

IMPACT OF ONLINE LEARNING BASED ON CREATIVITY AND ACHIEVEMENT IN DESIGN AND INVENTION SUBJECT

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ABSTRACT

This research aimed to study students' understanding and creative thinking in Innovation Subject through online learning. This quasi-experimental quantitative study focused on students' understanding and creative thinking of the subject through online learning brainstorming technique. Samples of 36 students from School Y participated in the treatment (online learning) and every student sat for the pre-test and post-test to measure their understanding and creativity of the subject. Results from paired t-test have shown that the pre-test and post-test for aspects of student achievement in the subject of design is $t = 13.858$ and the level of significance is $p = 0.001$ and student creativity in the Invention Subject is $t = 16.739$ and a significant level is $p = 0.001$. This significance level was lower than 0.05 ($P < 0.05$). Results showed that there are significant differences between students' achievement and creativity after applying the online learning brainstorming technique. This showed that online learning has successfully increased students understanding and creative thinking of the subject, aligned with the government's wish and education blueprint, which is to produce creative products.

Keywords: brainstorming, online, innovation subject, understanding, creativity

INTRODUCTION

Globalization has changed the education system of both developed countries and developing countries. The implication of this phenomenon has led to various ways, methods and techniques for effective student learning programmes being introduced to the world. Among the main processes in student learning development are cognitive skills, psychomotor skills and the inculcation of values (Hafiza Abas & Halimah Badioze Zaman, 2010).

In classrooms with project-based learning, each process for student development requires students to use different skillsets. For example, 80% of cognitive skills are required in developing themes, selecting appropriate project materials and resources as well as generating and refining creative ideas based on project materials (Michinov et al., 2015). Apart from that, psychomotor skills of drawing and sketching are also important in generating students' creative ideas. The existing approach of rote memorization bears many weaknesses especially in terms of thinking skills (Rainal et al., 2016). The designed learning process is more about cognitive skills and psychomotor and indirectly affects learning which has led to producing altruistic behavior and positive thinking.

Common teaching and learning strategies practiced in today's classroom are often restricted to rote memorization of textbooks. However, the traditional teaching and learning method is now out-dated. In the current pandemic situation, online teaching and increased accessibility of free existing and new resources are preferred. Rote memorization often leads to students' inability to think outside the learning box. Thus, students' learning needs to be

supported with a reasonable strategic approach that could stimulate their thinking creatively and critically (Hashim, 2015).

The existing learning and teaching of Design subjects are a method of approach that focuses on sketches and produces more products on psychomotor skills. This approach has long been used and was found to be less impactful; this is because sketches and products made by the students are stereotyped. Students lack the contribution of creative and critical ideas as well as their motivation. In addition, the knowledge of performance for this subject has also failed to improve. Students are more attuned to receiving teachers' instructions in the classroom and as for that, the achievement scores and creativity levels are also affected.

The second factor is that teachers lack motivation and confidence in their teaching as well. This is because they do not practice the teaching approach recommended by the government (Muhamad Abdillah Royo & Haleefa Mahmood, 2011). Therefore, drastic changes in the teacher-to-student teaching approach need to be implemented. Experienced teachers need to change their way of thinking and delivery during their teaching in order to implement the government's aspirations in producing balanced individuals in the era of Industrial Revolution 4.0 (IR 4.0).

To address the two challenges faced by both teachers and students in Design and Invention subject, this paper presented a proposed solution in by introducing a brainstorming approach in online learning, and investigated its effectiveness in improving secondary students' creativity levels and achievement in the subject. Two hypotheses were devised as the following:

H₀1: Is there a significant difference in the level of understanding among students about the online brainstorming approach in the pre- and post-test?

H₀2: Is there a significant difference in the level of creativity of students in the pre-test with post-test in an online brainstorming approach?

LITERATURE REVIEW

Osborn (1953) is the proponent of brainstorming techniques in groups. He explained that working and thinking individually will give fewer effective ideas and thoughts compared to discussions in the brainstorming method (Alshammari, 2015). Brainstorming is a proliferation of creative ideas that have rules and guidelines. In brainstorming, the teachers need to be proficient in using the technique in order to provide better impacts to their teaching (Emami et al., 2013).

Among the common brainstorming rules are:

- Without criticism: group members are free to give ideas, after which, the ideas will be criticized if it does not make sense and finally different and thoughtful ideas will be reviewed.
- Ideas in Thought: In this session, all members of the group will set aside all restrictions of thought. To think creatively one needs to explore and thinking of things that are logical and out of the ordinary.
- Focus on quantity: Many ideas are given so they are easy to classify.
- Combine and enhance ideas: all ideas are given either through thought that makes sense or otherwise will be evaluated and reviewed to get an idea that is relevant.

Brainstorming can be done in various situations such as classrooms, meetings and it can be done online. The online approach can involve many students learning at the same time and learning also occurs wherever students are (Qiu, 2010). Other than that, students can learn online regardless of their age and level of knowledge (Young & Cho, 2014). Even discussions

will be livelier in groups and the generation of students' creative ideas will occur indirectly (Paulus et al., 2013). In the presence of dynamic relationships between group members with the benefits of using online learning, brainstorming techniques can support the increasing number of new creative ideas created.

In addition, the advantage of flexibility information technology (ICT) is able to showcase students' ideas during discussion sessions without any delay (Michinov, 2012) and in turn, promote a competitive environment directly for creative thinking (Sophonhiranrak et al., 2015) where the throwing of ideas can be broadcast live and students can respond to peer ideas immediately, thus enhancing students' creative thinking abilities and their understanding on the concept of Design and Invention. In addition, ICT is a tool that can help students' learning by providing creative ideas which is indispensable in educating the culture of deep creative thinking in students' education (Wood & Bilsborow, 2011).

Furthermore, embedding brainstorming in online learning helps students' creative thinking in Design and Invention subject. It will also address the challenges that teachers are facing in their classroom and conform to the teaching of 21st century education. In this study, the researcher did an experiment using the online brainstorming approach for creative ideas enhancement and students' comprehension in the Design and Invention subject.

METHOD AND SAMPLING

Learning theories emphasized in this research are cognitive, effective communication and psychomotor. The cognitive learning approach takes place in the human's mind and brings to the change of knowledge, understanding, appearance, value and attitude (Bhagwatwar et al., 2013). Meanwhile, communication skills stimulate students into contributing ideas in sharing of ideas and train the students to be more polite and respectful towards each other when communicating (Faste, Rachmel, Essary, & Sheehan, 2013) and psychomotor skills is the students' ability to act when receiving the experience through previous schemata and lesson (Michinov, 2012).

The research used the quantitative approach. It was a quasi-experimental research involving school Y. Thirty six students took a pre-test and a post-test. Pre-test was administered before the intervention of brainstorming in online learning was implemented. After two months, the students then underwent the post-test.

In the online teaching approach, students were required to access the necessary applications such as Telegram, Padlet, and Google Docs. Every student needed to have a Gmail account to make it easier for the facilitators to share materials in Google drive. The instruments used to test the student's creativity were the pre and post-tests. The Torrance Test of Creative Thinking (TTCT) which consists of four aspects of creativity was used. The four important measurement of creativity were originality, efficiency, flexibility and description (Runco et al., 2010). The data from this study were analyzed using Statistical Package for Social Science (SPSS) program. Achievement scores were obtained from the students' monthly tests while creativity scores were assessed via the pre and post-tests before and after the intervention of brainstorming in the practice modules. Creativity scores were obtained using the rubric derived from the Torrance Test of Creative Thinking (TTCT).

FINDINGS AND DISCUSION

In general, the findings are presented based on the two hypotheses as the following:

H₀1: There was no significant difference in the level of understanding among students about the online brainstorming approach in the pre- and post-test.

H₀2: There was no significant difference in the level of creativity of students in the pre-test with post-test in an online brainstorming approach.

Results of paired sample t-test analysis for comparison of achievement and creativity levels students in the pre-test and post-test in the online brainstorming approach are as shown in Table 1.

Table 1: Paired T-Test Comparison of the Pre-Test and Post-Test in Online Brainstorming Approach

Aspects	Test	N	Min	S.D	Dif.	Value-R	Value-T	Sig.
Achievement	Pre	36	46.44	13.799	28.667	.623	13.858	.001*
	Post	36	75.11	14.724				
Creativity	Pre	36	38.11	9.704	35.111	.281	16.739	.001*
	Post	36	73.22	11.195				

*significant $p < 0.05$

Table 1 shows the T-value for the comparison of pre-test and post-test for aspects of student achievement in the subject of Design is $t = 13.858$ and the level of significance is $p = 0.001$.

This significance level was smaller than 0.05 ($p < 0.05$). Therefore, H₀1 is rejected. So, there was a significant difference in the level of understanding of students in the pre-test with the post-test in an online brainstorming approach. The mean score of the post-test (mean = 75.11) was higher than the pre-test (mean = 46.44). This proves that brainstorming teaching online can improve students' achievement in the Design and Invention Subject.

Table 1 also shows that the t-values for the comparison of pre-test and post-test for the aspect of student creativity in the Invention Subject is $t = 16.739$ and a significant level is $p = 0.001$. This significance level was smaller than 0.05 ($p < 0.05$). Therefore, H₀2 is rejected. So, there was a significant difference in the level of creativity of students in the pre-test with the post- test.

The results showed that there are significant differences between students' achievement and creativity in applying the online technique approach. This proves that the online brainstorming technique serves to improve students' cognitive abilities, achievement and creativity in the Design and Invention subject.

Nevertheless, the findings from the study indicated that there is a gap in the post-test creativity score. However, the increase in knowledge achievements of the online brainstorming group was higher than the pre-test.

The findings of this study can be compared to previous studies; for example, Wang and Fussel (2010) stated that online learning has eased students' communication and discussion. Blended learning which consists of online learning mixed with face-to-face learning in the classroom also contributed to the process of instilling creativity (Wang & Fussell, 2010). In addition, the use of the existing free online platform to implement the online brainstorming method has also brought favourable results (Dharmawa et al., 2015).

The implementation of the Osborn's (1953) brainstorming technique also helped students to contribute ideas in group discussions. With the aid of the brainstorming technique, students have further strengthened the basic knowledge of design and invention subject as well as students' creative thinking (Eliason & Lynn, 2014). However, through the online brainstorming process, students' achievement in the Design and invention subject was better

because students had no problem communicating with facilitators or classmates as the discussions sessions took place online hence the information obtained was faster and easier (Abigail, 2016).

CONCLUSION

In a nutshell, the researcher would suggest a few models and approaches to teachers in contributing to the development of the subject of design and innovation specifically to produce more creative products and improve students' achievement. The existing traditional approach may no longer be relevant and should be improvised by following the students' learning preferences for effective teaching and learning to take place. The change should consider students' cognitive development through online learning. The researcher believes that students' cognitive skills should be stimulated specifically for the creative outcome. The online approach is suitable as proven by this research as it is indeed a limitless and on-going learning process. Students who were exposed to online learning increased their ability to produce more creative products compared to those who went through the traditional approach.

It is clear that the learning environment plays an important role in learning. It is obvious that online learning has the potential to offer not only an open system that blends access to information and purposeful communication into dynamic and intellectually challenging learning community; it also offers deep and meaningful learning. Students are able to immerse themselves productively across time and space and be enriched immensely through the content of the internet. Online learning is a useful source of idea to complement the direct injection of ideas associated with the defined content of the Innovation subject.

As for the design, students are our future generation in producing new competitive products. Therefore, they need to be equipped with skills and knowledge so that they are brave enough to voice their thoughts, throw creative ideas, understand the basics of Design and Invention. Not only that, the global online learning approach also plays a role in preparing students for an increasingly challenging world.

Overall, the researcher suggests that the existing teaching model is an irrelevant approach and needs to be modified so that it would be more effective with the changes of the present era. The brainstorming technique can be used not just for Design and Invention subject but for all subjects offered at school. Researchers believe that online students' cognitive skills are appropriately implemented at all ages of students both in primary, secondary and university levels. This is because online learning is a process of students' continuous self-learning and borderless as well. Finally, it is also able to promote high order level thinking and ensures that students can compete well with other students all around the globe.

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