1. INTRODUCTION

Drag abuse issue is a common problem in the world. Some news media reported that drugs are spreading rapidly around the world, and causing problems [1, 2]. In World Drug Report 2019 [3], United Nations Office on Drug and Crime (UNODC) estimated 271 million people had used drugs in 2017; it increased by 30 percent since 2009. The report emphasizes that young people, especially 12-25 years old people, tend to use drugs and get health problems from the drugs. Our World in Data [4] also reported that more younger generation people are getting harms because of substance abuse than elder generation people.

To protect young people from drug-related damages, anti-drug educations [5,6] are conducted. In the education programs, several types of anti-drug educational materials have been developed. For example, Taiwanese government has been promoting anti-drug education through lectures and activities [7]. They help students establish correct sense-of-values for their health, and increase their anti-drug ability.

A main purpose of the anti-drug educations is to learn the harms and risks of drugs and skills to avoid them. However, it is not easy to learn such things with traditional learning materials, e.g. textbooks and videos, because it is difficult for learners to image actual situations which have social pressures from friends and fears of harms realistically. If they cannot image the situations, they also cannot empathize them by their emotions and it prevents their significant learnings. As a technology to solve the problem, virtual reality system (VR system) can be expected. In this paper, a learning material with VR system (VR-based learning material) for getting anti-drug skills is proposed. With this material, learners can have experiences of temptations to touch drugs and the farrowing results. Then, the results of experiments are shown to evaluate the proposed system from aspects of learners’ motivations, satisfactions, and anti-drug self-efficacy. As the result, it became clear that learners can learn effectively with the VR-based learning material more than with the video-based learning material.

2. BACKGROUND

2.1 Risk factors for teenagers and educations

Many countries are carrying out measures required for protecting young people from harms of drugs. For example, Japan Pharmaceutical Association provides several text-books for anti-drug educations through the home page [8]. It sends pharmaceutical technicians to anti-drug education class as teachers too. In 2016, 82.5% of elementary schools, junior high schools, and high schools conducted such classes and 9,364 pharmaceutical technicians were sent to the classes.

Multi media materials are also used in the education programs. In Japanese schools, students watch educational video and play online games to learn about anti-drug skills. Especially, the online games attract students’ interests and help students understand the problems from drugs.
In Taiwan, students study effects on their health by using VR/AR based learning materials.

The results of survey by Drug-Free World Foundation show that the reasons teenagers start to touch drugs are; mere curiosities, temptation from friends, and escape/oppositional behaviors. Especially, they get significant effects from friends of them. When they meet the situations in which their friends smoke, drink alcohol, and use drugs, and suggest them these things, they tend to follow the suggestions because of their self-esteem needs [9]. One of their main channels of obtaining drugs is also friend.

Thus, to avoid the risks of drugs, they need to learn not only the knowledges about drugs but also skills to surmount temptations and social pressures from friends. Educational program which teach both of knowledges and social skills can reduce using drugs significantly [10].

2.2 Learning materials with VR technology

VR is widely used in different domains, such as medical care, e-commerce, and education, to assist learning in domain knowledge and skills. Because the technology can provide interactive communications, immersion, and imaginative environment, it gives new learning media to educators and learners. VR technology can provide also attractive learning environments to learners and can enhance their learning experiences significantly [11]. Thus, students’ motivations and attentions are improved [12, 13]. It is also reported that learners’ emotion was more positive when they used a 360-degree VR system than when they used a traditional video material for learning aerography [14]. Positive emotions in learning processes effect positively in future learning behaviors of the learners [15]. VR system can provide users dangerous experiences without serious risks. Thus, we can learn many unusual situations in the environments. For example, students of an elementary school practice fire safety behavioral skills in a VR environment, so that they can apply their skills to real situations [16]. VR-system can provide concrete experimental environment safely [17,18]. Therefore, by using VR system, interactive, authentic, and secure learning environments are expected, and they help to improve motivations of the learners.

PC head-mounted display (HMD) of virtual reality devices have high immersion characteristics, but the user’s activity range will be limited by the length of the cable [19]. It is a disadvantage for learning materials used in schools. Cost is also an important factor for learning materials used in schools. Introducing HMD needs to take high costs of time and budget. Meanwhile, mobile VR has lower immersion characteristics, and it has some valuable features such as low cost, easy to carry, and easy to develop applications for developers [17]. Because of these characters, it is more suitable for learning materials used in schools.

3. SYSTEM DESIGN

3.1 Design concepts

Motivation and satisfaction: In the past, style of the anti-drug educations was with lectures and films. It has not frequent interactions with learners. Because of the passive learning style, it was difficult for many students to keep their motivations and concentrations for learning. Motivation is an important factor for educations, and it is an indicator of satisfaction of learners. Motivation is an internal state of human that affects to activation level, continuousness and direction of the action [20]. Thus, we have to consider about learners’ motivation when we develop education materials.

Usually, many learners have never used drugs. Most of them have never even seen drugs. For such learners, it is difficult to image situations of consequences of drug abuse with realities. Such learners difficult to consider the risks as serious one which they could encounter in the future. As a result, their learning satisfactions tend to be low. Thus, we also have to consider to give learners realities when we develop anti-drug education materials.

Self-efficacy: Self-efficacy has a significant impact on learning achievement [21-23]. Bandura [24] argued that self-efficacy is the foundation of human motivation. Self-efficacy means a person’s confidence and belief for an action or a task in which he/she can accomplishable it at a certain level [25]. To get high level self-efficacy, successful experiences are important. To have successful experiences, people can believe that they surely get the abilities. By using VR system for educations, learners can immerse themselves in several simulated situations [26], and the technology can enhance learning effectiveness [27].

Based on the above discussions, in this paper, a learning material with VR system (VR-based learning material) for anti-drug education is proposed. In the material, educational contents for anti-drug skills are displayed on the Google cardboard display as 360-degree views. The learners can study their interesting points by following textual and audio instructions.
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3.2 Process of developing the VR-based learning material

Developing process of the proposed VR-based learning material is shown below. The process consists of six steps:

1. **Create a scenario:** A storyboard of learning content is created.
2. **Capture scenes of scenario:** Footages of the scene are shoot as 360-degree photos by using 360-degree camera (RICOH THETA®).
3. **Create project:** A project is created on Tour Creator platform [28], and the captured scenes are uploaded on the project.
4. **Edit scenario:** The project is edited according to the storyboard.
5. **Publish and Download:** Publish the project and download it on Google Expeditions [29].

Finally, learners can study the contents with google cardboard. The schematic diagram of experiencing an anti-drug learning environment is shown in Fig. 1.

3.3 Anti-drug content

We decided the theme of the VR system of anti-drug as “Friend’s temptation and drug deal.” The main scene of the story was in a classroom, two students are speaking about their lives. One person is in a dilemma in which his mother pressed by the financial burden, and he wants to help her. The other proposes him to sell drugs to solve the problem. He can make money easily by accepting his offer. So that he was in the temptations of peer and inner desires. Scenario design is mainly to let learners feel interpersonal pressure again and again. In the case of friends repeatedly persuading you to use drugs and selling drugs. The learners have to make their decision under the situation. Figure 2 shows an outline of the scenario. In order to attract learners to learn anti-drug issues and to expose them in the situation, VR environment is used.

Through the VR experience, learners can reduce risks of drug abuse come from social pressures.

### EXPERIMENT

4.1 Experiment design

Based on the literature review [30, 31], the following three hypotheses are made:

**H1** Learning motivation (LM): The VR learning environment could prompt students’ motivation for learning.

**H2** Learning satisfaction (LS): When students use VR system that could make them feel satisfied during the learning process.

**H3** Self-efficacy (SE): Designing a curriculum with a contextual story to make students to explore and affect self-efficacy and awareness after learning VR content.

Experiments were conducted in order to test the above hypotheses. Figure 3 shows the flows of the experiments. First, participants need to fill in the questionnaire of anti-drug self-efficacy (pre-test). Next, participants were divided into two groups, experimental group and control group. The participants in the experimental group studied on the proposed system at individual paces, from 10 to 15 minutes. Figure 4 (A) shows a scene of the experiments.
of the experimental group. Participants of the control group watched a teaching video for learning anti-drug projected on a screen. The movie was created by recording the screen of the VR system. Thus, the video has a similar story with the VR system. Figure 4 (B) shows a scene of the experiment of the control group. And finally, participants’ anti-drug self-efficacy, learning motivation, and learning satisfaction were evaluated by means of questionnaires (post-test). The system was also evaluated from the aspects of effect on the students’ attitudes and students’ satisfaction. 

4.2 Participants

The participants of the experiment are twenty-four university students. They were shown the process of the experiment, and given the following guidance:

- They can stop the experiment anytime.
- Each set of data is kept with an ID number. Thus an individual cannot be identified from the data.

As a result, they took part in the experiments voluntarily. The participants were divided into two groups, (1) experimental group (VR group) and (2) control group (Video group). In the experiment, 12 participants (10 males, 2 females) were assigned to the experimental group. The participants are from 20 to 24 years old (Mean = 22.33, SD = 1.07); 12 participants (11 males, 1 female) were assigned to the control group. The participants are from 21 to 28 years old (Mean = 21.33, SD = 1.82).

4.3 Questionnaires

The assumptions shown in Section 4.1 are investigated by using questionnaires. The question items were decided based on previous studies. The question items of questionnaires are shown in Table 1.

Learning motivation (LM): Six question items are used to evaluate learning motivation (LM). These items were decided based on Ferguson’s work [30].

Learning satisfaction (LS): Six question items are used to evaluate learning satisfaction (LS). These items were decided based on previous studies [31,32].

| Question | Description |
|----------|-------------|
| Q1       | This learning material is very attractive to me. |
| Q2       | This learning material makes me more concentrate on learning. |
| Q3       | This learning material excite my interest in drag problems. |
| Q4       | This learning material can improve my concentration. |
| Q5       | This learning material makes me confident in learning drag problems well. |
| Q6       | This learning material helps me to understand the drag problem well. |
| Q7       | I am satisfied studying with the experience. |
| Q8       | I am satisfied with the sounds and images. |
| Q9       | I am satisfied with the convenience of the learning material. |
| Q10      | I am satisfied with the exploratory learning of 360° VR (video). |
| Q11      | I am satisfied with the course content of the learning material. |
| Q12      | Overall, I am satisfied with the learning material. |

Anti-drug self-efficacy (SE)

| Question | Description |
|----------|-------------|
| Q13      | I can identify reliable and correct anti-drug information. |
| Q14      | I can clearly understand the hazards of drug abuse. |
| Q15      | I can bravely refuse drugs. |
| Q16      | If a friend of mine entices me to use drugs, I can refuse it skillfully and steadfastly. |
| Q17      | I can judge believability of information about drags heard from friends of mine. |
| Q18      | If a friend of mine entices me to use drugs, I can tell him/her the major health hazards appropriately. |
the LM and LS scales had good reliability (Cronbach’s α was 0.81 and 0.69, respectively). Table 2 shows the results of questionnaires. Each number shows average score for each evaluation aspects, i.e. LM and LS.

**Anti-drug self-efficacy (SE):** Six question items to evaluate self-efficacy were decided based on some previous studies [33, 34]. The scales had good reliability (Cronbach’s α was 0.86).

A five-point Likert scale is used for the questionnaires where “1” stands for “totally disagree” and “5” stands for “totally agree”. In addition, each participant wrote his/her feedbacks in the free description field.

### Table 2: Results of the experiments

| Participants | Anti-drug self-efficacy (SE) | Learning motivation (LM) | Learning satisfaction (LS) |
|--------------|------------------------------|--------------------------|---------------------------|
|              | Pre-test | Post-test | Pre-test | Post-test | Pre-test | Post-test | Pre-test | Post-test |
| VR-1         | 3.67     | 3.67     | 3.50     | 4.17     |           |           |           |           |
| VR-2         | 3.83     | 4.50     | 4.83     | 3.33     |           |           |           |           |
| VR-3         | 3.67     | 4.17     | 3.67     | 3.67     |           |           |           |           |
| VR-4         | 5.00     | 5.00     | 5.00     | 5.00     |           |           |           |           |
| VR-5         | 4.67     | 5.00     | 4.83     | 4.83     |           |           |           |           |
| VR-6         | 4.00     | 4.83     | 4.83     | 4.17     |           |           |           |           |
| VR-7         | 4.00     | 4.50     | 3.00     | 4.00     |           |           |           |           |
| VR-8         | 4.83     | 4.83     | 3.67     | 4.17     |           |           |           |           |
| VR-9         | 4.17     | 4.50     | 3.67     | 3.17     |           |           |           |           |
| VR-10        | 4.83     | 5.00     | 4.33     | 3.67     |           |           |           |           |
| VR-11        | 4.17     | 4.67     | 4.00     | 4.17     |           |           |           |           |
| VR-12        | 3.33     | 4.33     | 3.83     | 3.83     |           |           |           |           |
| Video-1      | 4.17     | 5.00     | 4.67     | 4.67     |           |           |           |           |
| Video-2      | 4.17     | 4.83     | 4.00     | 4.33     |           |           |           |           |
| Video-3      | 5.00     | 5.00     | 4.83     | 5.00     |           |           |           |           |
| Video-4      | 4.00     | 4.00     | 4.00     | 4.00     |           |           |           |           |
| Video-5      | 2.83     | 3.67     | 4.00     | 4.33     |           |           |           |           |
| Video-6      | 3.67     | 4.00     | 3.50     | 4.00     |           |           |           |           |
| Video-7      | 4.67     | 5.00     | 4.83     | 4.17     |           |           |           |           |
| Video-8      | 4.50     | 5.00     | 4.50     | 4.50     |           |           |           |           |
| Video-9      | 3.67     | 3.33     | 3.50     | 3.83     |           |           |           |           |
| Video-10     | 4.50     | 5.00     | 4.83     | 5.00     |           |           |           |           |
| Video-11     | 4.00     | 4.00     | 3.50     | 4.33     |           |           |           |           |
| Video-12     | 3.83     | 4.17     | 3.83     | 3.33     |           |           |           |           |

### Table 3: Results of analyses

| Group   | Mean | SD  | p-value |
|---------|------|-----|---------|
| Learning motivation (LM) |         |     |         |
| VR      | 4.10 | 0.65| 0.78    |
| Video   | 4.17 | 0.54|         |

| Learning satisfaction (LS) |         |     |         |
| VR      | 4.01 | 0.54| 0.19    |
| Video   | 4.29 | 0.48|         |

### Table 4: Means and SDs of pre/post-test of SE for each group

| Group  | Pre-test | Post-test | Pre-test | Post-test |
|--------|----------|-----------|----------|-----------|
| VR     | 4.18     | 0.54     | 4.58     | 0.40     |
| Video  | 4.08     | 0.57     | 4.42     | 0.62     |

## 5. RESULT AND DISCUSSIONS

### 5.1 Quantitative analysis

Table 3 shows the results of analyses of the experiments. In this table, means and SDs of LM and LS are shown for each group. The both of the results of LM and LS, there are not significant differences between the two groups (p>0.05).

Table 4 shows the means of SE of pre-tests and post-tests for each group. Both of the groups, the result of post-test is better than the result of pre-test. VR group increased 0.40 meanwhile Video group increased 0.34. In order to investigate the detail, results of pre-test and post-test of each question item were compared for each group. Table 5 shows the result. From the table, we can see that most of the item increased significantly after learned with the VR-based learning material. On the other hand, only one item increased after learned with the video-based learning material.

The sense of reality and urgency provided by the VR-based learning material could effect the results. The students felt peer pressure through the scenario, and they could concentrate study the anti-drug knowledges.

After learned with the VR-based learning material, most of the results has improved. However, only the results of Q15 and Q16 have no significant differences between the pre-test and the post-test. The two question items asking refusing drugs, i.e. “I can bravely refuse drugs,” and “If a friend of mine entices me to use drugs, I can refuse it skillfully and steadfastly.” The answers of these question strongly depend...
on the story of the educational contents. In the scenario used in the experiments, a person who has trouble of economy is suggested to sell illegal drugs as a part time job. This situation cannot be empathized with everybody despite an understandable one. Qualities of the story are not the scope of this paper, but it is also important element when we develop learning materials. Thus, we should better to consider the point in the future. For example, stories which have multi scenario developments based on individual learner’s conditions can improve the efficiency of the system.

5.2 Qualitative analysis
Most of the participants were excited and interested when they were learning with the learning materials. Specific feedbacks from the participants are shown below:

**Video-1**: Unlike watching usual videos, I felt like watching them nearby. So that I could make decisions by putting myself in the position of the scenes.

**Video-4**: It is a good video. I can understand the situation easily.

**Video-9**: The video-based learning material is easy to understand visually, and the texts are also well-designed for effective learning. I could concentrate easily on the video contents. On the other hand, I could not look back at the part that I missed\(^1\).

**VR-7**: The VR-based learning material can provide immersive environment. I felt I was getting into the scenario\(^2\). I think if the operability is better, we can use it in schools\(^3\).

**VR-11**: Because the VR-based learning material can provide a tense atmosphere\(^4\), so it helps to understand the danger of drugs and how to refuse the temptations to use them.

**VR-12**: I think that the VR-based learning material can help understand deeply by providing feelings of being in the situation. I think that the poor operability causes negative effect on comfortable learning\(^5\).

From these feedbacks, we can see that both of the learning materials can help understand the situations and learn anti-drug knowledge.

**Video-9** (1) points out a problem of the video-based learning material. In the educational material, if learners missed a scene, they cannot play back the scene again by themselves. On the other hand, learners can watch where they want to watch with the VR-based learning material. It can be said as an advantage of VR-based learning materials.

**VR-7** (2) and **VR-11** (3) point out that the VR-based learning material can provide a sense of immersion and a tense atmosphere. Learners can feel the pressures realistically with this learning material. Thus, the learning material makes an impression on the learners’ memories.

**VR-7** (3) and **VR-12** (5) point out a problem of the VR-based learning material. Many of the participants had never used any VR-based system before, and they could not operate the device skillfully during the experiments. In addition, we used a low-end VR device by considering initial costs for introducing educational institutions. It also makes the operations difficult. These facts made the participants difficult to focus on anti-drug learning contents. Device and system operation major impacted learning. The device and the human-interface must be considered to improve the system.

6. CONCLUSION
In this paper, a VR-based learning material for anti-drug education is proposed. To evaluate the learning material, experiments were conducted. In the experiments, the proposed tool was compared with a video-based learning material which has the same contents from the aspects of learning satisfaction (LS), learning motivation (LM), and self-efficacy (SE). The results can be summarized as follows:

With regard to LS and LM, there are no significant differences between the two learning materials. However, the results were more improved by learning with the VR-based learning material than learning with the video-based learning material.

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**Table 5**: P-values of t-test, compared the results of pre-test and post-test of SE for each question item

| Item | p-value |
|------|---------|
| Q13  | 0.013** |
| Video| 0.137   |
| Q14  | 0.004** |
| Video| 0.111   |
| Q15  | (none)  |
| Video| 0.166   |
| Q16  | 0.590   |
| Video| 0.166   |
| Q17  | 0.039*  |
| Video| 0.004** |
| Q18  | 0.039*  |
| Video| 0.338   |

* p <.05; ** p <.005; *** p <.001
With regard to SE, the results show that the VR-based learning material is better than the video-based learning material. By using VR environments, the learners can be immersed in the situations, and it can effect positively on the learning.

As a future work, we have to consider the usability. In the experiments, the poor usability often obstructed immersion of the participants. The device is made of cardboards and stiffness of the body is low. Especially, the control button does not work stably. On the other side of the coin, the cheap device is an ideal one for introducing mass educational institutions. We have to improve the operational interface with considering both of usability and costs.

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REFERENCES
1. Jones, S.; Cocaine seized from ‘narco-submarine’ in Spain was likely headed for UK, The Guardian, November 2019.
2. Doherty, B.; Sydney woman maria exposto has drug conviction and death sentence overturned in Malaysia, The Guardian, November 2019.
3. Costa, A.M.; World drug report 2019, Tech. Rep., United Nations Office on Drugs and Crime, 2019.
4. Hannah, R., and Max, R.; Drug use, Our World in Data, 2019.
5. Wilson, R., and Kolander, C.; Drug abuse prevention: A school and community partnership, Addison Wesley Longman Press, New York, 1997.
6. Ray, O., and Ksir, C.; Drugs, society, and human behavior, Times Mirror, St. Louis, 1995.
7. You use a drug, or not?, https://antidrug.mo.gov.tw/cp-48-6520-2.html (accessed 2021.04.12). (in Taiwanese)
8. Materials for supporting educations; https://www.mhlw.go.jp/bunya/iyakuhin/yakugai/index.html (accessed 2021.04.12). (in Japanese)
9. Huang, C.M., Lin, L.F., Lee, T.C., and Guo, J.; Proximal to distal correlates of the patterns of illicit drug use among night school students in Taiwan, Addictive behaviors, 38(1), pp.1481-1484, 2013.
10. Tobler, N.S., and Stratton, H.H.; Effectiveness of school-based drug prevention programs: a meta-analysis of the research, Journal of Primary Prevention, 18(1), pp.71-128, 1997.
11. Chen, X., Chen, Z., Li, Y., He, T., Hou, J., Liu, S., and He, Y.; ImmerTai: immersive motion learning in VR environments, Journal of Visual Communication and Image Representation, 58, pp.416-427, 2019.
12. Alfalah, S.F.; Perceptions toward adopting virtual reality as a teaching aid in information technology, Education and Information Technologies, 23(6), pp.2633-2653, 2018.
13. Parong, J., and Mayer, R.E.; Learning science in immersive virtual reality, Journal of Educational Psychology, 110(6), pp.785-797, 2018.
14. Ulrich, F., Helms, N.H., Frandsen, U.P., and Rafn, A.V.; Learning effectiveness of 360° video: experiences from a controlled experiment in healthcare education, Interactive Learning Environments, 29(2), pp.1-14, 2019.
15. Wrzesien, M., and Raya, M.A.; Learning in serious virtual worlds: evaluation of learning effectiveness and appeal to students in the E-junior project, Computers and Education, 55(1), pp.178-187, 2010.
16. Çakiroğlu, Ü. and Gökoğlu, S.; Development of fire safety behavioral skills via virtual reality, Computers and Education, 133, pp.56-68, 2019.
17. Estriegana, R., Medina-Merodio, J.A., and Barchino, R.; Student acceptance of virtual laboratory and practical work: an extension of the technology acceptance model, Computers and Education, 135, pp.1-14, 2019.
18. Freina, L., and Ott, M.; A literature review on immersive virtual reality in education: state of the art and perspectives, The International Scientific Conference e-Learning and Software for Education, 1, p.133, 2015.
19. Papachristos, N.M., Vrellis, I., and Mikropoulos, T.A.; A comparison between oculus rift and a low-cost smartphone VR headset: immersive user experience and learning, 2017 IEEE 17th International Conference on Advanced Learning Technologies (ICALT), pp.477-481, 2017.
20. Kleinginna, P.R., and Kleinginna, A.M.; A categorized list of motivation definitions, with a suggestion for a consensual definition, Motivation and Emotion, 5(3), pp.263-291, 1981.
21. Honicke, T., and Broadbent, J.; The influence of academic self-efficacy on academic performance: a systematic review, Educational Research Review, 17, pp.63-84, 2016.
22. Lee, W., Lee, M.J., and Bong, M.; Testing interest and self-efficacy as predictors of academic self-regulation and achievement, Contemporary Educational Psychology, 39(2), pp.86-99, 2014.
23. Lee, Y.S., and Jonson-Reid, M.; The role of self-efficacy in reading achievement of young children in urban schools, Child and Adolescent Social Work Journal, 33(1), pp.79-89, 2016.
24. Bandura, A.; Self-efficacy: the exercise of control, W.H. Freeman, New York, 1997.
25. Bandura, A.; Perceived self-efficacy in cognitive development and functioning, Educational Psychologist, 28(2), pp.117-148, 1993.
26. Serrano, B., Baños, R.M., and Botella, C.; Virtual reality and stimulation of touch and smell for inducing relaxation: a randomized controlled trial, Computers in Human Behavior, 55, pp.1-8, 2016.
27. Messinis, I., Saltaouras, D., Pintelas, P., and Mikropoulos, T.; Investigation of the relation between interaction and sense of presence in educational virtual environments, 2010 International Conference on e-Education, e-Business, e-Management and e-Learning, pp.428-431, 2010.
28. Tour Creator; Create a virtual tour, https://arvr.google.com/tourcreator/ (accessed 2021.04.12).
29. Google; Bring your lessons to life with Expeditions, https://edu.google.com/products/vr-ar/expeditions/ (accessed 2021.04.12).
30. Chittaro, L., and Sioni, R.; Serious games for emergency preparedness: evaluation of an interactive vs. a non-interactive simulation of a terror attack, Computers in Human Behavior, 50, pp.508-519, 2015.
31. Cai, Y., Chiew, R., Nay, Z., Indhumathi, C., and Huang, L.; Design and development of VR learning environments for children with ASD, Interactive Learning Environments, 25(8), pp.1098-1109, 2017.
32. Ferguson, E.D., and Wee, B.E.F.; Motivation: a biosocial and cognitive integration of motivation and emotion. Oxford University Press on Demand, 2000.
33. Domer, D.E., Carswell, J.W., and Spreckelmeyer, K.F.; Understanding educational satisfaction, The University of Kansas School of Architecture and Urban Design. (ERIC Document Reproduction Service No. ED 232 600), 1983.
34. Chai, K.W.; Explore the impact of m-learning on students’ learning motivation and satisfaction, Journal of Far East University General Education, 23(1), pp.43-54, 2010.