Journal of Theoretical and Applied Information Technology
15th May 2025. Vol.103. No.9

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

INTERDISCIPLINARY VIRTUAL LEARNING COMMUNITY MODEL FOR SOCIAL ENGINEER

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ABSTRACT

The paper suggests developing a Metaverse interdisciplinary learning community model - M-ILC - to develop social engineers. The interdisciplinary learning community process leverages the Metaverse platform tool to foster social engineering skills among students. The study offers a synthesis of materials with regard to interdisciplinary learning communities in various formats. Emphasis is placed on the significance of nurturing human soft skills through utilizing the Metaverse in the learning process to provide learners with a 3D virtual experience. This collaborative learning approach leads to a more profound comprehension of subject content and expands educational opportunities for students. The suitability of the Metaverse Interdisciplinary Learning Community model (M-ILC) developed by experts in Information Technology, Communication Technology, and the Metaverse, was assessed. The evaluation results were rated as "excellent", indicating the suitability of the overall learning community model. This suggests that the M-ILC model can effectively cultivate students' social engineering skills and prepare them for the upcoming digital transformation. Furthermore, it contributes to sustaining a consistent quality standard in the education system. The researchers have introduced new teaching concepts and innovations that align with the current situation in the form of a learning model, fostering a boundary-less learning society that can be accessed anytime and anywhere.

Keywords: *Metaverse, Interdisciplinary, Social Engineer, Virtual Learning Community*

1. INTRODUCTION

Improving a population's quality of life raises many essential issues, with one key focus being enhancing education quality across countries. International organizations recognize and emphasize the significance of education. This includes the United Nations, which has designated education as one of the Sustainable Development Goals (SDGs). In Goal 4 the United Nations has specifically outlined the need for promoting equal education and lifelong learning for all, reducing inequality in opportunities and educational equality [1] Addressing moral and ethical dilemmas and raising awareness about the importance of virtues such as discipline, honesty, and public consciousness among the Thai population is also crucial about tackling the challenges faced by the education system. Consequently, Thailand must reform its education infrastructure, making it a driving force for national development under the new Constitution of the Kingdom of Thailand. This framework is pivotal in guiding national progress to achieve sustainable economic, social, and environmental development in alignment with the SDGs set forth by the United Nations [2]. Sustainable development is based on the principles of the King's science Understand, Access, and Develop. "Understand" requires that community members comprehend the truth about the community's resources, finances, and potential. "Access" involves systematically analyzing this understanding within the community, identifying cause-and-effect relationships, and applying academic principles to problem-solving using available resources and funds within the community. Regarding "develop", Rajabhat University was established to produce high-quality teachers, serve as a repository of academic knowledge, and propel local development. As a result, the university has improved the quality of education and contributed to the development of local areas. As part of local development efforts, the university has enhanced the quality of life by integrating knowledge from various fields of study, overseen by the Faculty of Education. Through such integration, academic knowledge and

skills are applied through operations, in relevant areas functioning as a "Social Engineer."

The term "social engineer" in this study refers to the development of soft skills for students and is distinct from "social engineering" which involves deceptive techniques for data theft. Social engineering exploits human vulnerabilities in relation to technology. This form of attack may employ psychological manipulation, hypnotism, phone or email scams, or the fabrication of situations to deceive the target. For example, in phone or email scams, attackers may impersonate trusted individuals or organizations to elicit personal or registration information, using bullying or emotional harassment techniques to get the victim to listen and comply with the attacker's request. Additionally, through social media, attackers may create fake accounts or platform personalities to listen to other people's private information and use the gathered information for future scams or attacks [3].

Virtual reality is a technology that enables users to engage with their surroundings through a computer-generated virtual world. The metaverse refers to a 3D universe filled with virtual spaces and objects available on the internet. Imagine a future where people can work remotely, visit virtual museums, and attend concerts from anywhere in the world. Various industries are leveraging advanced technologies such as blockchain, edge computing, augmented reality (AR), virtual reality (VR), 3D visualization, artificial intelligence (AI), and the Internet of Things (IoT) to enhance the 3D metaverse experience. For users to truly immerse themselves in the metaverse, creating an experience that feels comparable to reality is essential.

In the modern era, education leverages information and communication technology that extends beyond the confines of the traditional classroom. Educational institutions worldwide have transitioned from in-person classes to online teaching, offering educators and students greater flexibility in maintaining high learning standards [4]. Implementing a Virtual Learning Community (VLC), an integrated platform that prioritizes learning under a network-sharing mechanism involves users not only as consumers of knowledge, but also as contributors to the platform's knowledge base through continuous sharing and communication [5]. VLC play a crucial role in fostering sustainable community development.

The Metaverse is a valuable tool that can enhance the enjoyment of teaching and learning. Beyond just creating a virtual space in a physical aspect, it enables immersive, story-based experiences through user interaction [6]. This paper thoroughly examines the applications and technologies that imbue social significance into Metaverse's hardware, software, and content through three approaches: user interaction, usability, and application. It also evaluates the pros and cons of virtual environments for multi-user education, addressing the access, interaction, and generation of information in higher education, as well as practical considerations and educational strategies for instructors. The interdisciplinary learning model that integrates the Metaverse into the creation of social engineers combines interdisciplinary learning processes with a virtual learning community to cultivate the social skills of higher education students. This development equips students with social engineering skills, utilizing the Metaverse platform for learning anytime and anywhere, creating a conducive learning environment.

Given the background and significance of the issues noted above, the researchers anticipate that implementing the model of an interdisciplinary learning community integrated with the Metaverse to foster social engineers for sustainable community development in organizations, particularly in all 38 Rajabhat higher education institutions with a primary focus on local development, education quality enhancement, and management system development, will be beneficial. This implementation should be driven through mission-related activities encompassing teaching, learning, student and teacher engagement, and active involvement in local development. Student leaders and organizations play a crucial role in fostering development. These two parts helps ensure that graduates possess the essential qualities recommended by the royal institution, have a deep understanding of local issues, contribute to community progress, and support the strategic plan for local development.

2. LITERATURE REVIEW

2.1 Social Engineer

Sections Social engineers willingly volunteer or make sacrifices to advance society. Despite facing numerous obstacles, they persist in their efforts, putting the collective interests of the nation ahead of personal gain. This initiative aims to bring back a harmonious and joyful community in Thailand. Additionally, by promoting public involvement in addressing challenges and participating in community networks, collaborative problem-solving can strengthen citizenship and

promote democracy within society. Each community presents unique challenges that demand customized solutions. A social engineer possesses exceptional leadership skills and a commitment to effecting positive change in these communities. Observation, interviews, discussions, and effective communication are used by a social engineer to analyze and address problems thoughtfully, encourage systematic problem-solving, and promote community participation in devising innovative solutions, allowing the empowered community to self-govern. Ultimately, the social engineer is critical in establishing educational management processes to encourage local residents to develop strategies to overcome challenges and enhance community well-being. They are part of the Social Engineering Skill Process [7].

2.2 Metaverse

The Metaverse integrates virtual world technology in such a way as to recreate natural environments and facilitate various activities. It aims to enable people to interact and engage in activities through their avatars in a 3D graphical representation, making the experience more immersive than traditional social media [8]. The virtual world functions as a mirror reflecting reality, simulating realistic digital spaces, buildings, and environments in a parallel world format [9]. This research provides a comprehensive exploration of the applications and technologies that imbue the Metaverse with social significance in terms of hardware, software, and content using three approaches: user interaction, usability, and application. It promotes avatar creation and interaction, enabling individuals to showcase their personalities even from a distance [10]. The diverse and individualized characteristics of the virtual space are further developed [11]. Metaverse spaces facilitate integrated education, combining e-learning with the ability for many individuals to convene [12]. These spaces offer users freedom in terms of time and location, fostering practical participation [13]. The Metaverse represents an emerging educational model, a boundaryless 3D digital world, promoting self-learning, collaborative learning, and learning by doing. Similar to the internet, it can be accessed to create and merge real-world environments with the virtual world, ultimately forming a "Virtual World Community" that seamlessly integrates surrounding objects and environments [14]. This integration is achieved through the merging of Augmented Reality (AR) and Virtual Reality (VR) technology, creating a unified world space [15].

2.3 Virtual Learning Community

The term Virtual Learning Community (VLC) refers to a community or group organized around interests aimed at learning, sharing, and exchanging knowledge through online platforms [16]. A Virtual Learning Community displays the unique characteristics of being borderless and being able to act as a tool for exchanging knowledge. Individuals or groups can participate, regardless of their physical location, provided they can access the necessary network technology [17]. In the case of students, it fosters a learning environment centered on common objectives that encourage interaction and collaboration [18]. Leveraging technology to facilitate teaching and learning through computer networks and the internet, VLCs enhance the learning process and promote participant engagement [19]. Furthermore, VLCs serve as an effective platform for honing the skills of high-level of students, fostering collaboration, communication, and knowledge creation, as well as facilitating networking and cooperation. VLCs can effectively engage community members, fostering a strong sense of community through interactive communication (Conversational Interaction) [20]. Conversations between virtual classroom members play a pivotal role in facilitating community building [21]. This online space enables the delivery of high-quality courses and creates a virtual learning environment in which teachers can offer guidance, answer questions, and support students through the use of online technologies [6].

2.4 Interdisciplinary

Interdisciplinary is the process by which instructors develop a collaborative learning approach that brings together students from diverse majors or fields, fostering cooperation and integrating knowledge and theories from different perspectives [22]. This interdisciplinary approach promotes the integration and cooperation of those from various academic backgrounds, leading to effective problem-solving [30]. The overarching goal of interdisciplinary learning is to merge knowledge and theory from different disciplines, ultimately achieving a profound understanding and offer innovative solutions to complex issues. Not only does this involve learners from different fields [31], but it also unites experts from diverse domains to combine their knowledge and understanding in devising problem-solving strategies. Moreover, interdisciplinary learning strengthens and expands knowledge across disciplines by incorporating insights from various fields [32]. The process of

integrating interdisciplinary learning entails instructors brainstorming encouraging students to brainstorm collaborative ideas to organize interdisciplinary learning units. Regarding teaching methods, the choice of content for student practice is at the instructor's discretion [33], but it should align with the planned topics, concepts, and issues. The instructor will design interdisciplinary activities for students, typically through plans or projects. Subsequently, the instructor will break down the project into smaller assignments for each student group to become engaged [34]. Presently, the focus in teaching and learning is on integrating learning in the form of interdisciplinary learning, such as merging content across related subject areas [35]. The integration of learning can also be used to incorporate shared skills. The coordination of interdisciplinary skill-based activities involves grouping learning areas and consolidating content from various learning areas under the same theme. Instructors are responsible for clearly outlining the specifics of integrating each subject [36].

3. RESEARCH METHODOLOGY

This research involved designing, developing, and evaluating the model and processes. This involved 2 phases.

Phase 1: Develop the M-ILC Learning Model. The researchers synthesized an interdisciplinary virtual learning community by analyzing and synthesizing data, theories, and research documents related to its components and the integration of interdisciplinary learning from online databases ERIC, Scopus, IEEE, and Web of Science published between 2015 and 2024 were 44 issues. Content analysis was utilized to evaluate the content of the research documents. After that, Element of the Interdisciplinary Virtual Learning Community Process are synthesized.

Figure 1: Element of the Interdisciplinary Virtual Learning Community Process

Phase 2: The suitability of the M-ILC model: The Metaverse Interdisciplinary Learning Community Model, was evaluated using a questionnaire designed to collect the insights of nine experts, each possessing over five years of experience in their relevant fields. The selected experts specialize in communication and information technology for education, the metaverse, and social engineering. The research instrument utilized for this assessment was the M-ILC model. All questions in the survey employed a 5-point Likert scale, and the data were analyzed using arithmetic means and standard deviations.

3.1 Population and Sample

The population targeted in this research comprises specialists with expertise in information and communication technology, the Metaverse, and social engineering. These individuals were selected using a purposive random sampling method, which included the following criteria:

1) Academics in information and communication technology who possess a doctorate degree and hold a position as assistant professor or higher.

2) Experts in the Metaverse with a minimum of five years of knowledge and experience in the field, particularly in its application for teaching and learning.

3) Social engineering experts who are academic staff at Rajabhat Universities and have completed a training course on coaching skills for social engineering advisors.

3.2 Variables

The independent variable in this study is the M-ILC learning model implemented via the Metaverse, which aims to enhance social engineering skills among undergraduate students at Nakhon Si Thammarat Rajabhat University. The dependent variable is the evaluation results regarding the suitability of the M-ILC learning model via the Metaverse for developing these skills.

4. RESULTS

4.1 The Result of Development the Metaverse Interdisciplinary Learning Community Model to create Social Engineers

4.4.1 Synthesized of Social Social Engineer Skills

From the synthesis results presented in Table 1, it can be inferred that social engineers possess four key skills: 1) Cause-effect analytical thinking (Critical Thinking), 2) Knowledge communication for problem-solving (Communication), 3) Working with others without conflict (Collaboration), and 4) Being an innovator (Innovation).

Accordingly, the researcher has synthesized document and related research about social engineer skills (see Table 1) 1. Critical thinking involves distinguishing between facts and emotions and embracing diverse perspectives. It is essential for problem-solving and developing strong cause-and-effect analytical skills, which are crucial for making decisions, solving problems efficiently, and enhancing the capacity to work and learn on a daily basis. 2. Effective communication is a crucial skill that enables individuals to exchange information and problem-solve collaboratively. This article explores communication skills that facilitate effective problem-solving. Carefully listening and using clear, easily understandable language is essential to effective communication. Moreover, asking the right questions is critical to comprehensively understanding and clearly defining the problem at hand. 3. Working collaboratively with others is a crucial skill that can significantly benefit individuals in the workplace. Effective communication is vital in ensuring a precise and efficient exchange of information. Active listening and understanding others' perspectives and recommendations are also crucial for students. Group work facilitates the division of responsibilities and tasks, enabling the sharing of knowledge, collaborative learning, and experiences within the team. To support collaborative learning, it is essential to cultivate an environment that fosters the development and advancement of all team members. And 4. The ability to innovate and present novel ideas for enhancing products, services, or processes is crucial in a rapidly evolving world. Thinking creatively and beyond conventional boundaries enables individuals to devise fresh approaches and solutions that were previously inconceivable. The collection, analysis, and application of data support both decision-making and creative thinking, facilitating adaptation to new challenges and changes.

Table 1: Synthesized Results of Social Social Engineer Skills

Social Engineer Skills	[8]	[9]	[10]	[11]	[12]	[13]	Social Engineer Skills
1.Critical Thinking	✓	✓	✓	✓	✓	✓	✓
2.Communication	✓	✓	✓	✓	✓	✓	✓
3.Collaboration	✓	✓	✓	✓	✓	✓	✓
4.Innovation	✓	✓	✓	✓	✓	✓	✓

Table 2: Synthesized results with regard to the Metaverse for education components

Metaverse Components	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	Metaverse Components
Physical devices and sensors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Recognition and rendering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Scenario generation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
User Interaction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Technical Methods	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Metaverse Applications	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

4.4.2 Synthesized of Metaverse for education

The metaverse has the potential to transform education by providing immersive and interactive learning experiences for students. Researchers have gathered relevant documents and studies on the components of the metaverse (see

Table 2) and have identified key components of the metaverse for education, including:

- Physical devicesand sensor s In creating the Metaverse, various devices and sensors play a crucial role in providing an immersive and interactive experience. These technologies enable users to interact with the virtual world as they would in the real world. Such devices and sensors include VR headsets, AR glasses, MR headsets, haptic feedback devices, motion tracking sensors, eye tracking sensors, environmental sensors, and more.
- Recognition and rendering Recognition in the Metaverse involves identifying and interpreting various elements within a virtual environment. These encompass object recognition, which facilitates accurate interactions between virtual objects and enhances the creation of more immersive and lifelike environments. Facial recognition also enables virtual characters to mimic the user's expressions and emotions, enhancing realism.
- Scenario generation Creating a situation or environment in a virtual world can be applied to various fields, including education, training, entertainment, simulation, and more. Scenario generation in the Metaverse enables users to develop diverse and lifelike virtual environments. This technology allows users to have a more immersive and effective experience.
- User Interaction User interaction in the metaverse refers to how users interact with the virtual world and its various elements, such as movement and exploration, hand and gesture control and communication (through VRChat and AltspaceVR. These allow users to talk and interact with each other) customization and creation, avatar customization to express the user's identity, building construction, clothing design, or space design.
- Technical Methods The metaverse is made possible with various technologies. Key technologies used in the metaverse include Virtual Reality (VR), Augmented Reality (AR), 3D Modeling, Blockchain, Computing and Graphics, Artificial Intelligence (AI), Social Platforms, and more.
- Metaverse Applications These applications include gaming, virtual learning environments, interactive learning platforms in virtual environments, virtual meeting spaces, co-working areas, social interaction, and 3D social platforms. The Metaverse is rapidly evolving and promises to impact various aspects of human life and work significantly.

When these components come together, they create a more engaging and interactive learning experience for students, allowing them to explore and learn in a digital environment that is both fun and educational.

4.4.3 Synthesis of Virtual Learning Community

The researchers have synthesized relevant documents and studies on the Virtual Learning Community (see Table 3) and identified the following components:

- Membership Community Membership encourages the participation of learners who join the community based on various fields of study. It is also about using learning management systems and assessment, including stimulating learning and creating motivation to learn, learning roles and responsibilities, and understanding each other in terms of their abilities or specific aptitudes.
- Planning Community Collaborative community planning involves working together to organize teaching and development initiatives and effect positive change in the community. This approach may involve assigning groups of students to work about different work responsibilities and allowing them to focus on areas of particular community interest as they plan their collective efforts. It fosters participation and cooperative learning among the community members.
- Exchange Community Learners from various fields bring the knowledge gained from each subject they study to exchange and learn together. Subsequently, they create works to solve the set problem. They use the knowledge gained from exchanging knowledge within the group and integrate it with what they have learned through projects to solve the problems that arise.
- Practice Community This is a process that enables students to apply the knowledge they've gained as a result of knowledge exchange and what they've learned in a project to solve problems that arise effectively.
- Presentation Community This is a process that encourages students to present their results. A community will participate in listening, exchanging knowledge, and jointly presenting work in the designated area.
- Evaluation Community The instructors collaboratively summarize and assess the outcomes, reviewing and ensuring any enhancements or adjustments to the assigned tasks. They conduct a thorough evaluation of academic knowledge and comprehension. Additionally, they evaluate the capacity of individuals to collaborate within the team and across different teams.

Table 3: Synthesized results of a Virtual Learning Community components

VLC Components	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	VLC Components
Physical devices and sensors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Recognition and rendering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Scenario generation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
User Interaction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Technical Methods	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Metaverse Applications	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

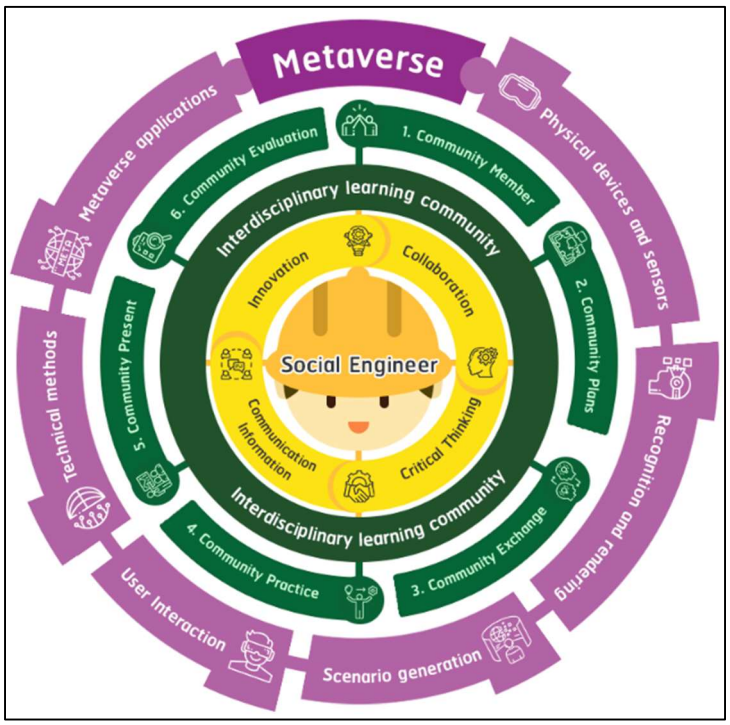

Figure 2: M-ILC Model: Metaverse Interdisciplinary Learning Community Model to create Social Engineers

4.2 Results of the Developed Model of an Interdisciplinary Virtual Learning Community Integrated with Metaverse to Cultivate Social Engineers

From Figure 2, the Metaverse interdisciplinary learning community model to create social engineers. It was learning to use a variety of mixed techniques. The study gathered data and essential information on interdisciplinary learning, virtual learning communities, the Metaverse, and the development of social engineers. This information was then analyzed and synthesized to establish the conceptual framework for the model. The researcher employed the concept of designing an instructional system consisting of three main components. The specifics are as outlined below:

Component 1: The Metaverse is a technological tool that serves as a virtual environment for teaching and learning. It seamlessly integrates and operates within an augmented reality setting, capturing life in both the physical and virtual worlds. The classroom areas in the Metaverse are as follows:

VLC Center Room: An area used for collaborative activities for learners and teachers. They can interact in real-time through an online learning platform using technology and tools to communicate and share information.

SEN Tool Room (Social Engineer Tool): A learning area for social engineers. They can go in and access information by themselves. Learners can review lessons or expand their learning beyond the scope of the lesson content. Learners can use the service without limitations in terms of time or place.

01 SEN Critical Thinking Room: A learning area for working to develop critical thinking skills

02 SEN Communication Room: A learning area for working to develop communication skills

03 SEN Collaboration Room: A learning area for working to develop collaboration skills

04 SEN Innovation Room: A learning area for working to develop innovation skills

05 VLC Meeting Room: A space for students to engage in collaborative activities or to learn to enhance their learning experience and exchange knowledge with one another. However, suppose the students' learning achievements does not meet the set objectives. In that case, the instructor can review the previous learning process to re-explain the misunderstood parts to the students or can repeat the exercises to ensure a deeper understanding. The above steps are four critical steps in the learning process and neglecting any one of them could lead to a failure in learning.

Component 2: The Interdisciplinary Virtual Learning Community comprises six sub-components: 1) Membership Community—becoming a member involves the recruitment of individuals from diverse backgrounds. Upon joining the community, it is important for them to understand their respective roles and responsibilities. This process aims to foster understanding on the part of members, learners, and the instructor, based on their abilities and specific aptitudes. 2) Planning Community—the community comes together to plan teaching, development, and to create change. One key aspect is the grouping of learners. This is done to distribute work responsibilities and enable learners to explore community areas. 3) Exchange Community—this is a process that supports learners from diverse fields to encourage them to collaborate and share the knowledge they have acquired from their studies. Students will engage within the community to collect and exchange information that can be used to address problems. 4) Practice Community— the process enables students from diverse fields to apply their knowledge to develop innovative solutions for community challenges. Students will address community problems by initiating and executing projects. 5) Presentation Community— this is a process that encourages students from various subjects to present their work. During the presentation, the community will participate in listening and exchanging knowledge. 6) Evaluation Community— instructors collaborate to review and evaluate outcomes. During the evaluation process, suggestions from the community will be considered.

Component 3: The creation of a Social Engineer comprises four skills as follows: 1) Cause-effect analytical thinking (Critical Thinking)—this develops an understanding of the connection between cause and effect and addressing the problem is undeniably challenging, 2) Knowledge communication for problem-solving (Communication)—this encourages the students to be capable of sharing acquired knowledge to solve community problems, 3) Working with others without conflict (Collaboration)—this encourages the ability to work harmoniously with others and to mobilize local and external forces to contribute to local development, and 4) Being an innovator (Innovation)—thia aims to collaboratively develop skills to drive innovation when it comes to solving local community problems.

Table 4: M-ILC LEARNING PROCESS for Social Engineer

M-ILC process	Learning Activity	Metaverse	Social Engineer Skills
Community Member	• The instructor sets the stage by introducing the learners to the Metaverse, a key element that will help them understand the topic and its learning objectives. This introduction also prepares the learners for the different classrooms on the platform, the platform usage, and the measurement and evaluation methods. • The instructor gives an example of a situation or asks questions to encourage the learners to think logically and separate facts from feelings. • The instructor summarizes and identifies the issues the learners are interested in solving to prepare the learners for the next process. • The learners introduce themselves, their aptitudes, and special abilities.	VLC Center Room	• Skills to work with others without conflict • Skills to communicate knowledge to solve problems Skills to think analytically and logically

	• The learners show interest in solving problems. • The learners participate in expressing their opinions, making suggestions, and jointly analyzing the problems.		

Table 4: Continued

M-ILC process	Learning Activity	Metaverse	Social Engineer Skills
Community Plans	• The instructor prepares the content for the learners in terms of the learning plan by presenting it through slides or videos in various classrooms prepared in the Metaverse and the learning community platform. In addition, if the learners want to review the lesson or subsequently learn more, they can access the learning community platform by themselves or invite group members to brainstorm and work at any time. • The instructor organizes the teaching and learning together in terms of the learning plan. • The instructor divides the learners into groups. • The instructor and the learners plan to organize activities in the community to find topics to create a project. • The instructor checks and adjusts to check how much the learners understand the lesson. • The learners study using social engineering tools to collect community data.	• SEN Tool Room (Social Engineer Tool) • 01 SEN Critical Thinking Room • 02 SEN Communication Room • 03 SEN Collaboration Room • 04 SEN Innovation Room • 05 VLC Meeting Room	• Skills to work with others without conflict • Skills to communicate knowledge to solve problems • Skills to think analytically and logically • Skills to create community innovation
Community Exchange	• Each group brings knowledge from their studied subject to exchange learning. The instructor and students can exchange opinions and analyze problems and factors affecting the work. • In each group, students are encouraged to gather information from the community using social engineering tools, with the aim of using this information to brainstorm and solve problems together. • The instructor assigns tasks to students so that students can use their knowledge and skills to solve problems or create work together on the Metaverse platform.	• 01 SEN Critical Thinking Room • 02 SEN Communication Room • 03 SEN Collaboration Room • 04 SEN Innovation Room • 05 VLC Meeting Room	• Skills to work with others without conflict • Skills to communicate knowledge to solve problems • Skills to think analytically and logically Skills to create community innovation
Community Practice	• Learners use the knowledge they have gained to create innovations to solve problems in the community. Learners will	• 01 SEN Critical Thinking Room	

	receive problems from the community and turn them into projects. Learners use knowledge from various disciplines and integrate it with the community. They work in groups to create works, projects, or pieces of work to solve the desired problems.	• 02 SEN Communication Room • 03 SEN Collaboration Room • 04 SEN Innovation Room • 05 VLC Meeting Room	

Table 4: Continued

M-ILC process	Learning Activity	Metaverse	Social Engineer Skills
	• The instructor observes and monitors the learners' practice and provides advice and assistance.		
Community Present	• Each group presents its work, including solutions to problems based on the tasks they have jointly considered in the VLC Center Room. • Learners present their knowledge or solutions to problems based on their assigned tasks. • The instructor brings the community together to listen and share knowledge.	VLC Center Room	• Skills to work with others without conflict • Skills to communicate knowledge to solve problems • Skills to think analytically and logically • Skills to create community innovation
Community Evaluation	• The instructor evaluates students' social engineering skills through assigned tasks within the platform. The four essential social engineering skills are: 1) Analytical thinking skills 2) Problem-solving communication skills 3) Collaborative skills that minimize conflict 4) Social innovation skills • The instructor evaluates the performance of the students. • The instructor communicates the quality of students' success. • The instructor collectively summarizes and discusses the reasons for mistakes, prompting suggestions from the community for participation in this process. • The students acknowledge the quality of their success and recognize mistakes with the aim of correcting them to ensure greater success in the future.	VLC Center Room	• Analytical thinking skills • Skills to work with others without conflict • Skills to communicate knowledge to solve problems • Skills to create community innovation

4.3 The Appropriateness of the M-ILC Learning Model

During the evaluation of the M-ILC model, nine experts in Information and Communication Technology, Metaverse, and Social Engineering assessed its suitability using a specially designed evaluation form. The results of this assessment are presented in Table 5. All participants agreed to take

part in the study and provided their evaluations anonymously. To ensure data accuracy, the researchers employed an evaluation form validated with an Index of Consistency (IOC) to ensure that the questions aligned with the objectives as perceived by the experts. Prior to the evaluation, the researchers shared comprehensive and thorough information, along with study-related documents, with the participants, allowing them to make an informed decision about their participation. Participants were assured that their personal information would be kept confidential and not shared with others. Furthermore, they were given a detailed explanation of the evaluation's purpose and were encouraged to ask any questions they may have had to ensure full understanding.

Table 5: The Appropriateness of the M-ILC Learning Model

Items for Evaluation	Result		Interpretation
	Mean	SD	
Part 1 Elements of the Metaverse Interdisciplinary Learning Community Model to Cultivate Social Engineers			
1. Metaverse			
1.1 Physical device and sensor	4.89	0.31	Very high
1.2 Recognition and rendering	4.78	0.42	Very high
1.3 Scenario generation	4.89	0.31	Very high
1.4 User Interaction	5.00	0.00	Very high
1.5 Technical Methods	4.78	0.42	Very high
1.6 Metaverse Application	4.89	0.31	Very high
2. Interdisciplinary Learning Community			
2.1 Membership Community	4.78	0.42	Very high
2.2 Plannin Community	4.89	0.31	Very high
2.3 Exchange Community	4.78	0.42	Very high
2.4 Practice Community	4.78	0.42	Very high
2.5 Presentation Community	4.89	0.31	Very high
2.6 Evaluation Community	4.89	0.31	Very high
3.Social Engineer Development			
3.1 Cause-effect analytical thinking (Critical Thinking)	4.89	0.31	Very high
3.2 Knowledge communication for problem-solving (Communication)	4.89	0.31	Very high
3.3 Working with others without conflict (Collaboration)	5.00	0.00	Very high
3.4 Being an innovator (Innovation)	4.78	0.42	Very high
Part 2 Overall Suitability of the Metaverse Interdisciplinary Learning Community Model to Cultivate Social Engineers			
1. The Metaverse interdisciplinary learning community model to create social engineers has a clear, continuous sequence of components and steps.	4.89	0.31	Very high
2. The development of the Metaverse interdisciplinary learning community model to create social engineers is arranged in an appropriate sequence for easy understanding.	4.78	0.42	Very high
3. Every component in developing the Metaverse interdisciplinary learning community model to create social engineers is interconnected.	4.89	0.31	Very high
4. Overall, the Metaverse interdisciplinary learning community model to create social engineers is complete, fulfilling the needs and accomplishing the research objectives.	4.89	0.31	Very high
Overall efficiency	**4.87**	**0.30**	**Very high**

Table 5 shows that the nine experts evaluated the M-ILC model. The results indicate its overall suitability to be at an excellent level (mean = 4.87, standard deviation = 0.30). When considering each component, each was rated excellent (mean = 4.89, standard deviation = 0.31). At the same time, the M-ILC learning community process and social engineering skill abilities were also rated at a very good level, with a mean of 4.84 and 4.89 and

standard deviations of 0.31 for both. Moreover, the overall suitability was found to be excellent (mean = 4.89, standard deviation = 0.31), indicating that the M-ILC model is practical with regard to developing the social engineering skills of undergraduate students.

Most learning models emphasize developing learners' skills and awareness regarding ecological sustainability through various activities, including learning, research, and community service. Different learning management methods can lead to varying outcomes within the Metaverse interdisciplinary learning community model, which aims to cultivate social engineers. The success of the learning process in achieving its objectives depends not only on the learners' achievements but also on several other factors that contribute to effective teaching and learning. As mentioned previously by the researcher, the focus of all learning processes is on the learners themselves. Therefore, to effectively develop learners, teachers must understand their contexts and the specific abilities they wish to enhance.

5. DISCUSSION

The Metaverse interdisciplinary learning community model to create social engineers for sustainable community development universities has three main components: 1) The Metaverse: This component encompasses physical devices and sensors, recognition and rendering, scenario generation, avatars, technical methods, and Metaverse applications. 2) Interdisciplinary Virtual Learning Community: This component involves a six-step process, including community membership, planning community, exchange community, practice community, presentation community, and evaluation community. 3) Social Engineering: This component focuses on four skills in the form of critical thinking, knowledge communication, collaboration, and social innovation. This is consistent with the research of [22] and [40], who have developed the VPLC learning model, a virtual learning management model applied to develop learners' abilities through the virtual world, and the Metaverse interdisciplinary learning community model to create social engineers for sustainable community development universities. It is also consistent with the main components of the Metaverse interdisciplinary learning community model. The Metaverse tool and gamification techniques were used in this research. The purpose of the development was to enhance the overall experience of the learners. There were four main components: 1) Input, 2) Metaverse learning management process based on gamification technique, 3) Evaluation, and 4) Feedback. The main components of the learning model to enhance life skills for non-formal professional students and the M-ILC model are promising approaches to developing social engineering skills in undergraduate students. This model promotes collaborative learning by combining learning approaches with the Metaverse, a virtual reality platform. It provides students with an engaging and interactive learning experience that will help develop their social engineer skills. The use of the Metaverse in the M-ILC model can provide students with the opportunity to participate in realistic simulations and experiments that would be difficult or impossible to conduct in a traditional classroom. In this way students can greatly develop their skills and knowledge. Additionally, the M-ILC model can help develop students' collaboration and communication skills by connecting students from different locations and backgrounds. The Metaverse can provide opportunities for knowledge exchange and interdisciplinary collaboration, which can be invaluable for developing skills that require interdisciplinary knowledge and teamwork. Introducing the Metaverse as a teaching tool creates immersion for learners, exposes them to new experiences, and stimulates them, consistent with the research of [1] and [2]. From the results of the overall suitability assessment by experts, the Metaverse interdisciplinary learning community model to create social engineers for sustainable community development universities is highly suitable for practical use. This shows that the Metaverse interdisciplinary learning community model can be used as a model to develop social engineering skills on the part of university undergraduate students.

6. CONCLUSION

This model is a valuable reference when it comes to designing and developing the Metaverse interdisciplinary learning community model to cultivate social engineers. The researchers anticipate that this model will offer practical guidelines for enhancing social engineering skills among learners, and bolstering students' soft skills to prepare them for the workforce and local development. Contemporary education strongly emphasizes learner participation, and digital technology can significantly enhance the learning experience, promoting knowledge exchange through social networks and fostering a learning society. This approach will equip students with essential social engineering skills and 21st-century competencies.

This tool empowers users with access to seamless communication, accessible from anywhere and at any time. The Metaverse enables real-time interaction for interdisciplinary learning communities, allowing everyone to use various applications on PCs and smartphones. This initiative is designed to advance lifelong learning by leveraging digital technology in teaching and learning management in higher education.

This study contributes significantly through rigorous methodology and practical implications, enhancing understanding of the Metaverse interdisciplinary learning community model for developing social engineers. It offers valuable insights for academia and industry but also acknowledges inherent limitations and potential validity threats.

One significant threat to the validity of this study stems from the selection criteria used. The sample size and its composition may limit the generalizability of the findings, as the study focuses on a specific population or industry. Additionally, while the methodology is sound, the criteria used for evaluation may introduce potential biases. Subjectivity in assessing specific aspects of the data or framework could influence the interpretations. To address this issue, the researcher implemented simple random sampling to improve the reliability of the study. The sample group comprised 40 third-year students enrolled in the Computer Technology and Digital Industry program at the Faculty of Industrial Technology, Nakhon Si Thammarat Rajabhat University. These students used the Metaverse interdisciplinary learning community model to develop their skills as social engineers.

Furthermore, external validity may be affected by contextual factors unique to the study's environment, making it difficult to generalize results across different settings. Future studies should explore cross-context validation to strengthen the applicability of these findings. Despite these limitations, the research remains a valuable contribution, offering a foundation for future investigations and practical applications in all fields, especially in local community development.

To implement the research findings, educational personnel using the Metaverse interdisciplinary learning community model to cultivate social engineers must prepare three main components: learners and teachers, learning objectives for each content area, and the Metaverse. Each component should exhibit the characteristics defined by the researcher. Related subjects should be integrated to create a learning management approach that aligns with the steps of the Metaverse interdisciplinary learning community model, all aimed at training social engineers in a unified direction.

For future research, the developed learning community model is well-suited for learners who aim to enhance their social engineering skills. Educational personnel and institutions can utilize the findings of this research as a guideline for creating learning community models that cultivate skills in various other areas. The application of the Metaverse interdisciplinary learning community model can also be extended to other subject content. In future applications, this model can be further refined to broaden the scope of learning, making it more adaptable for subsequent use. Additionally, universities should focus on developing relevant curricula that prepare students to work effectively. Programs should be created to enhance students' skills, emphasizing practical application.

ACKNOWLEDGMENTS

This research received support from King Mongkut's University of Technology North Bangkok. The researchers would like to express gratitude to Nakhon Si Thammarat Rajabhat University. The researchers would also like to express gratitude to all the experts for their support and valuable suggestions during this research.

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