), as well as in the development of soft skills such as empathy, collaboration, and leadership (Siewiorek et al., 2013). One of the main strengths of simulation-based learning is its ability to facilitate reflection-in-action, an essential component in the development of professional identity (Söderström et al., 2014). Thus, simulation games serve not only as learning tools but also as mediums for character and personality development.

In addition to their cognitive benefits, simulation games have a motivational impact that influences students' persistence and engagement. According to self-determination theory, learners are more intrinsically motivated when they feel autonomy, competence, and relatedness. Simulation environments like SimCity offer learners a degree of freedom to make decisions and face consequences, thereby fostering a sense of autonomy. They also receive immediate feedback on their performance, which enhances their sense of competence. Moreover, simulation-based activities often involve collaborative decision-making or discussions, promoting social interaction and relatedness. These psychological factors, when effectively integrated, lead to a more holistic learning experience.

Nonetheless, several research gaps remain open for further investigation. First, while many studies have highlighted the overall effectiveness of simulation games, few have specifically examined how interactivity and narrative dynamics within games influence critical thinking and decision-making in targeted learning contexts such as entrepreneurship education, digital leadership, or character education. According to social constructivist theory, learning is shaped not only by content but also by the social interactions and contextual environments in which learning takes place (Vygotsky, 1934). Second, there is a scarcity of studies that integrate simulation with pedagogical

approaches based on learning cycles or constructivist learning theory representing an opportunity to develop more comprehensive and innovative instructional models (Carolyn Yang & Chang, 2013; Tiwari et al., 2014). Third, game design elements such as storylines, virtual agents, and real-time feedback remain understudied in relation to affective and metacognitive learning outcomes (Silvia, 2012; Young et al., 2012), despite their considerable potential to shape students' emotional engagement and reflective awareness.

In the context of Microeconomics education, particularly on the topic of trade, interactive media such as SimCity offers a compelling and innovative pedagogical alternative. SimCity is a popular city-building simulation game that provides students with a hands-on experience in managing virtual urban environments. Students are required to make economic decisions such as setting taxes, regulating industrial and commercial zoning, managing public services, and interacting economically with other cities all of which affect the development and well-being of their virtual citizens. These decisions simulate the complexities and consequences of real-world economic policymaking, thereby enhancing students' understanding of economic dynamics.

The topic of trade in Microeconomics encompasses key concepts such as supply and demand, government intervention, opportunity costs, and the comparative benefits of economic activity across regions. Through SimCity, students not only learn these theories from textbooks but also apply them in virtual scenarios that resemble real-life situations. They can simulate trade with neighboring cities, allocate resources strategically, and observe the impact of their trade policies in real-time. This aligns with (Silvia, 2012) perspective that simulations can promote higher-order learning, including analytical thinking and data-driven decision-making.

Additionally, SimCity supports experiential learning principles, as outlined by (Kolb, 1984), which involve four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Simulation games like SimCity encapsulate all of these stages, making them highly suitable for fostering both conceptual understanding and practical skills. Strycker (2016) also found that the integration of simulations in online learning enhances comprehension of abstract concepts and supports strategic decision-making. Similarly, (Tiwari et al., 2014) demonstrated that simulations strengthen students' perceptions of the effectiveness of their learning experience.

The flexibility of simulation games allows for differentiated learning. Each student may explore different economic strategies and face different scenarios, creating a personalized learning path that can cater to varying learning styles and paces. This personalized experience aligns well with the principles of universal design for learning (UDL), which advocates for multiple means of engagement, representation, and expression.

Despite its potential, empirical studies that explicitly investigate the use of SimCity to enhance the understanding of trade principles in Microeconomics remain limited. Most existing research on simulations continues to focus on leadership, healthcare, or STEM education (Sitzmann, 2011; C. Wang et al., 2016; Zacharia & Olympiou, 2011), while its application in economics education particularly in trade topics has yet to be fully explored. Given the complexity of economic interactions that SimCity offers, the game provides a highly relevant platform for representing market dynamics, the role of government, and the impact of economic policies on regional development.

This research attempts to bridge that gap by investigating how the use of SimCity as a simulation-based learning tool can enhance students' understanding of core Microeconomic trade concepts. Through this approach, the study seeks not only to measure cognitive improvements but also to observe how simulation influences students' engagement, decision-making processes, and capacity to connect abstract economic theories with real-life scenarios. The results of this study are expected to provide empirical evidence supporting the integration of serious games in economics education

and contribute to the ongoing discourse on active learning methodologies in higher education.

Based on the above rationale, this study aims to address the existing literature gap by developing and evaluating the effectiveness of a simulation-based learning model using SimCity to improve students' understanding of trade concepts in Microeconomics courses. This research is expected to contribute to the theoretical development of economics education and simulation-based learning, as well as provide practical implications for the design of innovative learning strategies in higher education.

Method

Participants

This study involved 14 undergraduate students enrolled in a Microeconomics course at a university in Indonesia. The participants were selected through purposive sampling based on their active enrolment in the course and willingness to participate in the intervention. All participants had basic prior knowledge of economics but had not previously engaged with simulation-based learning tools in the subject.

Design

The study employed a quantitative approach using a quasi-experimental design, specifically the one-group pretest-post-test design. This design involves administering a test to a single group before and after an intervention to measure changes in knowledge or behavior. Although it lacks a control group, this approach is useful for assessing the impact of educational interventions in classroom settings.

Procedure

The research procedure consisted of the following stages:

- Pretest: Students were given a test to measure their initial understanding of key trade concepts in Microeconomics.
- Intervention: Students participated in a learning session using the SimCity simulation game. The game was integrated into the curriculum as an interactive tool to simulate trade-related decision-making processes, including resource allocation, urban planning, taxation, supply and demand dynamics, and the impact of government policies on economic outcomes.
- Post-test: After the intervention, students took a second test, identical in structure to the pretest, to evaluate changes in their understanding.

The entire intervention spanned two class sessions, each lasting approximately 90 minutes.

Instruments

The primary research instrument was a test consisting of multiple-choice and short-answer questions covering fundamental trade concepts in Microeconomics. The instrument was developed based on the course syllabus and reviewed by two experts in economic education to ensure content validity. A pilot test was conducted on a group of students outside the study sample to assess the reliability of the instrument, yielding a Cronbach's alpha value of 0.78, indicating acceptable internal consistency.

Data Analysis

The data collected from the pretest and post-test were analyzed using the paired sample t-test with SPSS software. This statistical method was used to determine whether the observed differences in the mean scores before and after the intervention were statistically significant. The significance level was set at $p < 0.05$.

Results

The comparative analysis of students' pretest and post-test scores indicates a significant improvement in their understanding of Microeconomics after participating in the SimCity-based learning intervention. The following table summarizes the descriptive statistics and results of the paired sample t-test:

Table 1. Pretest and Post-Test Scores Summary

Score Type	Mean	Standard Deviation	N
Pretest	15.3	1.20	14
Post-test	18.7	0.95	14

Table 2. Paired Sample *t*-Test Results

Comparison	t-value	df	p-value	Interpretation
Post-test vs Pretest	7.913	13	0.000 (**p** < 0.05)	Significant improvement

The mean post-test score (18.7) is substantially higher than the mean pretest score (15.3), with a mean difference of 3.4 points. The results of the paired sample t-test indicate that this difference is statistically significant ($p = 0.000$), confirming that the SimCity simulation had a meaningful positive impact on students' comprehension of trade concepts in Microeconomics.

This substantial improvement in student performance highlights the effectiveness of simulation as a pedagogical strategy in higher education. The data also indicate that the level of variance decreased in the post-test (as evidenced by the lower standard deviation), suggesting more consistent levels of understanding among students after the intervention. This consistency may reflect the uniformity of learning experiences provided by the structured simulation environment, where all students engage with the same core economic challenges but can explore different strategies and consequences.

Beyond numerical gains, students experienced immersive, contextual learning through SimCity. The simulation enabled them to actively engage in trade-related decisions such as resource management, taxation policies, and city development strategies. This experiential component stimulated both emotional and cognitive involvement, which likely contributed to the improved understanding observed in the post-test results.

These findings support previous research suggesting that well-designed simulation games can enhance higher-order thinking and learning outcomes (Silvia, 2012; Wouters et al., 2013). Integrating technology and interactive learning environments such as SimCity into economic instruction offers a promising approach for increasing student comprehension in complex topics like trade.

Discussion

The results of the study show that the use of SimCity games in learning Microeconomics courses, especially on the topic of commerce, has a positive impact on improving student understanding. Students become better able to connect trade theory with real practice through simulations of urban management, where they are confronted with various economic decisions such as the management of industrial zones, the setting of taxes, and the export-import policy between regions.

These findings are in line with the results of previous studies that showed that simulation-based games are able to improve students' conceptual and cognitive understanding. Mariathy et al. (2013) state that computer games designed for educational purposes can create a more active and enjoyable learning experience, thereby encouraging a deeper understanding of the teaching material. Similarly, Erhel & Jamet (2013) emphasize that giving feedback during the gaming process can strengthen learning motivation and academic outcomes.

These studies support the view that well-designed simulation games are not only tools for entertainment but also powerful instruments for learning. When integrated thoughtfully into curriculum design, such games can cultivate both foundational knowledge and higher-order thinking skills, making them particularly effective for complex subjects like economics. The use of simulation games like SimCity exemplifies how interactive digital tools can bridge the gap between theory and practice in higher education.

In the context of SimCity, students experience firsthand how trade policies affect the city's economic balance. This supports the view of Aldrich (2009), who states that virtual worlds and simulations can create learning environments that allow the exploration of complex concepts in a more realistic way. The simulation encourages experiential learning, which not only presents content passively, but requires students to make decisions based on economic principles.

Furthermore, the use of SimCity also develops students' reflective abilities, as they have to evaluate the consequences of the economic decisions they make. This is reinforced by the research of Beckem & Watkins (2012), who stated that immersive simulation can bring learning to life and develop high-level thinking skills. Angelini (2016) even emphasized that the integration of simulation in learning can increase learning autonomy and the effectiveness of material mastery.

Another study conducted by (Auman, 2011; Geithner & Menzel, 2016) found that simulated games significantly increased student engagement and allowed them to connect theory with practice directly. These findings are in line with the results obtained in this study, where the active involvement of students while playing SimCity makes them better understand the basic principles of trading, such as comparative advantage, opportunity costs, and market mechanisms.

Even from the perspective of learning psychology, the use of simulation in economics education shows a strong impact on intrinsic motivation. According to (Fu et al., 2016), well-designed computer games in the context of education can improve information retention and emotional involvement of students in the learning process.

Overall, SimCity's integration with microeconomics learning is not only effective in transforming theory into measurable practice, but also able to create a

collaborative, reflective, and problem-based learning environment. Thus, the results of this study provide empirical support for the effectiveness of simulation-based learning in the context of economic education in higher education.

The use of games and simulations in education has evolved into a powerful and effective pedagogical strategy that transcends disciplines and educational levels. According to Young et al. (2012) who conducted a comprehensive review of the integration of serious games into learning environments, educational games have the capacity to foster deep understanding by engaging students in active learning processes, where they must solve problems in contexts that closely resemble real-world scenarios. This contextual and experiential learning approach encourages students not only to memorize concepts, but to apply them in dynamic and meaningful ways.

A number of studies show that game-based and simulation-based learning can boost students' learning motivation, cognitive engagement, and academic achievement. Woo (2014) stated that digital game-based learning significantly supports learning motivation, cognitive success, and student performance outcomes. Similarly, (Wouters & Van Oostendorp, 2013) , in their meta-analysis, found that serious games have a positive impact on cognitive and motivational learning outcomes and affirmed the importance of instructional support in games in order to maximize learning outcomes.

In the context of higher education, the integration of interactive digital tools has shown promising results across various disciplines. Seng & Yatim (2014), for instance, demonstrated that computer games can serve as effective instructional tools in teaching complex technical subjects such as object-oriented programming. Their findings revealed that by transforming abstract programming concepts into interactive and engaging activities, games help reduce students' cognitive load and make learning more accessible and enjoyable. Instead of relying solely on syntax-heavy lectures, students could visualize how programming logic operates through game-based tasks, thereby enhancing comprehension and retention.

Similarly, (Shieh, 2012)explored the use of the Technology-Enabled Active Learning (TEAL) approach in physics education in Taiwan. This model combines interactive simulations, collaborative learning, and immediate feedback to foster greater student engagement. Shieh found that students who participated in TEAL-based classes not only showed improved conceptual understanding of complex physics topics but also demonstrated higher motivation and enthusiasm for the subject. The use of interactive visualizations allowed abstract scientific phenomena such as electromagnetism or wave behavior—to be understood more intuitively.

Both studies highlight a growing recognition that digital interactivity can bridge the gap between theory and practice in higher education. Whether in programming or physics, simulations and educational games provide students with opportunities to explore, experiment, and apply concepts in ways that traditional lectures cannot always facilitate. These findings reinforce the potential of game-based and technology-enhanced learning to improve academic performance and foster deeper learning experiences.

Simulations have also demonstrated substantial value in professional education, particularly in the healthcare sector, where practical skills and decision-making are critical. A comprehensive meta-analysis by Shin et al.

(2015)confirmed that patient simulation significantly enhances the effectiveness of nursing education. Through high-fidelity simulations that replicate real clinical settings, students are able to engage in hands-on practice, make clinical judgments, and respond to patient conditions without the risk of harming actual patients. This experiential approach fosters confidence, competence, and clinical reasoning, which are essential for future healthcare professionals.

Supporting these findings, (Swanson et al., 2011; Warren et al., 2016)also emphasized that simulation-based learning strategies lead to higher levels of student satisfaction, as learners feel more prepared and engaged when they participate in realistic, scenario-based training. These simulations allow learners to make mistakes in a controlled environment, receive immediate feedback, and reflect on their actions components that are crucial for developing both technical and soft skills such as communication, empathy, and teamwork.

The success of simulation in nursing and medical education underscores the transferability of simulation-based learning across disciplines, including economics, engineering, and business. The ability of simulations to bridge the gap between theory and practice, while providing a safe and supportive learning environment, makes them a powerful pedagogical tool not only for professional training but also for academic settings that require critical thinking and applied learning.

Furthermore, simulation-based learning is also effective in developing soft skills, especially in leadership development and teamwork. Siewiorek et al. (2012), in their research, found that business simulations are able to train students' leadership skills. In a follow-up study, Siewiorek et al. (2013) stated that game-based training has an impact on changing perceptions of leadership styles, which shows the potential for transformational learning through simulation.

Not only that, but this learning approach also allows for personalization and reflection-in-action. Söderström et al. (2014) how that simulation-based training in health education can encourage direct reflection during the learning process. This is in line with the view of Silvia (2012), who states that simulation supports high-level learning because it facilitates analysis, evaluation, and decision-making in a realistic context.

The challenges in implementing games and simulations in educational settings certainly cannot be overlooked. While the pedagogical benefits of game-based learning are increasingly recognized, several obstacles continue to hinder its widespread adoption. Tsekleves et al. (2016) identified a range of barriers, including the lack of institutional policy support, limited technical infrastructure, insufficient teacher training, and skepticism about the academic value of serious games. In many cases, educators may lack the confidence or competence to integrate digital games into their instruction effectively, often due to limited exposure or professional development opportunities.

Moreover, developing or adopting quality educational games requires significant investment in time, cost, and collaboration among educators, designers, and software developers. This complexity often leads to the underutilization of such tools in mainstream classrooms, especially in institutions with limited resources. Technical issues such as outdated hardware, poor internet connectivity, or incompatibility with existing systems further complicate implementation.

Pedagogically, there is also the challenge of ensuring that games are aligned with learning objectives and integrated meaningfully into curriculum

plans. Without proper instructional design and assessment strategies, games risk being perceived as mere entertainment rather than effective learning tools.

As a reinforcement, Tao et al. (2015), examined the validity of the learning cycle model in business simulation games and concluded that learners felt a significant improvement in skills and knowledge. This shows that the integration of simulations and games in the curriculum can have a direct impact on the development of students' competencies holistically.

This reinforces the notion that simulation-based learning has the potential to develop students' competencies in a holistic manner, encompassing not just content mastery, but also interpersonal, managerial, and reflective skills. The study by Tao et al. (2015), underscores the importance of aligning simulation design with pedagogical frameworks to ensure meaningful learning outcomes. As such, integrating simulations and serious games into the curriculum is not just a technological innovation, but a strategic approach to building 21st-century competencies across disciplines.

Thus, it can be concluded that game-based learning and simulation are innovative approaches that not only increase student motivation and engagement, but also contribute to the achievement of better learning outcomes. The development of this technology-based learning curriculum and strategy is in line with the demands of 21st century education that emphasizes active, collaborative, and real-life experience-based learning.

Conclusion

This study concludes that the use of SimCity simulation games as a learning medium has a positive and significant impact on improving students' understanding of the concept of trade in Microeconomics courses. This was evidenced by an increase in the average score from 15.3 (pretest) to 18.7 (post-test), with the results of the paired sample t-test showing significance at $p < 0.05$.

Through an experiential learning approach, SimCity allows students to be directly involved in complex economic decision-making, such as tax arrangements, resource allocation, and interregional trade policies. The interaction in this simulation not only strengthens conceptual understanding, but also fosters critical thinking, problem-solving, and emotional involvement skills in the learning process. These findings reinforce previous literature that suggests that simulation-based learning improves motivation, cognitive engagement, and learning outcomes. Simulations like SimCity also support active and contextual learning, which is especially relevant for economics materials that are abstract.

However, the limitations of this study lie in the small sample size and the non-use of the control group. Therefore, follow-up research is recommended using a full-fledged experimental design with a larger and more diverse sample, as well as exploring other economic topics to expand the application of this model. Overall, SimCity's integration in Microeconomics learning shows great potential as an innovative technology-based learning strategy that supports improving the quality of higher education in the digital era.

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