

Research Article

# Secure Cybercitizenship (SET): A Gamification Learning Tool for Cybersecurity Awareness

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**Abstract:** SECURE CYBERCITIZENSHIP (SET) is a physical gamification cybersecurity tool to increase security awareness among computer and Internet users in a fun and interactive way. The aim of SET is to reduce the cybercrime victims and incidents by providing early education to produce more cyberliterate users. It also promotes the integration of Naqli & Aqli knowledge (iNaQ) via Ta'alim (education) iNAQ where users can learn ethical features in cybersecurity field. This product is the extension of our existing innovative gamification product known as CYBERPOLY (mobile application). It is an outcome-based product providing two levels of interactive quiz which are beginner (Ta'alim CyberSecurity L1) and intermediate (Ta'alim CyberSecurity L2). The user will be rewarded with a score by earning their own money via security awareness quiz that will be used later as their initial salary to begin the game. Each player is required to answer a set of questions using the given Quiz Booklet. Initial salary will be calculated based on each correct answer. At the same time, the user will also enhance cybersecurity awareness when the player landed at the following boxes such as Qada' and Qadar, Do This and and Info Sec box. It offers flexibility of ubiquitous learning as it allows portability, accessibility, and offline access in terms of technological aspect. In line with Malaysia's National Cyber Security Agency (NACSA) to be a better-informed netizen, SET generally can be used as a cybersecurity awareness campaign tool for society to produce more cybersecurity literate users. SET will be used as an engaging tool targeted to school and university students for early education in Service Learning Malaysia-University for Society (SULAM) course. The preliminary findings were carried out during the National Science Week Carnival in Negeri Sembilan. Thus, this product is on-demand as it is in line with industry-driven on increasing cybersecurity literacy society.

**Keywords:** Secure Cybercitizenship; Cybersecurity Board Game; Awareness; Game-based Tool; Gamification



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## 1. INTRODUCTION

Technology and the Internet have become an inseparable part of our modern lives, permeating nearly every aspect (Vasicek et al., 2018). Technology encompasses a vast range of tools, systems and

applications that enable us to solve problems, automate tasks and enhance our capabilities. Meanwhile, the Internet has opened endless possibilities enabling global connectivity and instant exchange of information across borders. The statistics show that there were 5.18 billion Internet users worldwide, which amounted to 64.6 percent of the global population as of April 2023 (Statista, 2023). Due to this, the Internet users tend to be a victim to the cyber threats. According to Cybersecurity Malaysia's Cyber999 Assistance Center, there were 319 reported cases of identity theft in Malaysia as of August 2021 (Experian & Cybersecurity Malaysia, n.d.). Therefore, this highlighting the urgent need for greater awareness and action to protect against cyber threats. Despite a 3.1% increase in cyber-attack incidents such as fraud, crimes, and harmful codes in October 2020 compared to the previous year, many people still lack knowledge on how to prevent such incidents. There is an urgent need to educate cybercitizen on the important of security when using computer and Internet.

Therefore, a gamification learning tool which is known as Secure Cybercitizenship (SET) is developed to provide early education to produce more cyberliterate users via edutainment concept. It is a physical gamification cybersecurity board to increase security awareness among computer and Internet users in a fun and interactive way. The aim of SET is to reduce the cybercrime victims and incidents by providing early education to produce more cyberliterate users. It also promotes the integration of Naqli & Aqli knowledge (iNaQ) via Ta'alim (education) iNAQ where users can learn ethical features in cybersecurity field. In line with Malaysia's National Cyber Security Agency (NACSA) to be a better-informed netizen, SET generally can be used as a cybersecurity awareness campaign tool for society to produce more cybersecurity literate users. SET also supports 10-10 Malaysian Science, Technology, Innovation and Economy (MySTIE) Framework for education and maps to all sectors which requires cybersecurity knowledge. SET will be used as an engaging edutainment tool targeted to primary and secondary school and university students for early education in Service-Learning Malaysia University for Society (SULAM) course offered in USIM. This product is a continuous social innovation that will be utilized every year to serve the community by increasing cybersecurity awareness from an early age.

## **2. METHOD & MATERIAL**

SET is an extended version from our innovative gamification product known as CYBERPOLY mobile application. It is derived from the idea of converting the virtual board game into a physical board since it is more suitable to be brought at the primary and secondary school which does not allow smart phone in the school. However, all the boxes in that board game including the questions have been reviewed and redesigned to match the requirements of physical board game.

This research is divided into four phases where each phase is related with the research questions and objectives. The targeted participants are primary and secondary school students in Negeri Sembilan dan Selangor. It is expected more than 100 participants will be assessed after playing the SET game. A preliminary survey before the game began and feedback form after the game ended will be given as the measurement tool to measure the knowledge of cybersecurity awareness during the SULAM project that will be carried out in June 2023.

In terms of the reliability and validity of this game, SET is designed by the information security lecturers and has been recognised via the international innovation competition (Malaysia Technology Exposition) 2023. SET is awarded Gold Award by the judges from industry and academician from other institution. This Table 1 summarized the research activities and the following expected outcome.

Table 1: Flowchart of Research Activities

| Phase 1 - Preliminary Study                                             |                                                                                                      |                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RESEARCH QUESTIONS                                                      | RESEARCH OBJECTVIES                                                                                  | RESEARCH PROCESS                                                                                                                                                                                                                                | EXPECTED OUTCOME                                                                                                                                                                                                                                                                                                                                                                                  |
| What are the social needs required by the early age citizen (students)? | To identify the social needs in educating early age citizen (student) about cybersecurity awareness. | <div>Define research area, research problem, objectives, and scope.</div> <div>↓</div> <div>Identify literature on existing related game-based learning.</div> <div>↓</div> <div>Review features of existing related game-based learning.</div> | <ul style="list-style-type: none"> <li>Defined problem statement, objectives, and scope.</li> <li>A comparison list of existing related game-based learning.</li> </ul>                                                                                                                                                                                                                           |
| Phase 2 – Preliminary Design                                            |                                                                                                      |                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                   |
| RESEARCH QUESTIONS                                                      | RESEARCH OBJECTVIES                                                                                  | RESEARCH PROCESS                                                                                                                                                                                                                                | EXPECTED OUTCOME                                                                                                                                                                                                                                                                                                                                                                                  |
| What are the social needs required by the early age citizen (students)? | To identify the social needs in educating early age citizen (student) about cybersecurity awareness. | <div>Identify cybersecurity threat and recommended solutions.</div> <div>↓</div> <div>Review and select the most relevant of cybersecurity threat and solutions.</div>                                                                          | <ul style="list-style-type: none"> <li>List of questions and answers for starting the board game.</li> <li>List of purchase items on cybersecurity solutions.</li> <li>List of questions and answers on cybersecurity for beginner level (L1).</li> <li>List of questions and answers on cybersecurity for intermediate level (L2).</li> <li>List of identified info on cybersecurity.</li> </ul> |

| Phase 3 – Preliminary Design                                                                      |                                                                                                                                                          |                                                                                                                                                                                                                      |                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RESEARCH QUESTIONS                                                                                | RESEARCH OBJECTVIES                                                                                                                                      | RESEARCH PROCESS                                                                                                                                                                                                     | EXPECTED OUTCOME                                                                                                                                                                     |
| How to integrate the cybersecurity game-based learning with integration of Naqli and Aqli (iNAQ)? | To design the game-based learning tool about cybersecurity with integration of Naqli and Aqli (iNAq) knowledge and towards building a resilient society. | <div>Identify and illustrate initial design of board game-based</div> <div>↓</div> <div>Design the physical board game and potential cards.</div> <div>↓</div> <div>Initial integration testing on board game.</div> | <ul style="list-style-type: none"> <li>List of questions and answers of ethical issues on the integration of iNAQ.</li> <li>Initial testing of integration of board game.</li> </ul> |

| Phase 4 – Evaluation and Validation                                                                                        |                                                                                                        |                                                                                                                                                                                                     |                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RESEARCH QUESTIONS                                                                                                         | RESEARCH OBJECTVIES                                                                                    | RESEARCH PROCESS                                                                                                                                                                                    | EXPECTED OUTCOME                                                                                                                                                                                                                |
| How the new proposed game in this research can assist users in education field and provide entertainment at the same time? | To evaluate the proposed board game engage with school and university students as an edutainment tool. | <div>Evaluation with the university students and get feedbacks.</div> <div>↓</div> <div>Improve the proposed game.</div> <div>↓</div> <div>Evaluation with school students and get feedbacks.</div> | <ul style="list-style-type: none"> <li>Result findings and suggested improvements.</li> <li>Participated in an innovation competition (Malaysia Technology Exposition) 2023 and Virtual Innovation Competition 2023.</li> </ul> |

### 2.1 SET Material

SET can be played by 2-6 players targeted to children above 8 years old to cultivate ethical behaviour among youngsters. SET is played in groups, so it also offers other benefits such as strengthening ukhwah, increasing social satisfaction and motivating learning. This cybersecurity board game will be used for early education in Service-Learning Malaysia University for Society (SULAM) course offered in USIM which can be a huge potential commercialization around at RM150 for early education level and society via social activities and global digital market platform.

## 2.2 Gamification

SET provides gamification concept where there are reward, level and badges are provided. It is an outcome-based product providing two levels of interactive quiz which are beginner (Ta'alim CyberSecurity L1) and intermediate (Ta'alim CyberSecurity L2). This quiz is to test player's knowledge where it acts as a quick and informal assessment of the player's knowledge. Meanwhile, reward will be given with score by earning their own money via security awareness quiz that will be used later as their initial salary to begin the board game. The winner will be decided based on the collected badge where every \$1000 will be given 1 SET badge. Each badge indicates the level of awareness on cybersecurity.

## 2.2 Edutainment concept

SET offers education and entertainment or known as edutainment concept where the player not only learn but they will enjoy playing this board game. The player is able to gain knowledge via Info SEC cards where they will be exposed to the cybersecurity information which can enhance their level of knowledge. Besides, the quizzes provided via Ta'alim CyberSecurity L1 and Ta'alim CyberSecurity L2 cards can also introduce new knowledge and information related to security. Since it presents in a board game, everyone can play together, and this led to an interactive discussion between them. By blending educational content with entertaining elements such as gamification, edutainment creates a captivating and immersive learning experience.

## 2.3 Board Design

This cybersecurity board provides the user with Integration of Naqli and Aqli (iNAQ) where there are important elements such as Ta'alim Cybersecurity, Ta'alim iNAQ, Qada' and Qadar, Do This and Info Sec. There is also buying item cards such as cybersecurity tool which can be used when the players needed. The design of the board game is shown in Figure 1.

- Ta'alim Cybersecurity  
Ta'alim cybersecurity exposes the user with security knowledge with two different levels which are beginner (L1) and intermediate (L2).
- Ta'alim iNAQ  
Ta'alim iNAQ integrates the Naqli and Aqli question on cybersecurity ethical and Muslim perspectives.
- Qada' and Qadar  
The player is required to take a card from the related section. Player may obtain a reward or penalty/punishment.
- Do This!  
The player is required to take a card from the related section and player should do as instructed by the card.
- Info Sec  
Take a card from the related section player and player will get information on the cybercrime cases.



Figure 4. SET design.

#### 2.4 How to Play

The user will be rewarded with score by earning their own money via security awareness quiz that will be used later as their initial salary to begin the board game. Each player is required to answer a set of five questions using the given Quiz Booklet simultaneously and compare the answers provided in the Answer Scheme booklet. Initial salary will be calculated based on each correct question with the amount of \$500 per question. The turn is decided based on the highest salary to the lowest salary and if the player obtained similar salary, the turn will be decided by rolling the dice. The player first must decide on the number of rounds that they want to play.

For the next following round, each player will be given the same amount of initial salary. The user will move around the board by rolling the dice and stop any of the boxes on the board game. The user has the option to end the game after one round or they may continue it. At the same time, the user will also enhance cybersecurity awareness when the player landed at the following boxes such as Ta'alim INAQ, Ta'alim CyberSecurity L1, Ta'alim CyberSecurity L2, Qada' and Qadar, Do This and and Info Sec box. The winner will be decided based on the collected badge based on the highest money at the end of the game. It offers flexibility of ubiquitous learning as it allows portability, accessibility, offline access, and free reliance from the technological aspect.

### 3. FINDINGS & DISCUSSION

115 respondents have played this SET board game during the two days event of National Science Week Carnival for Negeri Sembilan level that have been conducted on 26 and 27 May 2023 at Dewan Tuanku Canselor, Universiti Sains Islam Malaysia (USIM) as shown in Figure 2. While Figure 3 presents the showcase at Dewan Orang Ramai Taman Tasik Jaya that have been conducted recently on 14 June 2023 for SULAM course. The respondent's can answered the survey once the have completed playing the board game via scanning the QR code of survey by using the provided smartphone and tablet at the booth to ease the collecting data survey.



**Figure 2.** The booth SET during National Science Week Carnival, for Negeri Sembilan level on 26 and 27 May 2023.

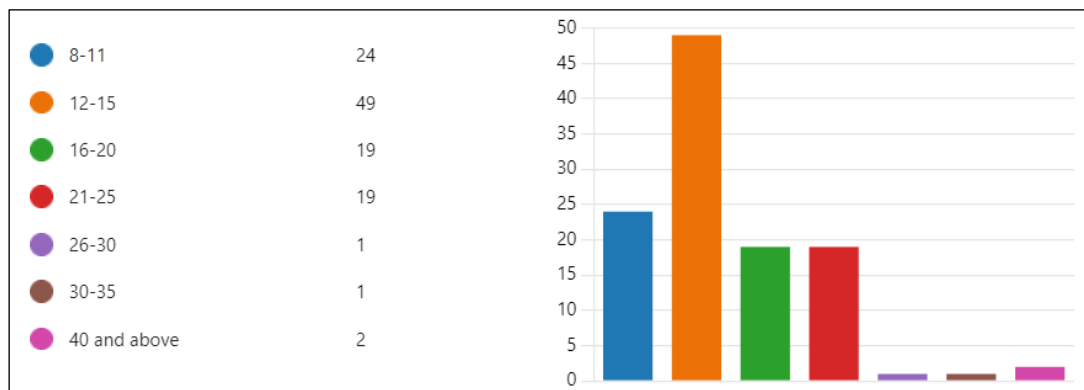
91% of the respondents voted that this game could attract users to deepen their information security knowledge while 85% respondents agreed that cybersecurity awareness knowledge has increased after playing SET.



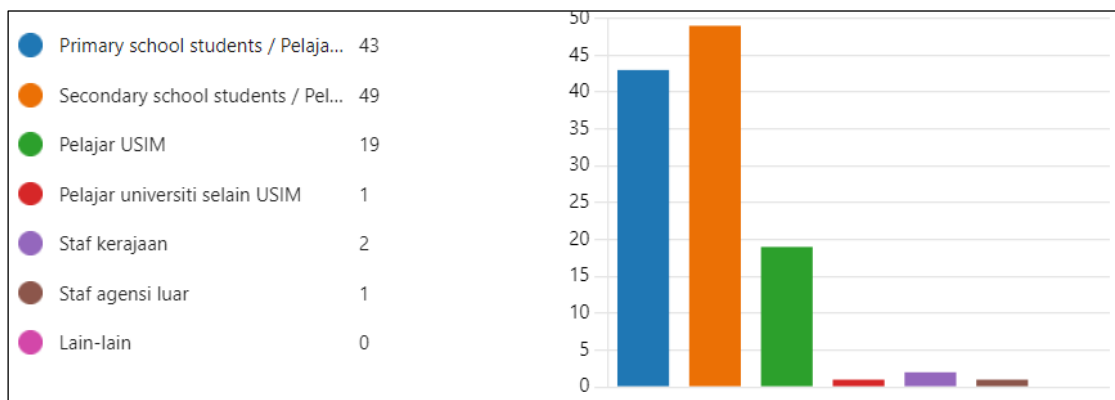
**Figure 3.** SET for SULAM course.

### 3.1 Demographic of Respondent

The respondent's distribution of age ranges from 8 years old till 40 and above can be found in Figure 4. Figure 5 displays a variety of respondent's status which are from primary, secondary school students, USIM students, other universities, government agency and non-government agency. Secondary school students are among the highest respondents that contributed to this user evaluation survey that has been carried out for two days at Dewan Tuanku Canselor USIM. Majority respondents are from Sekolah Menengah Kebangsaan Seremban 2, Sekolah Menengah Kebangsaan Datuk Undang Abdul Manap, Sekolah Menengah Kebangsaan Nilai Impian, Sekolah Menengah Agama Dato Klana Petra Maamor, Sekolah Kebangsaan Seremban Jaya, Sekolah Menengah Agama Nilai, Sekolah Kebangsaan Desa Jasmin, Sekolah Kebangsaan Desa Cempaka and Sekolah Rendah Islam (SRI) Al-Amin Nilai.

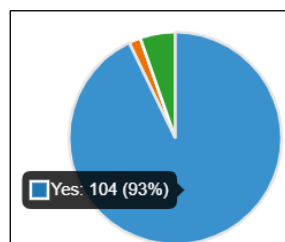


**Figure 4.** Age range for the SET survey.

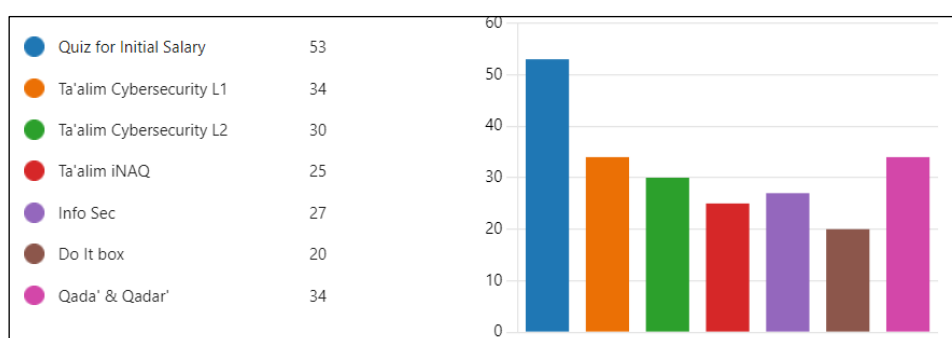


**Figure 5.** Status of the respondent that answered the SET survey.

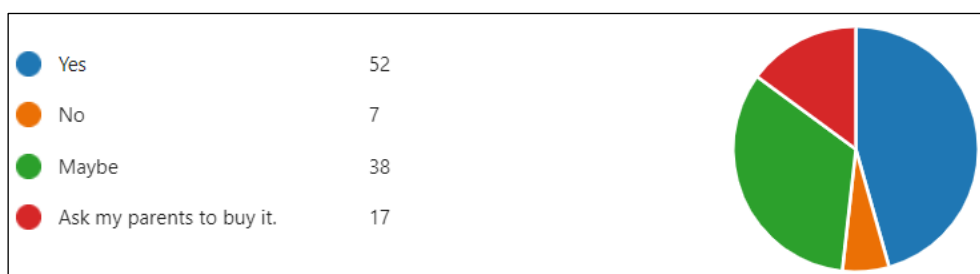
Figure 6 showed that 93% of them enjoyed playing SET board games. Figure 7 shows the variety of answers from respondents on which part of the game they find useful. Each respondent can answer more than one option. For the commercialization in future as shown in Figure 8.



**Figure 6.** Three different answers which are (Yes (blue), No (orange) and Maybe (green) for asking whether the respondents enjoy playing the game.



**Figure 7.** Most respondents prefer the beginning quiz for getting the initial salary and followed with the cybersecurity quiz while playing the board game when landed at Ta'alim Cybersecurity L1 and L2 boxes.



**Figure 8.** Most respondents (blue color) willingly to buy this edutainment (education and entertainment) board game while the small kids choose to ask their parents to buy it for them.

#### 4. CONCLUSION

Secure Cybercitizenship (SET) is a physical cybersecurity board game that can enhance security awareness among computer and Internet users in a fun and interactive ways. This board game offers huge potential commercialization for early education level and society to produce cyberliterate users. It will be used for Service-Learning Malaysia – University for Society (SULAM) course. It has a huge impact on society, quality education and country. With this SET board game, it can increase cybersecurity awareness literate society where the user can gain new knowledge related to security which can enhance their knowledge level. It also will be an engaging tool for school and university students via fun and interactive learning board games. With that, it can reduce cyberattacks incidents,

align with Malaysia's National Cyber Security Agency (NACSA) and Jabatan Siasatan Jenayah Komersil Royal Malaysia Police motto "Be Smart Stay Alert".

**Acknowledgments:** The authors would like to express their gratitude to the Research and Innovation Centre for the support of this research grant PPPI/BM/FST/USIM/13723.

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