Developing Teaching Multimedia to Improve Elementary Students' Understanding of Fraction Concepts

Andhin Dyas Fitriani
Universitas Pendidikan Indonesia, Jl. Dr. Setiabudhi No. 229, Bandung, Indonesia
andhindyas@upi.edu

Keywords: Teaching multimedia, students' understanding.

Abstract: This research work was focused on developing teaching multimedia to improve understanding about fraction concepts. Students' understanding about a concept may be influenced by their prior knowledge. In order for the students to construct and understand fraction concepts correctly, interactive multimedia are required to stimulate their understanding. The study involved 2 teachers and 30 students. Thus, experimental research was applied in the study that started with the development of learning media for the students. The result of the study shows that the understanding of fractional material through multimedia learning is increased. The utilization of this interactive media improved students' understanding about fraction concepts.

1 INTRODUCTION

Tony Buzan (in Mansur, 2008) puts forward that learning at the elementary school level is analogous to building a house of cards. Each card the house is built upon should be steadily positioned before stacking a new layer of cards. An unsteady or wrongly positioned card may result in the partial or even total collapse of the house.

As a matter of fact, many elementary school teachers, because of their position as a class teacher, have no choice but to teach mathematics. Hence, the process of mathematics teaching, especially in upper grades (4 to 6), is very abstract. As a result, mathematics is not thoroughly taught. The teachers only teach the parts that they know, leaving out other parts they don't. This is, among others, what makes many students flunk their mathematical reasoning. They become frustrated and demotivated in learning mathematics (Mansur, 2008).

A three-dimensional model expressed by Cockroft (1982, cited from Collin, 1988, in Turmudi, 2008) developed three main issues: mathematics as a subject matter, methods as the learning material delivery strategies, and students as the subjects who study the learning materials. Cockroft situated mathematics in a continuum line, from the concrete on the left and abstract on the other side. As for the teaching method, Cockroft put it on the left and textbook oriented on the other side. Cockroft put students as objects, as the *tabula rasa* that should be drilled with questions, on the top. While students as subjects, whose interests, needs, and psychological development condition should be taken into account, are put on the lower end of the continuum.

By utilizing the Cockcroft model, it can be seen how and what mathematical material is taught in Indonesia. The educational situation in Indonesia is like the point on the upper left corner of the Cockcroft model (octant 4), meaning that mathematics is viewed as an abstract concept, that it is rigid (not applicable), textbook oriented, teacher centered, and that the students are positioned as ranking objects, not as teaching objects whose interests and potentials are worthy of consideration. This way, mathematics becomes a 'dead' subject, and so does its teaching strategy (Turmudi, 2008).

Fitriani, A.
Developing Teaching Multimedia to Improve Elementary Students' Understanding of Fraction Concepts.
In *Proceedings of the 1st International Conference on Educational Sciences (ICES 2017) - Volume 1*, pages 441-445
ISBN: 978-989-758-314-8

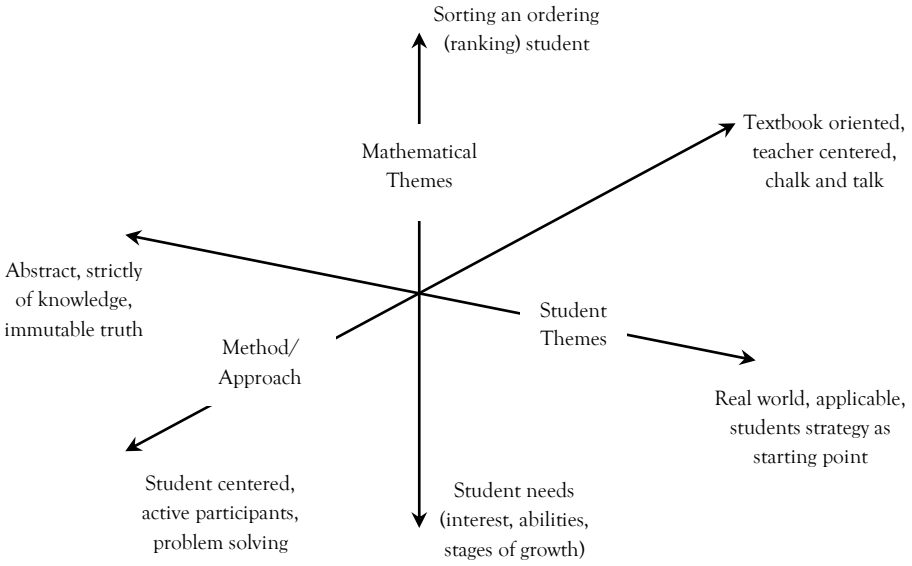

Figure 1: Figure of Cockroft's Teaching Model
(Cockroft, 1982; Collins, 1988 in Turmudi, 2008)

This is justified by a report of P4TK (the Center for the Development and Empowerment of Mathematics Teachers and Education Personnel) seminar and workshop in early 2007 that classroom mathematics teaching does not improve high order thinking skills, one of which is the ability to understand mathematical concepts that do not directly relate to everyday real life. As'ari of the Indonesian Mathematics Society reported that today's mathematics teaching is characterized by short-term objectives (passing the school, regional, or national examination), complex materials, focus on procedural ability, one-way communication, monotonous classroom management, low order thinking skill, textbook dependency, routine low-level thinking question drills (Shadiq, 2007).

2 STUDENTS' UNDERSTANDING

Students' understanding about a concept may be influenced by their prior knowledge. Students who have better understanding will be able to explain the various concepts in various ways. Thus, prior knowledge enables every student to understand a concept in a different way. In order for the students to construct and understand fraction concepts correctly, interactive multimedia are required to stimulate their understanding.

The degree of understanding is determined by the degree of relevance of an idea to a procedure. In other words, a mathematical fact can be understood comprehensively if it forms interrelated concepts. According Duffin and Simpson (2000), a conceptual understanding can be perceived as a student's ability to explain a particular concept, use the concept in different situations, develop its consequences. Department of National Education (2003) explains that a conceptual understanding is one of skills expected to be achieved by the students in learning mathematics; for example, by showing understanding of mathematical concepts, explaining the interconnection between concepts, and applying concepts widely, accurately, efficiently and appropriately in problem solving.

According to Skemp and Pollastek (in Sumarmo, 1987), there are two types of conceptual understanding: instrumental understanding and rational understanding. Instrumental understanding can be perceived as an understanding of mutually exclusive concepts, and mathematical formulas are memorized only in simple calculations. While the rational understanding contains a scheme or structure that can be used to solve a wider problem.

A misunderstanding can be defined as a contradiction between a concept in someone's understanding with the actual concept. A misunderstanding of a material cannot be ignored in the teaching and learning process because it may lead

to another misunderstanding of the subsequent materials, and it may also become fossilized in a student's mind.

Studies conducted in various countries asserts the importance of developing decimal teaching that imparts an understanding of the essence of decimal and fractional numbers (Brousseau, 1997; Hiebert, 1992; Irwin, 2001; Stacey, Helme, Archer and Condon, 2001 in Stacey, and Steinle, 2008). In line with this, Graeber and Johnson (in Wijaya, Stacey, & Steinle, 2008) put that without any understanding of decimal and fractional numbers, students may be able to work on decimal or fractional operations but cannot tell if the result of the operation is correct or not.

Studies revealed that teachers have potential misconceptions about decimals and fractions. Fixing these misconceptions and imparting an understanding of the basic concepts of decimal and fractional numbers become necessary to prevent them from being transmitted to their students (Menon, 2004; Putt, 1995; Stacey, Helme, Steinle et al, 2001; Thipkong and Davis, 1991; Tsao, 2005 in Wijaya, Stacey and Steinle; 2008).

The misconception of elementary school students in the lower grades in comparing decimal and fractional numbers is largely because of the generalization of the property of integers; i.e., the more the decimal numbers or the greater the numerator, the greater the integers. This property applies only to the set of integers but is not appropriately applied to the set of decimal or fractional numbers (Steinle, 2004 in Wijaya Stacey & Steinle, 2008).

In the perspective of developmental psychology, children at early childhood school level show their high natural tendency to play, especially when fed up with school activities. Most teachers and parents are not aware of this. What is worrying is that children are exploring and channelling their curiosity and passion through a variety of non-educational computer-based entertainment facilities. Parental response by providing entertainment devices at home is not equipped with the awareness that a new source of inspiration will have a major impact on children's emotional and intellectual development.

3 MULTIMEDIA

Sadiman (2008:6) state that the word media literally means instruments. According to Gagne (in Arsyad, 2009), media are the various types of components in the student environment that can stimulate them to learn. Thus, multimedia is the use of various media (text, audiovisual, and so on). Meanwhile, Munir (2008) states that multimedia refer to a computer system consisting of hardware and software which makes it easy to combine such various components as pictures, videos, graphics, animations, voices, texts, and data controlled by a computer program. Furthermore, Thompson (in Munir 2008:190) defines multimedia as a system that combines images, videos, animations, and sounds interactively. Some multimedia elements, according to Karyadinata (2006), include: texts, pictures, graphics, sounds, videos, and animations.

While learning is an active process of scientific inquiry or the process of science formulation, not just the process of knowledge disclosure (Munir, 2008). Furthermore, Sadiman (in Warsita, 2008) explains that teaching is a planned effort to manipulate learning resources in order to engage the learners in the learning process. In the teaching process, there is an interaction between learners and educators and resources available in the learning environment. Teaching is a process provided by a teacher to help the learners gain knowledge and build their characters. Put it another way, teaching is a process to help students learn well.

4 RESULT AND DISCUSSION

To determine the feasibility of the developed interactive multimedia, a validity test, namely expert judgement, was carried out. Aspects considered in this expert validation included content quality, learning goal alignment, feedback and adaptation, motivation, presentation design, interaction usability, accessibility, reusability, and standard compliance (Leacock and Nesbit, 2007), based on learning object review instrument (LORI).

Table 1: Feasibility of Interactive Multimedia Validation

Aspects and Indicators	Number of Items	Criteria on Score	Gained Score	%
Content Quality	4	12	54	90%
Learning Goal Alignment	4	12	50	83.3%
Feedback and Adaptation	1	3	11	73.3%
Motivation	1	3	13	86.7%
Presentation Design	1	3	13	86.7%
Interaction Usability	3	9	37	82.2%
Accessibility	2	6	26	86.6%
Reusability	1	3	14	93.3%
Standard Compliance	1	3	12	80%

The result shows that the gained feasibility percentage was 84.68% or could be categorized as very good.

This study used paired t-test and Analysis Tools menu on the Microsoft Excel 2010. The result showed that significance (α) 0.05 (see Table 2). Moreover, students' average scores pre-treatment is lower than post-treatment. The calculation by using *normalized gain* shows that the highest average comes from the students in the high group, which is 0.71 (the high category) (Hake, 1999). Meanwhile, the middle group and below group are in the score of 0.64 and 0.56 which belong to the middle categories.

Table 2: The comparison between before and after treatment

t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	22.5666667	33.6333333
Variance	87.871038	49.208451
Observations	30	30
df	29	
t Stat	7.873408	
P(T<=t) one-tail	1.03289E-13	
t Critical one-tail	1.32908344	
P(T<=t) two-tail	2.0041E-13	
t Critical two-tail	1.893207	

According to the Table II, it could be stated that the appliction of multimedia learning can help student in understanding the concept of fractions, and help teachers in doing variations in learning. It give positive feedback towards the students' improvement to the learning material.

The developed interactive multimedia have helped students to think reflectively in such a way that they could actively participate and try to connect ideas displayed in the multimedia. As Lest and Behr (in Walle, 2007) put it, in order to connect ideas, it takes five representations involved in the teaching process; they are images, written symbols, spoken language, real world situations, and manipulative models. These five elements are all in the developed interactive multimedia. Through this interactive multimedia, students could understand why $\frac{1}{2}+\frac{1}{3}=\frac{1}{6}$ and what $\frac{1}{2}x\frac{1}{3}=\frac{1}{6}$ means.

5 CONCLUSIONS

This study shows that the application of multimedia learning on fractional material gives a positive impact in mathematics learning. Therefore, by applying multimedia learning, teachers can help student in understanding the still abstract mathematical concepts for the student. It will also enhance students independence through mastery and mathematics learning process.

REFERENCES

Arsyad. 2006. *Media Pembelajaran*. Jakarta: Raja Grafindo Persada.

Duffin, J. M and Simpson, A. P. 2000. A Search for Understanding. *Journal of Mathematical Behavior*. Vol 18(4), pp 415-427.

Mansur. 2008. *Refleksi Kritis Pembelajaran Matematika*. LPMP Provinsi Maluku. [online]. Available: http://p4tkmatematika.com/web-p4tkmatematika.com.

Karyadinata, R. 2006. *Aplikasi Multimedia Interaktif Dalam Pembelajaran Matematika Sebagai Upaya Mengembangkan Kemampuan Berpikir Matematik Tingkat Tinggi Siswa SMA.* Doctoral dissertation submitted to UPI School of Postgraduate Studies, Bandung: Unpublished.

Leacock, T. L., and Nesbit, J. C. 2007. A Framework for Evaluating the Quality of Multimedia Learning Resources. *Educational Technology & Society Journal,* Vol 10 (2), pp 44-59.

Munir. 2008. *Kurikulum Berbasis Teknologi Informasi dan Komunikasi*. Bandung: ALFABETA.

R. R. Hake, Departement of Physics Indiana University, 19 June 1999. [Online]. Available: http://www.physics.indiana.edu/~sdi/AnalyzingChange-Gain.pdf. [Accessed 10 March 2011].

Sadiman, et al. 2008. *Media Pendidikan, Pengertian, Pengembangan, dan Pemanfaatannya*. Jakarta: Rajawali Press.

Shadiq, F. 2003. *Bagaimana Cara Matematika Meningkatkan Kemampuan Berpikir Tingkat Tinggi Para Siswa?* [Online]. Available: www.fadjarp3g.wordpress.com.

Sumarmo, U. 1987. *Kemampuan Pemahaman dan Penalaran Matematik Sisa SMA Dikaitkan dengan Penalaran Logik Sisa dan Beberapa Unsur Proses Belajar mengajar*. Doctoral Dissertation submitted to Bandung IKIP Postgraduate Studies.

Turmudi. 2008. *Landasan Filsafat dan Teori Pembelajaran Matematika (Berparadigma Eksploratif dan Investigatif)*. Jakarta: PT. Leuser Cita Pustaka.

Walle, J. A. V. 2007. *Elementary and Middle School Mathematics (sixth edition)*. Pearson Education.

Warsita, Bambang. 2008. *Teknologi Pembelajaran Landasan dan Aplikasinya*. Jakarta: Rineka Cipta.

Widjaja, W., Stacey, K. and Steinle, V. 2008. Misconceptions about density of decimals: Insights from Indonesian Preservice Teachers. *Journal of Science and Mathematics Education in Southeast Asia*, Vol 31(2), pp 117-131.