A Survey of User’s Backgrounds and Experience for the Design of UX and UI of the Virtual Studio Learning Environment

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Abstract
Virtual studio environment is an online learning environment the activities of which emphasize sharing and reflecting upon ideas through both learner-learner and the learner-instructor discussions to get feedback for further improvements or learning. Virtual studio environment is where learners are allowed to learn from their mistakes through a high flexible learning and through real-life situations or problems (West, 2014; McDonald et al., 2020). Due to the ongoing COVID-19 pandemic, learning styles have been seen to adapt accordingly, resulting in more flexible learning and more online learning, especially via mobile devices. Virtual studio environment is therefore seen to answer the mentioned needs, considering the following features: (1) a space for learners’ personal learning or activities, (2) a space for group activities and learner-learner or learner-instructor discussion and sharing ideas, (3) learning activities based on learners’ real-life situations, (4) a space for learners to showcase their works, and (5) evaluation, reflection, and feedback for both learners and instructors. This research study aims to conduct a survey on users’ backgrounds and experiences, along with the factors leading to high school learners’ technology acceptance, in the hope that it can be used to promote learners’ creativity in learning science. The data collection involves the questionnaires conducted among 128 high school students, including 65 female students (50.8%) and 63 male students (49.2%). The findings revealed that factors regarding perceived usefulness and perceived ease of use have an influence on the learners’ attitudes towards the use, while factors regarding technology complexity and social relationship in terms of communicating and sharing ideas with others play no roles in learners’ attitudes towards the use. Therefore, in the stage of designing the virtual studio environment to support learners’ scientific creativity, what should be highlighted is the use of technology and tools in the activities. Moreover, it is necessary to provide the learners with the space for personal learning as well as sharing ideas in order for them to learn and do activities of their interest based upon their real-life situations. Apart from that, other important points are learning through practicing, giving feedback, and sharing ideas between learners and instructors. By addressing these aspects, learners can improve their products and ideas in the carefully designed flexible learning environment which can be accessed by different devices.

Keywords: virtual learning environment, virtual studio environment, creativity in science
Introduction

In the era of digital transformation where technology has a major role in different sectors, the Independent Committee for Education Reform (ICER) proposed a program for the education and learning reform which emphasizes digitalization, big data, and learning through online platforms to enhance ubiquitous learning, along with adjustments to accommodate the changes in 21st century. Regarding the consequences of COVID-19 pandemic on education, what could be observed is the growing trend towards digital learning or online learning, the characteristic of which is that students can take control over their own learning both in synchronous and asynchronous manners (OECD, 2020). To this end, virtual learning environment is particularly advantageous in that it is flexible in terms of both time and place. It also supports collaborative learning, knowledge sharing, interactions among the learners and the instructors, as well as giving and receiving feedback (Phungsuk, Viriyavejakul, and Ratanaolarn, 2017; Khraisang and Songkram, 2019; Aslan and Duruhan 2020; Sus et al., 2020; Shyr et al., 2021).

The virtual studio environment is an online learning environment which highlights idea sharing and reflective thinking both between the instructor and learners and among the learners themselves. It is aimed to help students to improve their performance or their learning from the given feedback. It provides the opportunity for the learners to learn from their mistakes or from real life situations (West, 2014; McDonald et al., 2020). This learning environment is particularly favored among the practitioners in the field of architecture. Nowadays, however, it is seen to be increasingly adopted in the fields other than architecture, for example, in engineering education (Thekinen and Grogan, 2021; Nespoli, Hurst, and Gero, 2021). One notable example was the study by West et al. (2021), who developed a chemistry lesson during the COVID-19 pandemic by integrating inquiry learning and STEM education in the form of virtual studio. The study aimed to help learners to generate various solutions to the problem through collaborative synchronous and asynchronous discussions among the learners. Similarly, Loudon (2019) asserted that the obstacles to the development of learners’ creativity is the fear of making mistakes. This went in accordance with the study by Walker and Kafai (2021), who applied the virtual studio environment to secondary students in their biology classes. They fostered the students’ creativity and imagination by allowing them to create and present their own works, claiming that such environment focuses on designing, collaborating, presenting, giving, and receiving feedback from both their peers and their instructors.

Furthermore, the COVID-19 pandemic has driven the change of modes of instruction into online, especially through mobile devices and flexible learning approaches. Therefore, this study aims to explore the backgrounds of the users in terms of their genders, ages, learning programs, and user experience which includes equipment readiness and their experience in using technology. The key features of the virtual studio environment are (1) a space for learners’ personal learning or activities, (2) a space for group activities and learner-learner or learner-instructor discussion and sharing ideas, (3) learning activities based on learners’ real-life situations, (4) a space for learners to showcase their works, and (5) evaluation, reflection, feedback for both learners and instructors, and the study of relevant factors affecting the attitudes in using technology for learning. These aspects would be taken into account in order to improve the UX and UI of the virtual studio environment and to enhance learners’ creativity in science learning.
Literature Reviews

Virtual studio environment

Virtual studio environment is a type of virtual learning environment which is conducted online. It encompasses learning flexibility in terms of time and place. In virtual studio environments, instructors can present information as well as design various types of activities through digital technology so that the learners can construct their knowledge and develop their skills. Similarly, what could also be emphasized is collaborative learning and learner-learner and learner-instructor interactions, both synchronous and asynchronous. In this way, the instructors could give feedback and evaluate their students’ learning using various tools and techniques. The advantages of the virtual learning environment are essentially its learning flexibility, accessibility, and its emphasis on 21st century learning skills including creativity, critical thinking, collaborative working, and problem-solving skills, among others, through the exchanges of ideas and information they have found, presumably leading to higher rate of success in learning.

Virtual studio environment is the organization of both physical and social environments regarding learning and instruction. It promotes learners’ interactions and learning through the exchange of ideas and reflections among learners and instructors. This space opens for learners to think, learn by doing, and reflect upon practices. The exchange of learning would lead to the learners getting the feedback to improve their work as well as their potentials to think creatively (Loudon, 2019; McDonald et al., 2020; Jones, Lotz, and Holden, 2021; Iranmanesh and Onur, 2021). The environment emphasizes exchange of ideas and the exploration of new ideas from the works or from learners’ real-life situation so as to see different perspectives. The virtual studio environment consists of the following key features: (1) a space for learners’ personal learning or activities, (2) a space for group activities and learner-learner or learner-instructor discussion and sharing ideas, (3) learning activities based on learners’ real-life situations, (4) a space for learners to showcase their works, and (5) evaluation, reflection, feedback for both learners and instructors (Walker, Boyer, and Benson, 2019; Loudon, 2019; Fleischmann, 2020; Walker and Kafai, 2021).

Scientific creativity

The creative thinking skill is the ability to generate new ideas, new possibilities, or inventions, which could be in the form of works or even abstract ideas. It consists of two key components, namely novelty and appropriateness (Gu, Dijksterhuis, and Ritter, 2019; Sun, Wang, and Wegerif, 2020; Ozkan and Umdu Topsakal, 2021; Koc and Buyuk, 2021). As for scientific creativity, it encompasses creative thinking in the contexts specifically relating to science (Wiyanto and Hidayah, 2021; Yildiz and Guler Yildiz, 2021). It is considered essential competency for future innovation and sustainability (Aschauer, Haim, and Weber, 2021). Hu and Adey (2002) claimed that scientific creativity is different from creativity in the general sense in that it involves creativity in science experiments, creative science problem finding and solving, and creative science activities. Scientific creativity is the ability which could be affected by a number of non-intellectual factors. It is known to rely on science knowledge and skills. Moreover, Dwikoranto et al. (2020) asserted that scientific creativity is the ability to generate ideas, concepts, or new products which are relevant to the context, by means of scientific methods. Likewise, Sun, Wang, and Wegerif (2020) maintained that scientific creativity is necessary for science in order to find new problems and solve them with new solutions which could be new ideas or methods. Scientific creativity consists of the following elements: (1) the ability to generate various creative ideas, which entails fluency, flexibility, and original thinking, known as divergent thinking, and (2) the ability to locate the problems and achieve appropriate solutions through analysis and
synthesis, which is termed convergent thinking (Yang et al., 2019; Oh, 2021; Wiyanto and Hidayah, 2021; Atesgoz and Sak, 2021; Zhou, 2021).

**Objectives**

1. To study the backgrounds, namely genders, academic achievements, programs, and experiences in using technology in upper secondary levels in order to develop virtual studio environment to improve learners’ scientific creativity.
2. To study the effects of user experience, namely technology usage, perceived usefulness, perceived ease of use, technology complexity, and social relationship on the attitudes towards uses of learning technology to use as guidelines for designing virtual studio environments for further improvements of scientific creativity.

**Methodology**

This study explores the users’ background, experience, and other factors that could affect attitudes towards the use of learning technology in order to find the guidelines for designing virtual studio environment to enhance learners’ scientific creativity.

**Population and sample**

The population of the study is the upper-secondary school students in both public and private schools under the supervision of the Office of Basic Education Commission. The sample of the study consists of 128 upper-secondary school students, with 65 female students (50.8%) and 63 male students (49.2%). The number of the students who were studying in grade 10 was 23 (18%), while for grade 11 and grade 12 the numbers were 42 (32.8%) and 63 (49.2%) respectively. The average age of the students was 17 years old (SD = .969). The number of students in science-mathematics program was 103 (80.65%), which was considered the majority of the samples. The number of the students who were in the arts-mathematics and arts-languages was 25 (19.5%). The majority of the students, 91 students (71.1%), had the average grades in the range of 3.51-4.00. Following this were 28 students (21.9%), whose average grades were in the range of 3.01-3.5. The data derived from the surveys using quota sampling method among public and private schools.

**Research Instruments**

The instruments in this study are the survey of user experience about virtual studio environment for the improvement of scientific creativity among upper-secondary students. The survey consists of two sections. The first section investigates general information of the respondents of this survey. It is divided into sections according to the features of virtual studio environments: (1) a space for learners’ personal learning or activities, (2) a space for group activities and learner-learner or learner-instructor discussion and sharing ideas, (3) learning activities based on learners’ real-life situations, (4) a space for learners to showcase their works, and (5) evaluation, reflection, feedback for learners, instructors, and learning activities designed to promote scientific creativity. The second section is the study of technology acceptance in teaching and learning, consisting of perceived usefulness, perceived ease of use, technology complexity, social relationships, and attitude towards use, adopting a 5-point rating scale.
Data analysis

Data analysis employed percentage, average, and standard deviation to describe the general information and user experience. Multiple regression was employed to analyze the factors which affect the technology acceptance in learning and teaching.

Results

The results of this study consist of three sections: (1) experience in using technology, (2) technological tools in managing virtual studio environments to enhance learners’ scientific creativity, and (3) factors affecting technology acceptance.

Experience in using technology

The results reveal that most of the learners (74.4%) owned a computer, 84.5% of which could get access to the Internet. One hundred percent of the learners could get access to the Internet via their smartphone. In regard to tablets, about 70.5% of the learners did not have their own tablets. The operating system of the majority of the tablets/smartphones is android (58.1%) while the percentage is 52.7 for iOS.

In regard to the experience in using computers, most of the learners had more than 10-year experience (60.5%), followed by those who had 7–10-year experience in using computers (12.3%). As for the experience in using tablets and smartphones, it is found that most of the learners had 7–10-year experience (82.4%), followed by those with 4–6-year experience (8.8%). For the experience in using the Internet, 70.2% of the learners had 7–10-year experience, followed by 15.8%, which was the percentage of the learners who had over 10-year experience of using the Internet.

As for the ability to use applications, according to Figure 1, it is found that the majority of the learners (99.1%) could use social media applications, followed by those who could use search engines (95.6%), and those who use the learning management systems such as Google classroom, MOOC, Moodle (90.4%), respectively. In regard to online learning tools, learning management systems were found to be with the highest percentage of users (94.7%), followed by social media (64%) and websites (53.5%) respectively, according to Figure 2.

![Figure 1. Ability to use technology](image)

<table>
<thead>
<tr>
<th>Ability to use</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social network ex. Facebook, Line</td>
<td>99.1%</td>
</tr>
<tr>
<td>Search engine ex. Google</td>
<td>95.6%</td>
</tr>
<tr>
<td>Streaming video ex. Youtube</td>
<td>88.6%</td>
</tr>
<tr>
<td>LMS ex. Google classroom, MOOC, Moodle, Edmodo</td>
<td>90.4%</td>
</tr>
<tr>
<td>other ex. webex, MTeams, MSoffice</td>
<td>3.6%</td>
</tr>
</tbody>
</table>
Technological tools in organizing virtual studio environments to enhance learners’ scientific creativity

The technological tools in organizing virtual studio environments to enhance learners’ scientific creativity could be categorized according to different learning environments of the virtual studio. (1) a space for learners’ personal learning or activities: The findings revealed that the most suitable tool is the search engine, namely Google (73.7%), followed by cloud technology (58.8%), video streaming (53.5%), and blog writing as a way to summarize their own learning (28.9%), respectively. (2) a space for group activities and learner-learner or learner-instructor discussion and sharing ideas: The most suitable tool in providing such space is video conference such as Google Meet, Microsoft Teams, or Zoom (78.1%), followed by modes of personal communication among learners or between learners and instructors, such as chat applications (71.9%), and platforms for idea sharing among learners or between learners and instructors, such as discussion boards or other ways to give public comments (54.4%). Apart from this, it was found that virtual studio environment also employed the tools for brainstorming, metaverse, and VRChat. (3) learning activities based on learners’ real-life situations: The most suitable tool is social media (79.8%), followed by search engines (72.8%), and brainstorming tools (43%), respectively. (4) a space for learners to showcase their works: The most suitable tool is the tools for students to create their works, such as Canva, Video maker, 3D, VR, and AR (78.1%), followed by video conference, such as Google Meet, Microsoft Teams, and Zoom (71.1%), and presentation tools, such as social media and Pinterest (69.3%), respectively. (5) evaluation, reflection, feedback for both learners and instructors: The most suitable tool is modes of personal communication among learners or between learners and instructors, such as chat applications (77.2%), followed by platforms for idea sharing among learners or between learners and instructors, such as discussion boards or other ways to give public comments (64%), and the like and share buttons to support or share the works (45.6%), respectively.

The other aspect is learning activities which supported scientific creativity. According to the results from the section in which the learners are asked to prioritize different activities, the learners placed the ability to choose to work on the topic of their interest as their priority. The second rank was the involvement in the activities and practices. The flexibility in terms of time
and places in learning was the third rank. The fourth was getting feedback during the learning activities, followed by cooperative working, which was the fifth rank.

Factors of technology acceptance among learners

Factors of technology acceptance consist of (1) perceived usefulness, with an average of 3.09 (SD = .850), (2) perceived ease of use, with an average of 3.48 (SD = .923), (3) technology complexity, with an average of 3.53 (SD = .882), (4) social relationships, with an average of 3.47 (SD = .661) and (5) attitudes towards use, with an average of 2.78 (SD = .971).

By studying the factors of technology acceptance through stepwise multiple regression analysis, including perceived usefulness, perceived ease of use, technology complexity, social relationships, and attitudes towards use of learning technologies among upper-secondary learners, two models were constructed. The first model suggested that perceived usefulness affected attitudes towards the use of learning technology among the learners at the significance level of .05. To illustrate, perceived usefulness had the greatest impact on attitudes towards uses (Beta = .710) and can be used to predict the attitudes for 50.5%. The second model suggested that perceived usefulness and perceived ease of use had an impact on attitudes towards uses of learning technology among the learners at the significance level of .05. Perceived usefulness was found to have the greatest impact on attitudes towards use (Beta = .547) and could be used to predict such attitudes for 56.3%. Further details are shown in the Table 1 below.

Table 1. Stepwise multiple regression

<table>
<thead>
<tr>
<th>Perceived Usefulness</th>
<th>Perceived ease of use</th>
<th>Constant</th>
<th>R^2</th>
<th>Adjusted R^2</th>
<th>F-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>.710* (.076)</td>
<td>.349</td>
<td>.505</td>
<td>.500</td>
<td>106.973</td>
</tr>
<tr>
<td>Model 2</td>
<td>.547* (.087)</td>
<td>.291* (.081)</td>
<td>-.157</td>
<td>.563</td>
<td>.554</td>
</tr>
</tbody>
</table>

N = 128; p < .05

The results of the stepwise multiple regression could form the following prediction equations for the attitudes towards uses of the learning technology.

Model 1: Attitudes towards use = .349 + (.785) (perceived usefulness)
Model 2: Attitudes towards uses = -.157 + (.605) (perceived usefulness) + (.302) (perceived ease of use)

Discussion

In regard to the experience in using the technology, it was found that most of the learners had their own computers which can connect to the Internet. Moreover, the learners were found to have personal smartphones. Considering the duration of experience, the result shows that most of the learners had more than 10-year experience in using computers and 7-10-year experience in using smartphones, tablets, and/or the Internet. Turning to the ability to use the applications, during the COVID-19 pandemic, it was shown that most of the learners relied on social media, search engines, and learning management systems. In this respect, Bawack and Kala Kamdjoug (2020) stated that factors pertaining to the economic status and support from the family play an important role in the difference in terms of user experience in using learning technology. Therefore, throughout the process of designing virtual studio environments, it is necessary to take into account
the readiness of technology uses among learners. In particular, such learning environments should emphasize the accessibility via different types of technological devices such as laptops, tablets, and smartphones. It is also crucial to consider the designs, operations, controls, and optimization to create user-friendly interface. This went in accordance with Cardona-Reyes et al. (2021) who claimed that studying UX and UI would improve the effectiveness and understanding of learning activities among learners, especially in the learning environment during the pandemic.

Technological tools used in virtual studio environment to enhance scientific creativity among learners can be categorized according to different elements of virtual studio environments. (1) A space for learners’ personal learning or activities involves such tools as search engines, cloud technology, video streaming, and blog writing as a means to summarize their own learning. For (2) a space for group activities and learner-learner or learner-instructor discussion and sharing ideas, the suggested tools are video conference, personal communication among learners or between learners and instructors, such as chat applications, platforms for idea sharing among learners or between learners and instructors, such as discussion boards or other ways to give public comments, as well as the tools for brainstorming, metaverse, and VRChat. For (3) learning activities based on learners’ real-life situations, this study suggests social media, search engines, and tools for brainstorming. The fourth aspect is (4) a space for learners to showcase their works. The suggested tools are the platforms for the learners to create their works, such as Canva, Video maker, 3D, VR, and AR, as well as video conference and presentation tools. The last element is (5) evaluation, reflection, feedback for learners, instructors, and learning activities designed to promote scientific creativity. The suggested tools for the fifth aspect are chat applications, discussion boards or other ways to give public comments, along with the like and share buttons to support or share the works. It can be seen that among the lists of the technological tools used to support scientific creativity in such environments, there are tools which support personal learning and those which are suitable for collaborative learning, and the tools which promote idea sharing and giving feedback throughout the learning process. This was supported by Walker, Boyer, and Benson (2019), who claimed that virtual studio environments could promote creativity and innovations among learners through receiving feedback during their learning which could be used for further development of their work or designs. And through presentation sessions and further research, learners can learn from other presented works, reflect upon their own work, and apply the insights to their own works. These are regarded as ways of learning through interacting with others in the space specially designed for knowledge sharing, presentation, and learner-learner and learner-instructor interactions. Nespoli, Hurst, and Gero (2021) explained that virtual studio environments feature flexibility in both personal and collaborative learning, with instructors functioning as a mentor throughout the learning process.

According to the results from the session in which the learners were asked to prioritize different aspects of the activity, it was found that the learners prioritize the ability to choose the topic of their interest, followed by the participation and involvement in the activities. The third rank went to the flexibility in terms of time and place in learning, while receiving feedback during the learning process was ranked at the fourth place, and collaboration at the fifth. This is in accordance with Fleischmann (2020, who claimed that virtual studio environments place emphasis on interaction, reflection, and idea sharing among learners and instructors, by preparing the open space for learners to think, learn by doing, and reflect upon practices. The exchange of learning would lead to the learners getting the feedback to improve their work as well as their potentials to think creatively based on their interests (Chittum et al., 2017; Loudon, 2019; Iranmanesh and Onur, 2021).
Turning to the factors which affected the technology acceptance, the result shows that perceived usefulness and perceived ease of use affect learners’ attitudes towards uses. However, factors relating to technology complexity and social relationships have no effect on learners’ attitudes towards uses, which implies that the learners are ready to use or learn new technologies despite possible complexity in usage. This is also supported by Huang, Teo, and Guo (2021), who studied the complexity when bringing learning technology to an online English lesson. In that study, technology complexity did not affect the perceived ease of use or attitudes towards use. Therefore, when designing the user experience and user interface, what should be emphasized are the space for learners’ personal learning, the accessibility to the learning activities, as well as personalized learning. Learners should also be allowed to choose the topic in which they are interested. Such topics should be based on real-life situations, allowing them to plan for and engage in their own learning, in order to foster their scientific creativity.

**Summary**

In the process of designing the virtual studio environment to promote scientific creativity of the learners, it is important to pay attention to technological tools to be used in the learning activities as well as the space for personal and collaborative learning. It should allow the students to choose the topic of their interest, which should be based upon real-life scenarios. The learners should be encouraged to learn through practice, feedback, and knowledge sharing between learners and instructors. These would ultimately get the students to finetune their own works or concepts. Further aspect to emphasize includes the accessibility to the environment through different types of devices and the flexibility in learning.

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