Mathematic Learning-by-Teaching:Video Creation and Cross-Schools Staging

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Abstract: With the advancement of technology and the transformation of media, traditional paper-based teaching is no longer the only way for students to learn. With streaming media becoming more and more popular, the "video" is a supplementary resource to be integrated into teaching. In this study, we based on the Interest-Driven Creator Theory and integrated video creation and the learning-by-teaching model to design learning activities. By creating videos, students can play the role of teachers to explain their mathematics concepts to their peers (Peer Tutoring) and enhance their interest in mathematics. Moreover, Students also can discuss with other peers and enhance their video. Students can construct their mathematical concepts and deepen their impressions in this activity.

Keywords: Video Creation, Peer Tutoring, Learning-By-Teaching, Cross-Schools Staging

1. Introduction

In traditional math classes, the teaching tools used by teachers primarily consist of textbooks and blackboards. The knowledge is usually imparted through direct instruction, with the teacher taking the main role in the teaching process, and students primarily absorbing the content presented by the teacher. In mathematics, units and concepts build upon each other. If the foundation is weak, students may struggle with more complex topics in higher grades, leading to misunderstandings and difficulties in connecting concepts (Lewin, 2006). This can create a bottleneck in their learning, causing a sense of aversion, fear, and anxiety towards math. Eventually, it may impact their motivation, and some might even give up on the subject. In learning mathematics, students actively construct logical concepts and deepen their understanding, addressing issues in traditional education. Practical application and hands-on experiences can cultivate learners' knowledge application, reinforcing existing knowledge (Dewey, 1944). The "learning by teaching" approach transforms student and teacher roles, enhancing abilities through instruction. Video production facilitates interactive learning.

2. Literature Review

2.1.Interest-Driven Creator Theory

The 21st century is an era of rapid change. In order to survive in such an environment, it is necessary to possess skills such as problem-solving abilities, collaboration and communication skills, critical thinking, adaptability, creativity, and imagination. Lifelong interest-driven learning is also essential (Chan, 2013; Griffin et al., 2012). To address the challenges faced in the field of education and bring about sustained impact in Asian education, Chan and a group of Asian scholars proposed the "Interest-Driven Creator Theory" (IDC) in 2018 (Chan et al., 2018). The theory consists of three core concepts: Interest, Creation, and Habit. Interest is a crucial concept that runs throughout the theory, emphasizing that learning should be driven by interests. When students are interested in their learning, it becomes enjoyable and efficient, especially when they acquire knowledge that aligns with their interests. Creation makes learning more effective and rewarding. Habit serves as an indicator of students becoming interest-driven creators because their behavioral patterns shape the kind

of individuals they become. Therefore, if students can develop a habit of creating based on their interests, they will ultimately become lifelong interest-driven creators.

2.2.Learning-by-Teaching

Learning By Teaching is an activity of "Mathematical creation and sharing" that helps students reduce math anxiety. It adheres to the belief that students "can learn fast, learn slowly, but cannot fail to learn," aiming to enhance students' interest in math learning, self-confidence, and self-efficacy, thereby improving their math learning performance. Students engage in self-directed learning and grasp mathematical thinking, surpassing the traditional approach of understanding and applying conceptual problem-solving in math learning. In other words, after learning mathematical concepts, students reconstruct and explain these concepts, mastering mathematical thinking through practice. Learning By Teaching can be viewed as a form of peer tutoring, where learners help each other and learn through the process of teaching (Seel, 2011). Learners simultaneously take on the role of both learner and teacher, assisting peers as teachers. This approach effectively promotes the learning of both oneself and peers (Kobayashi, 2022). Utilizing such teaching methods reduces student pressure and encourages active participation. Peers can grow together, and explaining teaching content to others enhances one's own learning concepts (Fiorella & Mayer, 2013). Through the "Learning by Teaching" model, students can demonstrate their acquired mathematical knowledge, gain a sense of achievement and ownership, and enhance their self-efficacy and interest in learning.

3. Procedure

Video creation constitutes the core activity of this research. The filming approach involves utilizing physical tools such as paper, pens, whiteboards, and blackboards for explaining mathematical concepts and showcasing the processes of solving problems. Subsequently, recording equipment such as cameras, smartphones, and tablets with recording capabilities is employed to capture the video content. Following the completion of filming, the videos are edited to cater to students' specific requirements, utilizing technological tools. Upon the conclusion of the editing process, the works are considered finalized.

4. Research Method

Participant

The subjects of this research were fourth and fifth-grade students from three elementary schools in Taoyuan City. Specifically, there were 21 students from Class 1 of the fourth grade and 9 students from Class 1 of the fifth grade in School A, as well as 26 students from Class 1 of the fifth grade in School B, making a total of 56 students participating. Initially, the plan was for the research subjects to be fully engaged in all stages of the experiment. However, due to the impact of the pandemic, the experimental approach was adjusted to remote learning. As a result, 4 students were unable to complete the questionnaire within the designated time frame, leading to an adjusted sample size of 52.

5. Result

The analysis results of using paired sample t-test on the MSLQ motivation questionnaire for the entire student population indicate a significant difference in students' overall motivation towards mathematics after engaging in the activity of filming math lessons. It is evident that students have shown a significant improvement in their motivation for learning mathematics. In terms of the intrinsic goal orientation, the overall students' scores indicate a trend towards significance, suggesting that students are more likely to engage in learning activities due to their curiosity and desire for challenges. There is a significant difference observed in the extrinsic goal orientation aspect. (Table 1)

After the activities during the school phase, there is a significant difference in student ratings, indicating that for peers, the second video shows an improvement in video quality compared to the first video. In terms of teacher ratings, there is no significant difference after the activities during the school phase, but there is a slight improvement observed in the mean scores. However, in terms of the total score, there is a significant improvement after the activities during the school phase. Based on the above results, it can be inferred that students, after the first individual video recording and peer assessment, as well as teacher comments during the school phase, have shown a significant improvement in video quality in the second video based on the feedback received from classmates and teachers. (Table 2)

Table1 MSQL Motivation Questionnaire Results

MSLQ Motivation Questionnaire Results

		N	AVG	SD	*t*
Intrinsic goal orientation	Predict	52	3.47	0.837	-2.004
	Post	52	3.63	0.805	
Extrinsic goal orientation	Predict	52	3.19	0.740	**-3.586****
	Post	52	3.42	0.766	
Task value	Predict	52	3.33	0.822	**-3.149****
	Post	52	3.56	0.692	
Self-efficacy	Predict	52	3.17	0.825	**-5.683*****
	Post	52	3.57	0.767	
Learning anxiety	Predict	52	3.11	0.933	-0.824
	Post	52	3.20	0.912	
mathematics motivation	Predict	52	3.29	0.627	**-3.951*****
	Post	52	3.45	0.566	

p<.05,p<.01,***p<.001*

Table2 Video Quality Sample T-test

Video Quality Sample T-test

		N	AVG	SD	*t*	*p*
student assessment	First	52	18.76	2.550	-2.390*	.021
	Second	52	19.60	2.129		
Teacher assessment	First	52	20.35	2.862	-1.824	.074
	Second	52	20.86	2.275		
Total	First	52	39.11	4.550	-2.182**	.007
	Second	52	40.45	3.432		

p<.05,p<.01,***p<.001*

6. Conclusion

Based on the aforementioned discussion, it was found that the mathematics teaching through video creation activity had a positive impact on students' interest and motivation overall. There was also an improvement in video quality. Students gained a clearer understanding of mathematical concepts and a sense of achievement during the activity. Based on the actual implementation of the activity and the results of the interviews, it can be concluded that the mathematics teaching through video creation activity is feasible in different contexts. However, there are some minor details in activity and curriculum design that can be improved or given more attention to.

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