

**APPLICATION OF THE AUTHENTIC-UG USING AUGMENTED REALITY  
TO SUPPORT GEOMETRY LEARNING IN AUTHENTIC LEARNING DESIGN**



**BY:  
RIO NURTANTYANA  
STUDENT ID : 17720251022**

**This thesis has been written in partial fulfilment of the requirements  
For Master of Education**

**ELECTRONICS TECHNOLOGY AND INFORMATICS EDUCATION  
GRADUATE SCHOOL  
YOGYAKARTA STATE UNIVERSITY**

**2019**

國立中央大學

網路學習科技研究所

碩士論文

**Application of the Authentic-UG using  
Augmented Reality to Support Geometry Learning  
in Authentic Learning Design**

研究生：Rio Nurtantyana

指導教授：黃武元 博士 和 Suprpto, Ph.D

中華民國 一百零八 年 六月

**National Central University**

**Graduate Institute of Network Learning Technology**

**Master Thesis**

**Application of the Authentic-UG using Augmented  
Reality to Support Geometry Learning in Authentic  
Learning Design**

Master student: Rio Nurtantyana

Advisors:

Prof. Wu-Yuin Hwang

Suprpto, Ph.D

Republic of China, June 2019



## National Central University Library Letter of Authorization for Electronic Theses and Dissertations

(The latest version since Feb. 2017)

This license authorizes my complete electronic thesis (not in paper format, see footnote 1) be archived and read in the "National Central University Library Electronic Theses & Dissertations System".

- Agree (available immediately)  
 Agree (available in \_\_\_\_/\_\_\_\_/\_\_\_\_ (yyyy/mm/dd))  
 Disagree, because: \_\_\_\_\_

and be archived and read in NDLTD(National Digital Library of Theses and Dissertations in Taiwan)

- Agree (available immediately)  
 Agree (available in \_\_\_\_/\_\_\_\_/\_\_\_\_ (yyyy/mm/dd))  
 Disagree, because: \_\_\_\_\_

I undertake to submit my thesis to National Central University Library and NDLTD(National Digital Library of Theses and Dissertations in Taiwan), non-exclusively and voluntarily. Based on the concept of sharing sources and mutually benefited cooperation and in aims to repay the society and for the academic usage, I hereby grant a non-exclusive, for the full term of copy right protection, license to National Central University Library and NDLTD(National Digital Library of Theses and Dissertations in Taiwan), (a) to reproduce, publish, archive, preserve, conserve, communicate to the public by telecommunication or on the Internet and distribute my thesis, in microform, paper, electronic and/or any other formats, regardless of place, time, and frequency; (b) to authorize, sub-license, sub-contract or procure any of the acts mentioned in paragraph (a). And grant the reader the right to read, download and print out non-profitably.

Signature of the Author: Rio Nurtantjana  
Student Number: 107524606  
Thesis Title: Application of the Authentic-UG using Augmented Reality to Support Geometry Learning in Authentic Learning Design  
Supervisor: Prof. Wu-Yuin Hwang  
Faculty, Department, School: Graduate Institute of Network Learning Technology (NLT)  PH. D  Master  
Date: 2019, 06, 24 (year, month, date).

### Footnote 1:

1. The license is limited to only electronic files. In terms of Regulation of Copyright No 15, article 3, theses in paper can be published by the library. If you have patent or submitting concerns and do not want to publish your theses in paper, please fill out the Proclamation form.
2. This form requires the author's own signature, and it should be attached to a page after the paper theses' cover. (type-up signature is allowed for full electronic theses)
3. Readers should observe the Regulation of copyright while searching, reading, downloading and printing theses online non-profitably.

# National Central University

## Advisor's Recommendation for Graduate Students

This thesis is by Rio Nurtantyana of the graduate program in Graduate Institute of Network Learning Technology (NLT), entitled: Application of the Authentic-UG using Augmented Reality to Support Geometry Learning in Authentic Learning Design which is written under my supervision, and I agree to propose it for examination.

Advisor Wij Hary  
2019/06/24 (YYYY/MM/DD)

104.07.24

國立中央大學碩士班研究生  
論文口試委員審定書

網路學習科技研究所 Rio Nurtantyana 研究生所提之論文

Application of the Authentic-UG using Augmented Reality to

Support Geometry Learning in Authentic Learning Design

經本委員會審議，認定符合碩士資格標準。

學位考試委員會召集人

委

員

王怡鈺  
陳鴻仁  
吳武之  
[Signature]

中華民國 108 年 6 月 24 日

101.06.15

## 中文摘要

在 Android 平臺上開發使用擴增實境技術的 Authentic-UG，使用可以高精度測量線條和測量角度的 ARCore SDK，可以為學生在真實情境的學習設計中學習幾何學提供優勢。Authentic-UG 利用 xAPI 技術詳細記錄每個學生的學習活動，系統還實現了註記功能，方便學生在搜索幾何物件後可以解釋答案。Authentic-UG 具有彈性，可以使用 RESTFUL API 連接到 Dashboard-UG 系統，因此教師可以在進行實境活動時查看每個學生的紀錄。

在本研究中，我們開發了 Authentic-UG 來促進學生的實境式學習，並從角度和線的概念上探討了小學四年級學生學習幾何的學習行為與學習成績之間的關係。本研究的參與者共有 50 名學生，分為實驗組及對照組，實驗組有 25 名學生使用 Authentic-UG，對照組有 25 名學生，為期十週，兩組之間具有相同的先備知識。

在學習過程中使用 Authentic-UG 後的統計結果表明，實驗組具有更好的學習成績，特別是在幾何對象的估計能力方面，而實際操作的結果也通過教師評估和同儕評估進行檢查。因此，最具影響力的學習活動是結合角度和線及鷹架概念來幫助估算組合題型的能力，可以有效地提高同儕評估的品質。有一種現象是，在角度的概念中，比起關注線的準確性，學生們更注重的是角度的準確性。學生覺得使用 Authentic-UG 是一種更快樂的學習體驗，因為在真實的環境中，學生有對於搜索幾何物件和測量主動探索的動機也更健康。

*關鍵詞*: Authentic-UG, 實境式學習, 幾何學習, 擴增實境

## Abstract

Development of Authentic-UG adopting augmented reality technology on the Android platform with ARCore SDK that can measure lines and measure angles with high accuracy is an advantage that can be used for learning geometry to students in authentic learning design. Authentic-UG can detailed record each student's learning activities with the xAPI technology, the system also implemented with annotation features to facilitate student for explaining the answers after searching for geometry objects. Authentic-UG has a flexible system with the use of the RESTFUL API protocol that can be connected to the Dashboard-UG system, so that teachers can see each student's process when doing authentic activities.

In this study, we developed the Authentic-UG to facilitate student in authentic learning and we investigate the relationship between learning behavior and learning assessment with learning achievement in fourth-grade elementary school students to learn geometry in the concept of angle and the concept of line. The participants of this study with 50 students, divided two groups that 25 students in the experimental group using Authentic-UG and 25 students in the control group for 10 weeks with the same initial prior knowledge between groups.

The statistical results after using Authentic-UG in the learning process indicate that the experimental group has a better learning achievement, especially in the skill of estimation ability on geometry objects. The results of authentic work also checking by teacher assessment and peer assessment using scaffolding. Therefore, the most influential learning activities to help estimation ability in the combine topic which combines the angle concept & line concept and also the scaffolding can work well to help peer assessment quality. There is a phenomenon that students only focus on the concept of angle which is shown by the level on the accuracy of angle is more influent than the level of accuracy of the line. Student feel that using Authentic-UG is more happy learning experience because student feel motivated also healthy to active explore to searching geometry object and make measurement in the authentic environment.

Keywords: *Authentic-UG, authentic learning, geometry learning, augmented reality.*

## **Acknowledgement**

Praises and thank you to Allah for the blessing of grace and guidance me to complete the master degree program through this thesis. I would like to thank you to professor Wu-Yuin Hwang has become my advisor to provide research direction, good suggestions, and good assistance during every process when I go through the process of learning and completing my thesis at the Graduate Institute of Network Learning Technology. I would like to thank to Uun Hariyanti for collaborating and to lead the research team also thank you to Phoebe, Ken, and Carol for your help and giving me various lessons and valuable experiences while working on research activities with different cultural, especially the languages. I also thank to Tony and to all members in the High Interaction Multimedia lab for the support me and thanks to the all staff at National Central University, especially the Graduate Institute of Network Learning Technology and the Office of International Affairs for assisted and provided good environment for this research.

Thank you to double degree program between National Central University and Universitas Negeri Yogyakarta that give me opportunity, especially for Prof. Dr. Sutrisna Wibawa, M.Pd, Prof Marsigit, MA., Dr. Ratna Wardhani, MT., and Retna Hidyah, Ph.D for their support and help.

Thanks for all double degree programs friends: Cinthya, Ayu, Irfan, Aulia, Sultan, Lovely NLT and all student Indonesia member. Finally, I also thank to Epen and my family for giving prayer and giving support for me.

## Table of Contents

中文摘要 .....	i
Abstract.....	ii
Acknowledgement .....	iii
Table of Contents.....	iv
List of Figures.....	vi
List of Tables .....	vii
Explanation of Symbols.....	viii
Chapter 1 Introduction.....	1
1-1 Background and Motivation.....	1
1-2 Purpose.....	2
Chapter 2 Literature Review.....	3
2-1 Authentic Learning Design.....	3
2-2 Ubiquitous Geometry Learning in Mathematic .....	4
2-2-1 Ubiquitous Learning.....	4
2-2-2 Geometry Learning in Mathematic.....	5
2-3 Augmented Reality with ARCore Technology.....	6
2-4 Learning Behavior on Authentic-UG.....	8
2-4-1 Geometry on Authentic .....	8
2-4-2 Dimensional of Geometry Ability .....	9
2-4-3 Assessment for Learning .....	10
2-5 Student Perception and Motivation using Technology.....	11
Chapter 3 System Design and Implementation .....	14
3-1 System Design.....	14
3-2 Implementation .....	14
3-2-1 System Implementation for Student with Authentic-UG app .....	15
3-2-2 System Implementation for Teacher with Dashboard-UG.....	17
3-3 Learning Geometry using Authentic-UG.....	18
3-3-1 Learning Geometry.....	18
3-3-2 Learning Activities .....	19
3-3-3 Measurement Skill in Authentic Context .....	19
3-3-4 Peer and Teacher Assessment.....	20
Chapter 4 Research Method .....	21
4-1 Type of Research .....	21
4-2 Research Architecture and Research Variables .....	21
4-2.1 Control Variable .....	21
4-2.2 Independent Variable.....	21
4-2.3 Dependent Variable .....	21
4-3 Research Flow and Procedure.....	24
4-4 Research Subject.....	25
4-5 Research Tool .....	26
4-6 Experimental Activities .....	27
4-7 Experimental Function.....	27

4-8 Data Collection and Processing .....	28
Chapter 5 Result and Analysis.....	29
5-1 Analysis of Learning Achievement .....	29
5-2 Correlation Analysis between each Research Variables.....	31
5-2-1 Correlation Learning Behavior with Learning Achievement .....	32
5-2-2 Correlation Learning Assessment with Learning Achievement.....	35
5-3 Correlation Learning Behavior with Learning Assessment.....	36
5-3-1 Correlation Quantity of Measurement in Learning Behavior with Learning Assessment .....	37
5-3-2 Correlation Quality of Measurement in Learning Behavior with Learning Assessment .....	38
5-4 Lag-Sequential Analysis of Learning Activities when using Authentic-UG.....	44
5-5 Student Perceptions of Authentic-UG System.....	44
Chapter 6 Conclusion .....	49
References .....	51
Appendix .....	56

## List of Figures

Figure 1. Learning classification at the level of mobility and embeddedness.....	5
Figure 2. Diagram of Technology Acceptance Model (TAM).....	12
Figure 3. ARCS model for measuring motivation.....	13
Figure 4. Technology Architecture.....	14
Figure 5. The difference implementation between version one and version two.....	15
Figure 6. Experiment for accuracy of line testing.....	16
Figure 7. Experiment for accuracy of angle testing.....	16
Figure 8. Features on Authentic-UG.....	17
Figure 9. Student progress display on the Dashboard-UG.....	17
Figure 10. Workflow for student learning activities on Authentic-UG.....	19
Figure 11. Examples of results of authentic work on different topics.....	19
Figure 12. Peer assessment using scaffolding on Authentic-UG.....	20
Figure 13. Teacher assessment on Dashboard-UG.....	20
Figure 14. Research Architecture.....	23
Figure 15. Research Flow.....	24
Figure 16. Experimental Procedure.....	25
Figure 17. Location of authentic work with map clustering.....	36
Figure 18. Correlation each variable to post-test.....	43
Figure 19. The Model from Lag-Sequential Analysis (LSA) result.....	44

## List of Tables

Table 1. Interpretation of mean score .....	13
Table 2. The results of testing accuracy on Authentic-UG .....	16
Table 3. Test on the Dashboard-UG .....	18
Table 4. Learning Behavior Variables .....	22
Table 5. Learning Assessment Variables .....	22
Table 6. Learning Achievement Variables .....	22
Table 7. Learning Assessment Scoring Rubric .....	26
Table 8. Descriptive statistic of pretest and posttest between two groups .....	29
Table 9. Independent Sample T-Test for Pre-Test on prior knowledge .....	30
Table 10. Independent Sample T-Test for Post-Test .....	31
Table 11. Correlation between learning behavior based on quantity of measurement with learning achievement (post-test).....	32
Table 12. Correlation between learning behavior based on quality of measurement with learning achievement (post-test).....	34
Table 13. Correlation learning assessment with learning achievement (post-test) .....	36
Table 14. The location authentic of work on each topic .....	36
Table 15. Correlation Quantity of Measurement with Learning Assessment .....	37
Table 16. Correlation Quality of Measurement with Learning Assessment .....	39
Table 17. Correlation between teacher assessment and peer assessment .....	40
Table 18. Multiple Regression Model Summary.....	40
Table 19. Multiple Regression Coefficient.....	41
Table 20. Multiple Regression ANOVA .....	41
Table 21. Reliability analysis of TAM Questionnaire.....	45
Table 22. Descriptive analysis of TAM.....	45
Table 23. Reliability analysis of ARCS Questionnaire .....	45
Table 24. Descriptive analysis of ARCS .....	46
Table 25. Reliability analysis of Authentic Learning Questionnaire .....	46
Table 26. Descriptive analysis of Authentic Learning Questionnaire.....	46

## Explanation of Symbols

<b>Symbol</b>	<b>Description</b>
$\alpha$	Cronbach's alpha to show the internal consistency of items in group
$p$	Probability value for show the statistical significance
$r$	Correlation coefficient value that show the strength and direction linear relationship among variables.
R-Squared or $R^2$ or $r^2$	Coefficient of determination to show the predictable variable in in dependent variable from independent variable