Enhancing Students' Public Sector Accounting Learning by Using Augmented Reality

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Abstract. Public sector accounting is regarded as a critical component of accounting students' foundational skills that should be mastering. Basically, in terms of transaction recording, public sector accounting differs significantly from finance or managerial accounting. So it is important to give an interactive learning media to students so that they can master the basics of public sector accounting easier. Many real cases from any institution (government, worship place, hospital, school or university, and any other non-profit organization) can be utilized as examples in class to improve learning effectiveness. To pursuing all of that, the researcher use an augmented reality (AR) technology in this study. AR technology that has been developed in this research will figure out 2D explanation with animation by targeting a marker with the mobile camera to improve the learning experience. The application itself (AR) contain of 5 material and 2 assessment. Augmented reality will create objects that features the real environment and enable learners to interact with it through these objects. To confirm the effectiveness of this technology, 50 students studying public sector accounting was recruited as participants in this project to validate the effectiveness of this technique. The 50 students were divided into 2 groups, which were experimental group and control group. Then their AR-assisted learning outcomes was quantified using Blooms cognitive degrees, which indicate the degree of achievement at various stages of learning. The results found that the students in the experimental group approved greater knowledge significantly on fundamental concepts of non-profit accounting features and transaction recording on financial statements using AR than students in the control group. The research found that when compared to traditional methods learning, augmented reality-based 2D animation be possible significantly raise students higher-degree cognitive abilities, approving them to more effectively accomplishing fundamental concepts in non-profit accounting characteristics and financial statement recording transactions.

Keywords: Public sector accounting · Accounting learning · Augmented reality

1 Introduction

Traditional teaching approaches are frequently unproductive due to their nature which is teacher centered learning and too formal. This method was precludes the presentation of specialized knowledge in more informal learning contexts. As a result of these

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approaches without examining the student's abilities, students must learn more independently in order to grasp the content effectively [1]. This environment results in a variety of learning difficulties, including boredom and saturation during class [2] and failures throughout the knowledge transfer process.

Furthermore, the accounting learning that focuses more on comprehending theory and does not optimize the practice of working on practice questions based on real-world industry settings can diminish students' overall knowledge. In public sector accounting courses, effective presentational techniques are essential. Students' cognitive development and achievements may be harmed if they merely comprehend the fundamentals of a subject without delving deeper [3]. According to a revised Blooms taxonomy [4], cognitive skills development comprises the expansion of knowledge and intelligence and can be grouped into six degrees based on their degree of difficulty [5]. A revised version of Blooms cognitive degrees has been proposed for monitoring and evaluating students cognitive activities [4]. Apart from the fact that the meaning of each degree changed, another noticeable change in Blooms cognitive degrees was the change of the titles from noun to verb forms [5].

The six phases comprise the new taxonomy which each of phases shows complexity as the student progresses. Thus are the Blooms cognitive degrees [4]: (a) Recalling degree, which involves retrieving useful information from long-term memory; (b) Understanding degree, which involves synthesizing previously acquired knowledge and new information; (c) Applying degree, which involves performing or employing a technique in order to complete a task in a particular environment. (d) Analyzing degree, in which information is broken down into constituent components and the links between them and the overall structure are determined; (e) Evaluating degree, in which information is evaluated using criteria and standards; (f) Creating degree, which assembling components into a comprehensive, integrated, and functionally whole or reconstructing varied data into a new pattern. The overall educational studies used cognitive domain [6, 7] and its used to evaluate course objectives.

Numerous studies [8] have demonstrated that technology can increase the learning effectivity both inside and outside the classroom. The development of technology such as augmented reality (AR) opens up new opportunities in education, hence they facilitate the teacher to give students with engaging experiences that are valuable in and of themselves [9]. Previous research found that the students motivation and self-efficacy will improve by the use of information technology do to it will enhance their ability to produce knowledge [10]. Augmented reality is still in its infancy technologically, even the broad definition of what constitutes a good, augmented reality is a work in progress [11].

In this study, the researcher used 2D animation-based augmented reality-based learning resources for public sector accounting to determine whether such materials aid in the promotion of higher-degree cognitive skills. This program was developed entirely in the offline mode. There are numerous benefits to using this application, including: ease of use [12], minimal cost if developed in offline mode, the ability to play frequently, and the ability to integrate with an interactive game [2]. Assessment based on the revised Blooms cognitive degrees were also develop by the researcher to evaluate students learning outcomes in the experimental group. In the end, this study was object to evaluate students' analytical ability by requiring them to answer cases presented by the lecturer

utilizing the material, theoretical, and practical examples provided in AR. Then the researcher evaluated the students' Blooms cognitive degree performance as the result of the augmented reality-based learning material used on their learning achievement.

2 Methods

To participate in the learning activities, the researcher recruited 50 third-grade students (37 females and 13 males) from the Bachelor Degree in Accounting Department at Malang State Polytechnic. This 50 students was divided into two groups, which 25 students in the experimental group and 25 students in the control group. A pretest was administered to the two classes selected for this exercise to ensure that all students began at the same degree of comprehension.

There were two kind of pretest questions, which are multiple-choice for the theoretical material as a remembering degree of taxonomy blooms measurement and case study as an understanding and analyzing measurement in this pretest. The total score of this pretest was 0–100. This multiple-choice questions were consist of 10 questions with the total score of 10. Case study questions were divided into two section, which the first section was by recording 20 transaction into general journal and adjusting journal with the total score of 40 and the second section was creating the financial statements of public sector accounting organizations, with the total score of 50. The financial statement are the balance sheet, the statement of comprehensive income, the statement of changes in net assets, and the statement of cash flows are among them. To assess the student achievement in both of groups after enroll in the activity, the identical scenario were built on the pretest and posttest.

This research employed a quasi-experimental methodology using a pretest-posttest non-equivalent groups that arrange to examine the effect of AR to the learning development of the third graders that enrolled in a public sector accounting course. A class of experimental group were guided to examine the content and case example using augmented reality. In this portion, the lecturer's act as a facilitator for students who have questions about information they did not comprehend in AR. In other session, the lecturer taught the control group directly, using the same material and situations as the experiment class. After the instructional activity was completed, students in both groups took a posttest to determine their learning results. This illustration will assist in simplifying the experiment technique (Figs. 1 and 2).

This AR-based learning takes place remotely, as well. This is due to the COVID-19 epidemic, which has required all learning systems to be online-based for the past two years. As a result, students can practice AR learning at a distance in this case. As well as the control class, where the lecturer's teaching is also done online via Zoom.

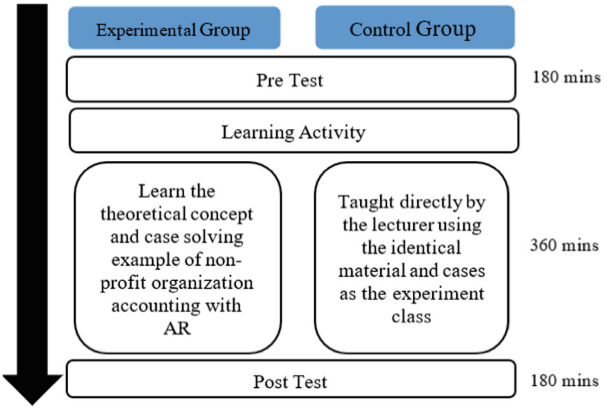

Fig. 1. Experimental procedure.

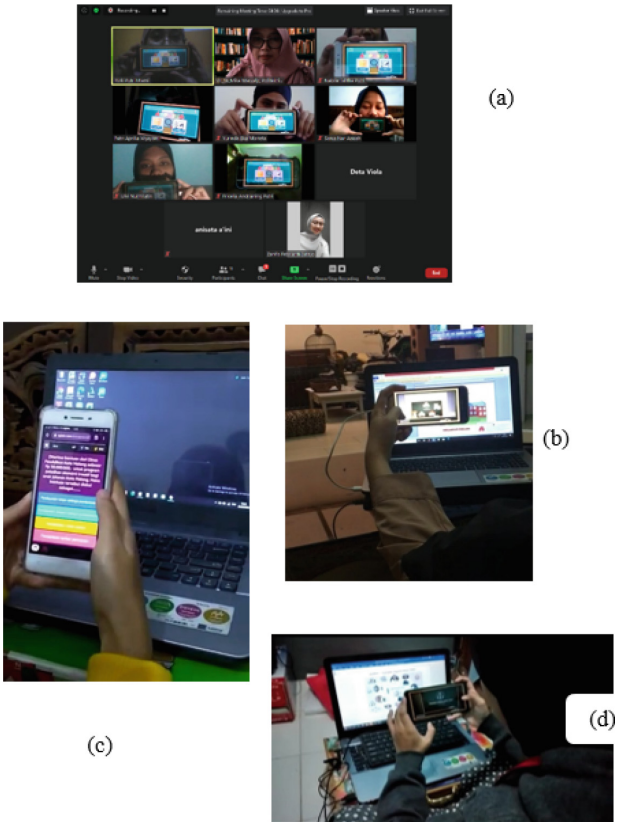

Fig. 2. Learning activities with AR, **(a)** The lecturer give an explanation for using the AR application; **(b)** the students doing the multiple choice test; **(c)** and **(d)** the students targeting the marker to get the 2D animation as an explanation

3 Results and Analysis

This Table 1 will explain the analysis result from the experimental group and control group.

As demonstrated in Table 1, students in the experimental group have an average score of 53.8 on the pretest, while those in the control group achieved an average score of 57. This was done to determine whether or not the students in the two groups possessed comparable baseline capabilities. The t value was 0.482, and no significant statistically changes ($p > .05$.), were seen with a lesser effect size for clinical significance (Cohen's d = 0.053). This result show that both of students groups had comparable baseline abilities. On the posttest, students in the experimental group reach 85.32 score in average, while those in the control group earned 81.12 score in average. The t value was 0.142, and there were no statistically significant differences ($p > .05$), with a clinically significant effect size (Cohen's d = 0.057). This result indicates that there were no statistically significant difference between the two groups in terms of learning outcomes following participation in the learning activity.

To get a better scores in the experimental and control groups when the questions with the different cognitive degrees assigned, a test on three cognitive degrees was administered to both groups. Students in the experimental group get an averaged score of 7, while those in the control group averaged a score of 7.36. The t value was 0.436, and no statistically significant differences ($p > .05$) were discovered, indicating that following the instructional exercise, the students in the two groups scored similarly on the degree of remembering. The experimental group averaged 36.08 on the comprehension (understanding & application) measure, while the control group averaged 34.4. The t value was 0.059, and no statistically significant differences were discovered ($p > .05$), with a moderate effect size of clinical significance (Cohen's d = 0.497). This result indicate that the following teaching activity, the experimental group's comprehension scores

Table 1. *t* test results of learning achievement

Variables	Experimental Group			Control Group			t	D
	N	M	SD	N	M	SD		
Pre-test	23	53.8	19.91	23	57	16.58	0.482	0.053
Post-test	23	85.32	13.56	23	81.12	11.84	0.142	0.057

Table 2. *t* test results of Blooms cognitive degree

Variables	Experimental Group			Control Group			t	d
	N	M	SD	N	M	SD		
Analysis degree	23	42.24	8.25	23	40.08	7.40	0.228	0.501
Comprehension degree	23	36.08	4.42	23	34.4	5.00	0.059	0.497
Remember degree	23	7.00	1.94	23	7.36	1.25	0.436	0.144

were significantly higher than the control groups. Students in the experimental group averaged 42.24 on the analyzing (analyzing & evaluating) scale, compared to 40.08 in the control group. The t value was 0.228, and there were no statistically significant differences (p.05), indicating that following the teaching activity, the experimental group's students scored significantly higher on the degree of analyzing and evaluating than the control group's pupils. Table 2 summarizes the findings.

4 Discussion

In this project, augmented reality technology was used to incorporate public sector accounting exercises for the Bachelor of Accounting Department at the State Polytechnic of Malang. The results indicate that there are no statistically significant differences in recalling measurement scales between the experimental and control groups. This reveals that adding augmented reality technology into public sector accounting learning activities has no discernible effect on students' fundamental cognitive knowledge acquisition. This findings may be associated to the development of training plans with same learning objectives in order to minimize the domination of the teacher on the experiment [0]. Particularly, regardless of whether the experimental or control groups got identical training, students acquired comparable degrees of recall.

The experimental group did much better on questions requiring comprehension (understanding & application) and analysis (analyzing and assessing) at a higher degree of Blooms taxonomy. This suggests that AR has a beneficial effect on students' ability to acquire capabilities at this degree, as demonstrated by better experimental group performance on comprehension, identification, and analytical activities. The rise in grades could be attributed to students continually analyzing and evaluating explanations and case resolutions demonstrated in AR applications to improve their understanding. As previously stated, this AR application was created with an offline mode in the hopes that students will be able to replay the content and case discussions in the AR application till they comprehend without having to use up their internet data allotment. So it would generate abstract knowledge to be specific concept [13].

The AR technology used in this research developed by designing and simplifying theoretical knowledge and case studies in public sector accounting can be used as comparators during students' exercise of public sector accounting cases, facilitating their reflective observation and guiding them in conceptualizing the knowledge and cases in public sector accounting. This corroborates an earlier hypothesis that learning material including abstract concepts can be reduced via augmented reality [14], allowing learners to notice details that would have been missed otherwise.

In comparison to textbooks, augmented reality can produce two-dimensional virtual objects that are presented in a manner that more closely features real-world objects. This enables pupils to make connections between learning materials and real-world situations and to engage with them. In other words, students are assisted in relating newly acquired knowledge to the actual world [15], leading in the development of analytical cognitive capacities.

As public sector accounting is a vital course in the accounting profession, it must emphasize the development of students' higher cognitive abilities and the optimal method

for assisting them in building expertise in a real situation using their previous expertise. The primary contribution of this study was to demonstrate how augmented reality technology boost the effectiveness of public sector accounting learning in pandemic and normal conditions. The researcher use a particular emphasis on the overall activities of the experimental learning cycle. The use of this technology provide effective improvement at the cognitive degree of analysis for the third year of a bachelor's degree, corroborated by earlier research [16, 17]. Confidentially speaking, augmented reality technology was able to assist students in mastering higher-degree abilities grows.

5 Conclusion

With the advancement of technology, instructional materials are becoming more diverse. Multimedia objects and augmented reality are two illustration of how information technology has been integrated into the classroom, both remotely and in person. How to leverage technical advantages to create resources that provide an engaging and holistic learning environment for them in public sector accounting content, as well as how to aid in the building of students' knowledge construction, are thus difficulties that demand additional consideration.

This study objective was to determine the effect of augmented reality on students learning outcome at various cognitive degrees by incorporating augmented reality into public sector accounting exercises. The researcher discovered that introducing augmented reality technology into the classroom can help students develop higher-order cognitive abilities by allowing them to connect observation assignments to previously acquired knowledge, thereby enriching their learning abilities. Augmented reality can create objects that features the real environment and enable learners to interact with it through these objects. As a result, it can facilitate students in connecting newly acquired knowledge to previous knowledge and providing the necessary construction for knowledge building.

Further research into the integration of augmented reality technology with other forms of technology or interactive multimedia, such as artificial intelligence or gamification, as the researcher as the building of customized scaffolds depending on the unique needs of learners, may be performed in the future. Additionally, future research should focus on the adoption of augmented reality in other social material courses; does it have the same effect as science knowledge?.

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