Preliminary Design of ILC-based Multimedia on Base of Number Concept

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Abstract. Interactive Conceptual Learning (ILC) based Multimedia has been developed to represent base of number concept turn into more interactive and meaningful learning. The first design of ILC based multimedia is multimedia supported computer that explore base of number concept in existing conceptual. Pre-service elementary teachers should be provided with the learning that can optimize the base of number conceptions. To collect and analyse data comprehensively, researchers developed a 3D-I1 developing method which has comprehensive stages: analysis, design, development, implementation and evaluation. The 3D-I1 developing stage has been utilized to describe comprehensively ILC based Multimedia. It can be proved with the increasing average score from 30.10 on pretest to 82.33 on posttest of pre service teachers’ understanding on base number concept. Based on data analysis, it can be concluded that ILC-based multimedia could effectively improve pre-service teachers’ conceptual understanding on base of number concept.

1. Introduction

Mathematics instruction for conceptual understanding is an essential aim of mathematics education. Such teaching is complex [1], and teachers may require a certain kind of information to teach mathematics for conceptual understanding successfully [2], including deep conceptual understanding of the mathematics [3]. However, have profound conceptual understanding may be lacking knowledge for recognizing conceptual understanding of particular learning aim in children’s mathematical work. Teachers require being able to assess whether their students are learning what is planned and educators need to provide experiences by media which help pre-service elementary teachers develop their understanding [4]. Knowledge that is rich in relationships. It can be attention of as a related web of knowledge, a system in which the connecting relationships are as famous as the separate some information [5]. Relationships permeate the individual specifics and propositions so that all pieces of information are linked to some network [6]. Conceptual understanding is regularly described in difference to technical information, which can be defined as “an expertise with the individual symbols of the system and with the syntactic conventions for acceptable arrangement of symbols consisting of rules or procedures for solving mathematical problems” [7]. For this study, procedural knowledge is measured purposely with respect to base of number where knowledge of relationships is primarily sequential: a step in a procedure is based multimedia.

Today, multimedia is viewed by many educators as a potentially dominant teaching medium. Several studies have reported that the use of multimedia in the classroom can encourage positive outcomes [8]. There is a lack of research connected to the impact that experience to multimedia has on students’
perceptions of the learning multimedia and engagement in mathematics classes [9]. Given the current importance in education on the potential of multimedia to transform high school classrooms and that some high-school students appear lazy and uninterested in standout of academic performance, we investigated whether revealing students to multimedia in mathematics classes enhanced students’ understanding of the learning based multimedia and their self-reports of engagement [10].

The present study drew on [11] understanding of multimedia in an educational context as learning based multimedia in which more than one media format is used to help to create mental models that meaningfully communicate verbal and graphic communication. By incorporating multimedia in their instruction, teachers have the potential to capture students’ awareness, engage students, explain hard concepts and motivate creativity [12]. Multimedia provides the skill for students to work at their own swiftness, building it easier for teachers to provide for the individual needs of specific students and to apply individual educational programmer. As such, multimedia gives teachers the means to present differentiated instruction to students with unreliable skills, giving teachers the possible to meet the needs of all learners. A main advantage of the use of multimedia in mathematics is the high degree of interactivity between the student and the concepts, as well as the practical submission of the skills educated [13]. Another assistance of using multimedia is its potential for students to expand their experiences and to have instantaneous feedback provided through their explorations and results [14]. Multimedia also offers opportunities for problem solving in collaborative groups and the sharing of ideas, both of which aid students in the development of communication and team skills [15].

Students’ successful learning engagement in mathematics is primarily determined by their level of stimulus and self-regulation in mathematics education [16]. Interactions between behavioral and personal determinants (that are planned in the social cognitive theory) propose that pertinent aspects of the learning environment impact both students’ understanding and their self-regulation. Psychologists have used up extensive try to build theories of appointment, mainly in the education context and, currently.

This study is aims to develop Interactive Conceptual Learning (ILC)-based multimedia in mathematics education utilizing 3D-11 (Define, Design, Develop and Implementation) to enhance pre-service elementary teachers’ conceptual understanding on base of number concept.

2. Method
The 3D-11 developing model has been utilized to develop ILC-based multimedia [17], which includes the stage of Define, Design, Develop and Implementation. The development of ILC-based multimedia through 3D-11 model has been implemented to the eleven pre-service elementary teachers in Universitas Riau. Judgment sheet obtained to measure validation ILC-based multimedia by expert. The Likert Scales (4 scales) has been utilized non-instrument in observing the implementation of ILC-based multimedia to the pre-service elementary teachers. The analysing process created the developing multimedia shown more emphasis on the concept of a base of number.

3. Result and Discussion
The development of ILC-based multimedia on base of number concept was more emphasis on the conceptual approach to assist pre-service elementary teachers more broadly understanding the concepts. The multimedia development has been utilized by 3D-11 developing model which included development stage, 1) Define 2) Design, 3) Development and 4) Implementation. In specify, multimedia development is discussed as follows.

3.1. Define
The analyzing step was a procedure of needs media such phase to identify the research problems and to perform tasks’ analyze. The output of the analyzed process was more promote on conceptual understanding through using multimedia computer. Based on further analysis, researchers have been obtained the development of multimedia on Interactive Learning Conceptual (ILC)-based Multimedia. Analysing was conducted on lesson plan and syllabus of basic mathematics.
3.2. Design
This stage was the constructed on paper before realist on multimedia. ILC-based multimedia design concept focused on exploration pattern and base of number especially arithmetic progression by animation and simulation. This multimedia design includes mathematics concept such as; arithmetic, geometry and pattern number. A sample of a multimedia design developed in the ILC-based multimedia in the structure of storyboard was given as shown Figure 1.

| Title                  | Frame name                        | Description of figure and simulation                  |
|------------------------|-----------------------------------|------------------------------------------------------|
| geometry               | Relation between geometric sequences and series | Figures of relation between geometric sequences and series with an example exercise and problem solving to determine Un. |

**Figure 1.** storyboard of an ILC-based multimedia

3.3 Development
Development stage is the process of realizing storyboard had become a reality. This step would learn process prepared. As an example design, the development stage has been organized on multimedia as following sample in Figure 2.

**Figure 2.** Homepage of ILC-based multimedia on base of number
The development was involving the development in multimedia design and multimedia content. Multimedia design that was developed using the macromedia flash program that has been developed by researcher.

3.4 Implementation
Implementation is the real stage to implement a media learning system that is being created. That is, at this stage all that has been developed in such a way appropriate to the role or function to be implemented. An example the implementation of the preliminary design ILC-based multimedia in based mathematics teaching. The score of pre-service teachers’ learning outcomes that showed the increasing in the conceptual understanding of the research was given as shown Table 1.

| NO  | NAME                  | PRETEST SCORE | POSTTEST SCORE |
|-----|-----------------------|---------------|----------------|
| 1   | Pre-service teacher 01| 20            | 88             |
| 2   | Pre-service teacher 02| 34            | 81             |
| 3   | Pre-service teacher 03| 30            | 80             |
| 4   | Pre-service teacher 04| 40            | 82             |
| 5   | Pre-service teacher 05| 30            | 84             |
| 6   | Pre-service teacher 06| 33            | 87             |
| 7   | Pre-service teacher 07| 30            | 83             |
| 8   | Pre-service teacher 08| 32            | 78             |
| 9   | Pre-service teacher 09| 30            | 89             |
| 10  | Pre-service teacher 10| 34            | 94             |
| 11  | Pre-service teacher 11| 30            | 93             |
| 12  | Pre-service teacher 12| 23            | 88             |
| 13  | Pre-service teacher 13| 33            | 80             |
| 14  | Pre-service teacher 14| 28            | 79             |
| 15  | Pre-service teacher 15| 30            | 84             |
| 16  | Pre-service teacher 16| 30            | 79             |
| 17  | Pre-service teacher 17| 30            | 84             |
| 18  | Pre-service teacher 18| 30            | 84             |
| 19  | Pre-service teacher 19| 30            | 83             |
| 20  | Pre-service teacher 20| 30            | 93             |
| 21  | Pre-service teacher 21| 30            | 78             |
| 22  | Pre-service teacher 22| 30            | 72             |
| 23  | Pre-service teacher 23| 30            | 79             |
| 24  | Pre-service teacher 24| 29            | 78             |
| 25  | Pre-service teacher 25| 31            | 77             |
| 26  | Pre-service teacher 26| 32            | 78             |
| 27  | Pre-service teacher 27| 30            | 80             |
| 28  | Pre-service teacher 28| 33            | 80             |
| 29  | Pre-service teacher 29| 32            | 79             |
| 30  | Pre-service teacher 30| 30            | 73             |
| 31  | Pre-service teacher 31| 30            | 76             |
| 32  | Pre-service teacher 32| 30            | 80             |
| 33  | Pre-service teacher 33| 30            | 76             |
| 34  | Pre-service teacher 34| 21            | 74             |
| 35  | Pre-service teacher 35| 30            | 79             |
| 36  | Pre-service teacher 36| 31            | 95             |
| 37  | Pre-service teacher 37| 30            | 90             |
| 38  | Pre-service teacher 38| 28            | 86             |
| 39  | Pre-service teacher 39| 30            | 88             |
4. Conclusion

Based on result and discussion research, it can be conclude that the development of ILC-based multimedia on the base of number concept through 3D-1I developing model (Define, Design, Development and Implementation) was able to effectively increase the pre-service elementary teachers’ conceptual understanding on base number concept from 30.10 on pretest to 82.33 on posttest. The ILC-based multimedia has been developed by using macromedia flash.

References

[1] O’Dwyer, L. M., Wang, Y., & Shields, K. A. 2015. Teaching for conceptual understanding: A cross-national comparison of the relationship between teachers’ instructional practices and student achievement in mathematics. *Large-scale assessments in Education* 3, 1-30.

[2] Bartell, T., Webel, C., Bowen, B., & Dyson, N. 2013. Prospective teacher learning: recognizing evidence of conceptual understanding. *Journal Mathematics Education*, 57-79.

[3] Saxe, G. B., Gearhart, M., & Nasir, N. S. 2011. Enhancing students’ understanding of mathematics: A study of three contrasting approaches to professional support. *Journal of Mathematics Teacher Education (4)* , 55-79.

[4] Hannigan, A., Gill, O., & Leavy, A. M. 2013. An investigation of prospective secondary mathematics teachers’ conceptual knowledge of and attitudes towards statistics. *Journal Mathematics Teacher Education*, 1-23.

[5] DeCaro, M. S. 2016. Inducing mental set constrains procedural flexibility and conceptual understanding in mathematics. *Memory and Cognition* 44, 1138-1148.

[6] Mintzes, J. J., & Chiu, M.-H. 2014. Understanding and Conceptual Change in Science and Mathematics: An International Agenda within a Constructivist Framework. *International Journal of Science and Mathematics Education* 2, 111-114.

[7] Newton, X. A. 2018. Conceptual Understanding of Foundational Mathematical Topics: What Might They Look Like? *Improving Teacher Knowledge in K-12 Schooling*, 133-180.

[8] Chipangura, A., & Aldridge, J. 2016. Impact of multimedia on students’ perceptions of the learning environment in mathematics classrooms. *Learning Environment research*, 1-18.

[9] Hermita, N., Suhandi, A., Syaodih, E., Samsudin, A., Isjoni, & Rosa, F. 2017. Assessing Pre-Service Elementary School Teachers’ Alternative Conceptions through a Four-Tier Diagnostic Test on Magnetism Concepts. *Advanced Science Letters* 23, 10910-10912.

[10] Suhandi, A., Muslim, Samsudin, A., Hermita, N., & Supriyatman. 2018. Effectiveness of the use of question-driven levels of inquiry based instruction (QD-LOIBI) assisted visual multimedia supported teaching material on enhancing scientific explanation ability senior high school students. *IOP Conference Series: Journal of Physics Conference Series* 1013, 1-8.

[11] Hermita, N., Suhandi, A., Syaodih, E., Samsudin, A., Marhadi, H., Sapriadil, et al. 2018. Level conceptual change pre-service elementary teachers on electric current conceptions through visual multimedia supported conceptual change. *IOP Conference Series: Journal of Physics: Conference Series* 1013, 1-8.

[12] Sapriadil, Setiawan, A., Suhandi, A., Malik, A., Safitri, D., Lisdiani, S. A., et al. 2018. Optimizing students’ scientific communication skills through higher order thinking virtual laboratory (HOTVL). *IOP Conference Series: Journal of Physics: Conference Series* 1013.

[13] Nusir, S., Alsmadi, I., Al-Kabi, M., & Sharadgah, F. 2013. Studying the Impact of Using Multimedia Interactive Programs on Children's Ability to Learn Basic Math Skills. *E-Learning and Digital Media* 10, 305-319.
[14] Liu, Y. 2012. Effect of integrating multimedia into the third grade mathematics curriculum to improve student learning. *Journal Educational Technology System* **40**, 251-271

[15] Malik, A., Setiawan, A., Suhandi, A., Permanasari, A., Dirgantara, Y., Yuniarti, H., et al. 2017. Enhancing Communication Skills of Pre-service Physics Teacher through HOT Lab Related to Electric Circuit. *IOP Conference Series: Journal of Physics: Conference Series* **953**, 1-9

[16] Kaczorowski, T. L., Hashey, A. I., & Cesare, D. M. 2018. An Exploration of Multimedia Supports for Diverse Learners During Core Math Instruction. *Journal of Special Education Technology*, 1-14

[17] Hermita, N., Suhandi, A., Syaodih, E., Samsudin, A., Isjoni, Johan, H., et al. 2017. Constructing and Implementing a Four Tier Test about Static Electricity to Diagnose Pre-service Elementary School Teachers' Misconception. *IOP Conference Series: Journal of Physics: Conference Series* **895**