EFFECT OF SECURITY EDUCATION USING GAMIFICATION

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Abstract

It’s the important problem in which a cyberattack cooperates with increasing industry closely to bring the human resources who could excel OT security up. The educational effect in the multiple practice and a problem of KIPS based on Gamification theory were considered. More than one performance contributed to the simple educational effect as a result of the experiment, and some things knew a possibility of the affirmative skill move, but KOSEN where the educational contents which can close a gap of more than one practice are needed has the big mission which renews a curriculum of a practice base all the time.

Keywords: security education, gamification theory, operational technology, ICT

Introduction

The cyberattack of industrial equipment is getting really hot in the industry. Japan's National Institute of Technology (KOSEN) has produced many high-quality industrial engineers in the industry. Last year, we started a cyber security education project and developed an educational system faced with the threat of cyberattack. The fact that KOSEN's students have security skills and knowledge leads to strengthening of cyber security in the field of OT (Operational Technology), so that students can contribute to the industry. Although we have promoted ICT security education using our own educational content, we believe that it is not easy to learn OT security at that time, cybersecurity developed by ourselves. Since many OT security can be learned by actual operation, there is an aspect that it is difficult to obtain the expected educational effect without actual industrial equipment and environment.

KIPS (Kaspersky Interactive Protection Simulation), which has developed by Kaspersky Lab, is the board game using Gamification Theory that we can experience the cyber security practice and will be possible to carry out actual practice by simulating realistic scenarios. In our security educational project, we are advancing the education using KIPS, and examined the relationship between the educational effect using the security contents we developed and the effect using KIPS [1].

It was possible to confirm the difference between to consider the security educational effect which practiced the “Enterprise scenario (Corporate version)” which is KIPS where we are toward ICT security and the “Plant scenario (Water Plant version)” which is KIPS where we are toward OT security and practice a ICT security skill and to practice a OT security skill there, we got the very useful knowledge to consider future's educational policy for the technical college which produces human resources to the industrial world.

The industrial world tries to practice KIPS more than one times targeted for the technical college rawness which acquires a basis of the engineer who can play an active part in such flow this time. When the effect of practicing KIPS more than one times is admitted, the framework to take in during educational policy and excrete stronger human resources effectively can be strengthened. The relation between the skill of OT security and the ICT security skill is also considered in more than one times of implementation. Consideration on this relation will be something to grope after a possibility of the skill transfer with effective OT security and ICT security, and we contribute to improvement of future's educational practice as expected.

Gamification Theory and KIPS

We describe two topics that support the fundamental direction of practice of education using the contents applying the gamification theory which is essentials of our investigation.

A. Gamification Theory

The definition of Gamification has been used as "the use of game-play mechanics for non-game applications" [2] and it is used in many areas such as education, business and medicine. One of the important features of learning by using Gamification or Game-Based Learning is that students actively learn problems and take solutions by facing problems. Problem solving with gamification is also noted to be an important benefit of using games in education [3, 4]. A problem-solving mechanism built with a game-based strategy enables both knowledge acquisition and its application throughout the learning process.
B. KIPS (Kaspersky Industrial Protection Simulation)

KIPS is the cyber security practice by team battle which designed to enhance analytical skill about problems on the cyber security and the risk about latest computer system in operation [5, 6]. Educational targets are executive managers including business managers, departmental managers and information security administrators.

The purpose of KIPS is that to prevent the profit maximally and to preserve the trust during exposure to a series of unexpected cyber threats. The aiming is that to develop and run the cyber defence tactics by selecting best suited plan out of cyber security countermeasure prepared preliminarily (see Figure 1).

(1) Completing in a short time (two hours) while concentrating and having fun in the form of a game
(2) Building up cooperativeness crossover the organization by teamwork
(3) Train upping the autonomy and analytic skill by re-experiencing realistic security events

Practical Procedure and Results

KOSEN students who belong Dept. of Electrical and Electronic Engineering practiced KIPS. They played it total four times. First they played the Water Plant version (see Figure 2) of KIPS twice and then played the Corporation version (see Figure 3) of KIPS twice. Concretely, they played the Water Plant version again after three days of first playing the Water Plant version. And they played the Corporate version of KIPS after four days of second playing of the Water Plant version and then they played the Corporate version again after seven days of first playing the Corporate version.

Figure 2 Water Plant version of KIPS

Figure 3 Corporation version of KIPS

We can confirm the effect of embeddedness of OT security skill and knowledge on multiple playing by examining the score of first playing the Water Plant version of KIPS twice. And we can examine the possibility of skill transfer between OT security and ICT.
security which have different fundamental by examining to compare the score of second play of the Water Plant version with the score of first play of the Corporation version (that is third playing as a whole). Finally, we can also confirm the effect of embeddedness of ICT security (this is the point which is not OT security, that is the ICT security) skill and knowledge on multiple playing by comparing the score of first playing the Corporation version of KIPS twice (the third and fourth playing as a whole) as is the case with examining on twice playing of the Water Plant version.

A. The results of first and second playings of the Water Plant version of KIPS

Figure 4 shows both score of first playing of the Water Plant version and second playing of the one on the scatter diagram. These scores have already standardized, and we said here that subsequent scores were standardized, too. As this result, we can confirm that second score is higher than first one significantly (tow-tailed t-test, \( p < 0.05 \)) and multiple playing makes the effect of certainly embeddedness of skill which they learned (a result of decorrelation test shows that coefficient of correlation had comparatively strong correlation with significant).

B. The result of second playing of the Water Plant version of KIPS and first playing of the Corporation version of KIPS

Figure 5 shows the scatter diagram between the score of second playing of the Water Plant version of KIPS and the score of first playing of the Corporation version of KIPS (which was third playing of KIPS as a whole). It is peculiar to which we can’t recognize the positive correlation and we can find negative correlation with no significant although the score of second playing is higher than first playing in totality differ from the comparison of Water Plant versions (a result of decorrelation test shows that coefficient of correlation had on significant). This result showed that a lot of reversal case on which the score of second playing is simply higher than the first playing occurred, and that result makes we can’t simply confirm the effect of multiple playing.

C. The result of third and fourth playing of the Corporation version of KIPS

Figure 6 shows both score of first playing (third playing as a whole) of the Corporation version and second playing (fourth playing as a whole) of the one on the scatter diagram. It is peculiar to which we can’t recognize the positive correlation and we can find negative correlation with no significant although the score of second playing is higher than first playing in totality differ from the comparison of Water Plant versions (a result of decorrelation test shows that coefficient of correlation had on significant). This result showed that a lot of reversal case on which the score of second playing is simply higher than the first playing occurred, and that result makes we can’t simply confirm the effect of multiple playing.

These results show that the possibility of the difference of difficulty between the versions on KIPS and the possibility that is different from simple effect that playing number of times influenced the score on the educational effect concerning operational skill and the skill based on knowledge about OT security and ICT security. This result was the important findings while we examine the educational effect and concept in the future. That is, we can suggest the possibility that we need the educational contents which can complement effectively between the multiple playing.
Figure 6 Scatter diagram of the scores about first and second playing the Corporation version

Conclusions

To produce human resources who are good at OT security is important task for KOSEN which is closely cooperation with the industry on which faces increasing cyber-attacks. To incorporate the educational effect using Gamification theory which KIPS has can contribute to accomplishment of original goal on which we have operated our (KOSEN) original security education. In this time, we examined the effect and issues on multiple practicing of KIPS while we advance a series of research to examine the security educational effect using KIPS. Multiple playing made that we can confirm simple positive effect on our practicing the version which has domain of OT security skill mainly. Moreover, we can find that the possibility which OT security skill can transfer to ICT security skill. However, we can’t confirm simple embeddedness of security skill and knowledge by multiple playing while we practiced the version which has domain of ICT security skill mainly. This result showed the needs of educational contents which can complement effectively the gap of multiple playing, and we obtain a great future works to develop such some effective educational contents and to measure that effect at the same time.

References

