THE EFFECT OF PRESENTATION STRATEGY ON MULTIMEDIA LEARNING-ANIMATION VS STATIC VISUALIZATION-AND LEARNING STYLE TO LEARNING RESULT

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ABSTRACT

The effectiveness of learning depends on four main elements; they are content, wanted learning outcome, instructional method and the delivery media. Besides that, the learning style also requires to be considered. This research aims to investigate the effect of the type visualizing—on the presentation strategy of the computer-based multimedia learning—and the learning style (sequential vs. global) toward the learning result. The type visualizing on the presentation strategy as an independent variable includes 2 treatments, static visualization and animation visualization. The learning result as dependent variable and the student's learning style as a moderator variable. Learning with computer-based multimedia was conducted in the class with the research subject was the students of STMIK-STIKOM Bali who were in their fourth semester in the year 2011/2012.The experiment design used Anova univariat factorial 2x2 design with the samples of 164 students spread in 6 different classes. Based on the data analysing, it is concluded that the student's learning results of a group of students who received learning by multimedia learning using animation visualization presentation were more superior rather than group of students with the static visualization presentation, anything the student's learning style (sequential or global).

Keywords: Multimedia learning, presentation strategy, visualization type, learning style, learning result.

FOREWORD

Multimedia learning (computer-based) is a type of e-Learning whose learning is delivered via computer with the learning content (text, picture, graphic, audio, video, animation, etc) is stored in CD-ROM or computer file. This multimedia technology keeps developing and increasing in use (Ganesan, 2009; Jereb & Šmitek, 2006). Multimedia learning can be obtained through, for example: internet by downloading the file on blended-learning, and CD-ROM on class-room or individually. But unfortunately this type of learning is still passive in general, emphasizing more on the media and element aspect rather than on the learning method, which means that it is just transferring information from an electronically source to a learning population without paying attention on the learning results/knowledge achievement (McLaren, 2008).

There are four main elements which has to be focused so that learning process can be effective, they are learning result (knowledge achievement), content type, learning method and delivery media (Clark, 2008). Because of that, in learning through multimedia context, multimedia learning is said to be effective if it is successful in integrating those four elements. Based on the research result by Mbarika et al. (2010) and Stanwick (2010) which states that multimedia learning has important role in enhancing the learners' learning

experience and or understanding further in solving problems and or the attitude to the learning material.

Besides that, the effectively of multimedia learning will improve if in designing and producing it noticing these things: learners' learning style preference (Clark & Mayer, 2008; Merrill, 2002); the availability of learner control (stop and play buttons) in adjusting the cognitive load of the learner during the learning process or interactivity multimedia (Hasler et al., 2007; Mayer & Moreno, 2002; Tabbers & de Koeijer, 2010); the topic condition (the static/dynamic content type) which is presented (Passerini, 2007; Guttormsen Schär & Zimmermann, 2007); and content visualization type (static or animation visualization) (Lin & Dwyer, 2010).

This research aims to investigate the effect of visualization type (animation vs. static)-on computer-based multimedia learning presentation strategy-and learning style (sequential vs. global) to the learning result (students' ability in applying concept of object-oriented modeling). The visualization type on the multimedia presentation strategy acts as independent variable with two treatments which are animation visualization and static visualization. The students' learning style (sequential vs. global) acts as moderator variable. The learning result acts as dependent variable. The learning strategy follows Merril (Component Display Theory) and the multimedia presentation format follows Mayer and Moreno (*Seven Principles of Multimedia Learning*). Learning with computer-based multimedia is done in the classroom with the research subject is the fourth semester students of STMIK STIKOM Bali in the academic year 2011/2012. The experiment design uses the factorial univariat ANOVA 2x2 with the size of samples are 164 students divided in 6 classes.

LITERATURE REVIEW

Multimedia and How Human Learns

The components of multimedia consist of: texts, picture/photo, graphic arts, sound, animation and digitally manipulated video elements (Vaughan, 2006). Whereas animation, according to Mayer & Moreno (2002) refers to a simulated motion picture which describes the simulated objects' movements. The multimedia referred here is a computer-based content/information presentation media, whether in static visualization or animation visualization.

Regarding with the content presented, Mayer & Moreno (2003) states three assumptions on how human learns: (1) the human information process system consists of two channels, they are audio/verbal which processes audio input and verbal representation, and visual/pictorial which processes visual input and pictorial representation; (2) both channels have limited capacity; and (3) meaningful learning needs some amount of cognitive process which occupy both channels. That learning is a deep understanding on material, including important material aspects which are presented, organizing them mentally in a cognitive structure and integrating with the existing/relevant knowledge.

Multimedia Learning

Multimedia learning (computer-based) is a type of e-Learning whose learning is delivered via computer with the learning content (text, picture, graphic, audio, video, animation, etc) is stored in CD-ROM or computer file. Learning with multimedia has characteristics as follow (Clark & Mayer, 2008): (1) the content for learning is relevant with the objective of learning; (2) using learning method such as examples and exercise/practice to help the learner in learning; (3) using the media elements such as words (texts) and images in delivering the content and learning method; (4) designed for the learners to be able to learn in asynchronous

learning; and (5) building new knowledge and skill which are connected to the purpose of learning or increasing the organization's performance.

Learning Cognitive Theory with Multimedia

Cognitive process is defined as changing in mind, intelligence, and learner's language. This changing happens because of the existence of learning process (Santrock, 2008). The model of how human learns (how human mind works) is presented in Figure 1. This model is known as learning cognitive theory with multimedia (Clark & Mayer, 2008; Mayer & Moreno, 2003).

According to Figure 1, there are 3 important cognitive processes which is pointed by arrow: (1) *words selection and pictures*, as the first step which give attention on words and pictures which are relevant from the material presented in short-term memory which connected with the five senses (sensory memory/senses); (2) *organizing words and pictures*, as the second step which mentally organizing selected material in coherent verbal and pictorial representation in working memory; and (3) *integration*, as the final step which integrate one pictorial and verbal representation with the others with the prior knowledge in long-term memory.

Sensory memory or short-term memory is a limited capacity memory system where information is kept for about 30 seconds, unless the information is repeated or processed furthermore; working memory is some kind of 'working table' in which some information process is done; and long-term memory is a type of memory which stores a lot of information for a long period of time relatively permanent (Santrock, 2008).

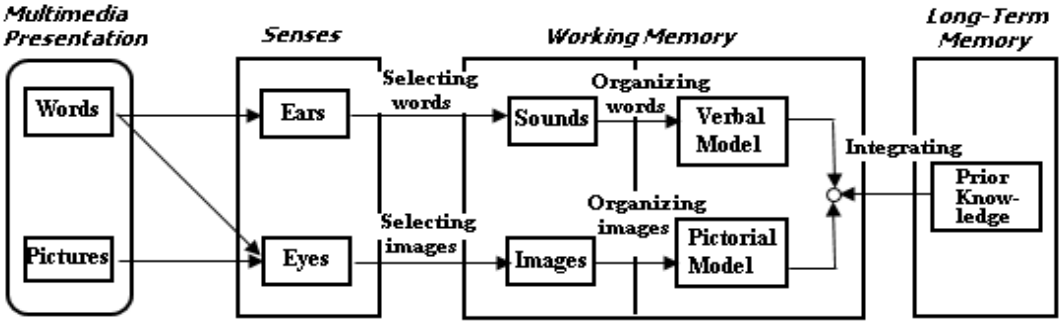

Figure 1. Learning Cognitive Theory with Multimedia*

Information Presentation Guide in Multimedia Format

There are 7 information presentation guide principles in multimedia format-animation (Clark & Mayer, 2008; Mayer & Moreno, 2002), they are: (1) *multimedia principle* (learner learns better on animation and narration/audio rather than on narration alone); (2) *spatial contiguity and temporal contiguity* (learner learns better if the words/text are delivered near a relevant animation (image) portion, and the portion related with the narration and animation are delivered together rather than sequential); (3) *Logical/coherence connection principle* (learner learns better on animation and narration if the irrelevant words/text, sound and picture are removed rather than used); (4) *modality principle* (the learner learns better on animation and narration rather than animation, narration and text on screen); (5) *redundancy principle* (learner learns better on animation and narration rather than on animation, narration and text on screen); (6) *segmentation/interactivity principle and pertaining principle*(learner learns better if the facility to organize essential processing is available to avoid overloading on the cognitive system (the availability of stop, previous and next buttons), and the learner

learns better if they are given material orientation session fast [relevant key-concepts] related to the content/material learned before the presentation begins); (7) *personalization principle* (learner learns better on animation and narration with conversational style rather than on formal one).

The Effect of Visualization Type-on Computer-Based Multimedia Learning Presentation Strategy-to the Learning Result

Visualization type on multimedia learning strategy acts as independent variable with two types of treatment, static visualization (the content is displayed all at once on the screen) and animation (the content is displayed in sequence on the screen). The material/content which is learned is the same for both treatments, which is the object-oriented modeling material.

Content presentation with animation visualization gives a facility to the students in managing the cognitive process more accurately while studying-to avoid overloading in working memory-rather than using the content presentation with static visualization. Therefore it is hoped that this can give a real influence on their learning result.

Learning Style

Learning style is an option of how student or learner receives information and processes it into a meaningful knowledge. Felder Model is one of the learning style model which has effect on academic performance, and retention. This model measures the learning style of the learner using *Index of Learning Styles (ILS)* from Felder and Solomon which its realiability and validity has been proven for the technical/engineering students (Litzingeret al., 2007). This model has four learning style dimensions which can be described as follows (Felder & Brent, 2005; Graf et al., 2006; Litzinger et al., 2007): *(1) Information processing, which is active* (the learner learns best through working actively on learning material, by applying and practicing it; they tend to study in group), and *reflective* (the learner likes to think and reflect the learning material; they prefer to study on their own); *(2) Perception, which is sensing* (the learner tends to like studying about facts and concrete learning material), and *intuitive* (the learner tends to like studying theoretical/abstract learning material); *(3) Input, which is visual* (the learner is able to remember better through learning on what they see [such as picture, diagram, and flowchart]), and *verbal* (the learner tends to like learning material through textual representation in text and sound/narration); and (4) *Understanding, which is sequential* (the learner learns with a small increasing step, and therefore has linear progress), and *global* (the learner tends to receive the material randomly without seeing the connection [holistic], but when it is felt enough with the learning material, suddenly they can get full image of the learning material).

The Impact of Learning Style to The Learning Result

In learning, the existence of different learning style of the learners can give a significant impact to the learning result (the learning becomes ineffective) if these things occur: (1) the teaching style of the teacher is not a match with half/all the learning style of the learners (Merrill, 2002; Felder & Brent, 2009), and (2) in the learning context with the multimedia, multimedia learning is not/less accomodate the many learning styles of the learners matchingly (Clark & Mayer, 2008).

Interraction between Visualization Type—onPresentation Strategy—andLearning Style and its Effect on Learning Result

The visualization type on content presentation strategy is a type of delivery strategy, so the strategy itself is a part of a learning strategy/method. The learning strategy consists of organizing, delivering, and managing (Reigeluth, 1983). On managing strategy, it is possible

to be an interraction between the learners and the delivering strategy (content presentation). Related to that matter, Merrill (2002) states that the interraction between the learning strategy and the learning style (strategy-by-learning-style) can affect significantly in increasing the learners' ability in acquiring knowledge/information which are presented.

METHOD

The Research Variable and Experiment Design

This research is a quantitative reserach with quasi-experimental approach. The purpose is to test the effect of the independent and dependent variables. The independent variable is a type of visualization-on multimedia learning presentation strategy-with two kinds of treatment (animation visualization and static visualization) and the learner's learning style (sequential vs global) as the moderator variable. The dependent variable is the ability of the students in applying concept. The material to be learnt is the object-oriented modelling. The experiment design is ANOVA 2x2 univariat factorial experiment.

Research Subject

The reseach subject of this research is the fourth semester students of Computer System in STMIK STIKOM Bali which are 164 students divided in 6 classes. The data of the amount of students of both treatment group is in Table 1. The equality of both groups have been tested based on the prerequisite subject grade of the students (converting the grade from letter into number) with Mann-Whitney Test technical analysis.

Treatment Design

The comparative aspects design of both multimedia learning treatment, which is the content presentation with static visualization and animation visualization is presented in Table 2. In its implementation, for each type of visualization there are three classes of students which receive the same treatment; there are six same multimedia learning modules (different topic for each module); the learning time on the same week for each topic; the final test on the same week.

Table 1. The Amount of Students Based On the Treatment and Class Group

Treatment Group	*Class*	*N*	*%*
Static Visualization	A	31	
	B	34	
	C	20	
	Amount	*85*	*51.8*
Animation Visualization	D	24	
	E	27	
	F	28	
	Amount	*79*	*48.2*
Total		164	100

Annotation: n = amount of students

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Table 2.The Comparative Design of Computer-Based Multimedia Learning Treatment

Aspect	*The Multimedia Learning with Static Visualization Presentation**	*The Multimedia Learning with Animation Visualization Presentation**	*Information*
Presentation	The content segment which consists of several sub-segments displayed **all at once** on computer screen.	The content segment which consists of several sub-segments displayed sequentially (sub-segment per sub-segment) on computer screen. The amount of time of sub-segment on the screen is 1-3seconds and the break between sub-segment is 2-5 seconds.	One sub-segment content consists of several words/sentences or half/all pictures/diagrams/tables. On animation visualization, the sub-segment content can be in many forms of format.
Learner control	The availability of **STOP** and **CONTINUE** buttons as the controller of **narration (voice).**	The availability of **STOP** and **CONTINUE** buttons as the controller of **narration (voice).**	The control button as representation of the existence of the user interactivity with multimedia learning besides the other buttons.
Practicing	The availability of practice/assignment practical materials. The materials are displayed **all at once** on computer screen without narration.	The availability of practice/assignment practical materials. The materials are displayed **sequentially** on computer screen without narration.	The lecturer with the students discuss the practice/assignment questions given

*Content adopted & modified from lecturing items of BIT 201, Dual Degree Program, STMIK-STIKOM Bali and Help University College

The Measurement of the Research Variable

Dependent variable is measured with final test, by using instrument which is adapted and modified from the test model or assignment which is facilitated by Min (2011). That instrument can be used to measure the students' ability in applying object-oriented modelling concept. This instrument along with the multimedia learning contents have been validated by two validators (information technology field expert) and it is stated good in general. This validation includes three aspects: (1) the content clarity in representing the topics, (2) the suitability of the content with the objective of learning, and (3) the suitability of the assesment instrument in measuring the students' performance (applying concept). This instrument has reability coefficient (Alpha Cronbrach) of 0,67.

The moderator variable-index of learning style (ILS)-is measured using instrument to measure the learning style based on the Index of Learning Style (ILS) from Felder-Solomon (Litzinger, 2007),also appear in Waras (2003). ILS is an online questionairre which is designed to grade 4 dimension preference learning style which are active/reflective, sensing/intuitive, visual/verbal, and sequential/global. Eah dimension covers 11 question items, which makes the total questions are 44 items. The learning style dimension applied here is the sequential/global learning style (understanding category).

Data Collecting and Analysis Method

The average description of the learning result scores are displayed on Table 3. Next the measuring data results are analyzed with univariat variant analysis technique (ANOVA) 2x2 with the help of SPSS statistic program package. Several statistic assumption that have to be taken before conducting the ANOVA analysis technique is data normality and equality variant matrix (Hair et al., 2006).

Table 3. The Score Description of Concept and Procedure Application Procedure

Treatment Group	*Learning Style*	*Concept Application Ability*		
		N	*Average*	*Deviation Standard*
Static Visualization	Sequential	46	2,48	0,52
	Global	39	2,57	0,54
Animation Visualization	Sequential	36	2,82	0,55
	Global	43	2,75	0,60

Annotation: n = amount of students

RESULT AND DISCUSSION

Normality Test and Variant Equality

Based on the normality test result on the dependent variable with the Shapiro-Wilk statistic test, it can be concluded that the data normality assumption of the dependent variable measurement result is fulfilled (Shapiro-Wilk statistic= 0,984, free degree= 164, with the significant number= 0,056). Therefore the Levene test result for the variant matrix equality test states that that assumption is fulfilled (significant number F is 0,913 bigger than α= 0,05).

Analysis Result

The test/analysis result of ANOVA 2x2 the effect of visualization type and learning style to the learning result is displayed in Table 4. The analysis result concludes that: there are significant effects of visualization type (animation vs static) to the learning results; there are no significant effect of the learning style (sequential vs global) to the learning results; and there are no significant effect of the interaction between visualization type and learning style to the learning result.

Table 4. The Test Result of ANOVA 2x2 the Visualization Type and Learning Style Factor Effect

Dependent Variable: The ability in applying the concept

Source	Sum of Squares	Freedom Degrees	Mean Square	F	Signifi-cance
Model	1151,970	4	287,993	943.081	0,000 s
Visualization Type (A)	2,658	1	2,658	8.705	0,004 s
Learning Style (B)	0,003	1	0,003	.009	0,924 ns
A * B	0,236	1	0,236	.772	0,381 ns
Error	48,860	160	0,305		
Total	1200,830	164			

Notes: s = significance; ns = non significance ; α = 0,05

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DISCUSSION

1. The Effect Of Visualization Type (Animation Vs Static)—OnMultimedia Learning Presentation Strategy-ToThe Learning Results

The analysis result concludes that learning with multimedia using animation visualization presentation is better that the static visualzation presentation, especially related to the students' ability in applying the concept (sub-ordinate procedure) of the object-oriented modelling. The result is consistent with the result of the previous research conducted by Lin & Dwyer(2010),and Pass et al. (2007).

The superiority of multimedia learning with animation visualization compared with the static visualization can happen because of the multimedia learning (animation) accommodateinformation presentation guide principles in multimedia format-animation, especially the multimedia principles, temporary contiguity principle and segmentation principle.

2. The Effect Of Learning Style To The Learning Result

The analysis result concludes that there is no significant difference of the students' learning result in applying object-oriented modelling concept in multimedia learning between student group with sequential learning style and student group with global learning style. This result is consistent with the result of the previous research conducted by Kozub (2010), McCann (2006), and Yilmaz-Soylu & Akkoyunlu (2002).

This thing can happen because the multimedia learning is successful in accomodating the students' learning style preferences (sequential/global) through providing facilities which allow the students to learn topics from a sequential material (via the next button) and randomly (via pull-down button). This is consistent with the statement in Clark & Mayer (2008), and Merrill (2002) about the effective or not a learning depends on how far the learning strategy accomodates the students' learning style.

3. The Interaction Effect Between Visualization Type-On Presentation Strategy-And Learning Style To The Learning Result

The Analysis result concludes that there is no significant interaction impact between the visualization type-on multimedia learning presentation strategy-and learning style on students' ability in applying concept of object-oriented modelling. This result is consistent with the previous research results conducted by Kozub (2010), and McCann (2006).

The unsignificant interaction between the visualization type-on multimedia learning presentation strategy and learning style is probable because the learning style factor does not have effect on the learning result.

CONCLUSION AND SUGGESTIONS

Conclusion

The students' learning result in applying concept (subordinate procedure) object-oriented modelling on interactive multimedia learning (learner's control) computer-based with animation visualization presentation is more effective/superior than the students' learning result on multimedia learning with static visualization presentation, regardless of the students' learning style (sequential or global).

Suggestions

1. On computer-based interactive multimedia learning, content presentation which is in concept (subordinate of the procedure content)-is better to visualize in animation (the contents are displayed continuously on screen) so that the learner can manage their cognitive load when learning. The students' control facility can be a stop and continue button.
2. In the development of computer-based interactive multimedia learning, for the concept kind of content (subordinate procedure), in the multimedia presentation, it is better to include/facilitate the availability of buttons (or menu) which has random and continuously function (in selecting the material/topic of the learning).

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REFERENCES

Single Author

[1] Clark, R. C. (2008). *Developing Technical Training: A Structured Approach for Developing Classroom and Computer-Based Instructional Materials*. (3rd Edition). San Francisco: John Wiley & Sons, Inc.

[2] Ganesan, N. (2009). Rapid Development of Multimedia Instructional Modules for Information Technology Education. *Journal of International Technology and Information Management, 18*(1), 83-97.

[3] Kozub, R. M. (2010). An ANOVA Analysis of The Relationships between Business Student's Learning Styles And Effectiveness Of Web Based Instruction. *American Journal of Business Education, 3*(3), 89.

[4] McCann, B. M. (2006). The Relationship between Learning Styles, Learning Environments, and Student Success. *Journal of Agricultural Education, 47*(3), 14-23.

[5] McLaren, A. C. (2008). Designing Effective E-Learning. *Journal of Distance Learning, 5*(2), 47-57.

[6] Merrill, M. D. (2002). *Instructional Goals and Learning Styles: Which takes precedence?* Dalam R. A. Reiser & J. V. Dempsey (Ed.). *Trends and Issues in Instructional Design and Technology* (pp. 99-106). Upper Saddle River, New Jersey: Merrill Prentice Hall.

[7] Min, N. S. (2011). *BIT 201 Object-Oriented Modelling using UML*. Assignment 1, lecturing assignment of Dual-Degree Program. STMIK-STIKOM Bali Denpasarand HELP University College Kualalumpur

[8] Passerini, K. (2007). Performance and Behavioral Outcomes in Technology-Supported Learning: The Role of Interactive Multimedia. *Journal of Educational Multimedia and Hypermedia, 16*(2), 183-211.

[9] Reigeluth, C. M. (1983). Instructional-Design: What is it and why is it? In C. M. Reigeluth (Ed.). *Instructional-Design Theories and Models, An Overview of their Current Status*. Hillsdale, New Jersey: Lawrence Erlbaum Associates, Inc.

[10] Santrock, J. W. (2008). *Psikologi Pendidikan* (Edisi Kedua). Jakarta: Kencana.

[11] Sien, V. Y. (2009). *BIT 201 Object-Oriented Modelling using UML*. Lecture 1-8, lecturing items of Dual-Degree Program. STMIK-STIKOM Bali Denpasar and HELP University College Kualalumpur.

[12] Stanwick, P. A. (2010). Using Multimedia Content To Present Business Ethics: An Empirical Study**.** *Journal of STEM Education; Special Edition 2010*, 38-44.

[13] Vaughan, T. (2006).*Multimedia: Making It Work*. Yogyakarta: Penerbit Andi.

[14] Waras, K. (2003). *Pengaruh Model Pembelajaran dan Gaya Belajar terhadap Kecakapan Akademik, Teknikal, dan Pemecahan Masalah Bidang Permesinan*. Disertasi.PPS UM Malang.

Two Authors

[15] Clark, R. C. & Mayer, R. E. (2008). *E-Learning and the Science of Instruction* (Second Edition). San Francisco: In Print of Wiley.

[16] Felder, R. M. & Brent, R. (2005). Understanding Student Differences. *Journal of Engineering Education, 94*(1), 57-72.

[17] Felder, R. M. & Brent, R. (2009). *Effective Teaching: A Workshop*. Athlone Institute of Technology. Retrieved July 10, 2012, from

[18] www.ait.ie/media/athloneit/formsanddocuments/felder-and-brent--Effective-Teaching.pdf

[19] Guttormsen Schär, S. G. & Zimmermann, P. G. (2007). Investigating Means to Reduce Cognitive Load from Animations Applying Differentiated Measures of Knowledge Representations. *Journal of Research on Technology in Education, 40*(1), 64.

[20] Jereb, E. & Šmitek, B. (2006). Applying Multimedia Instruction in E-Learning. *Innovations in Education and Teaching International Journal, 43*(1), 15-27.

[21] Lin, H. & Dwyer, F. M. (2010). The Effect of Static and Animated Visualization: a Perspective of Instructional Effectiveness and efficiency. *Educational Technology, Research and Development, 58*, 155-174.

[22] Mayer, R. E. & Moreno, R. (2002). Animation as an Aid to Multimedia Learning. *Educational Psychology Review, 14*(1), 87-99.

[23] Mayer, R. E. & Moreno, R. (2003). Nine Ways to Reduce Cognitive Load in Multimedia Learning. *Educational Psychologist, 38*(1), 43-52.

[24] Tabbers, H. K & de Koeijer, B. (2010). Learner Control in Animated Multimedia Instructions. *Instructional Science, 38*, 441-453.

[25] Yilmaz-Soylu, M. & Akkoyunlu, B. (2002). The effect of learning styles on achievement in different learning environments. *The Turkish Online Journal of Educational Technology, 8*(4), 43-50.

Three or More Authors

[26] Graf, S., Viola, S.R., Leo, T. & Kinshuk. (2007). In-Depth Analysis of the Felder-Silverman Learning Style Dimensions. *Journal of Research on Technology in Education, 40*(1), 79-93.

[27] Hair, J. F. Jr., Black, W. C., Babin, B. J., Anderson, R. E. & Tatham, R. L. (2006). *Multivariate Data Analysis* (Sixth Edition). Upper Saddle River, New Jersey: Pearson Education, Inc.

[28] Hasler, B. S., Kersten, B. & Sweller, J. (2007). Learner Control, Cognitive Load and Instructional Animation. *Applied Cognitive Psychology Journal, 21*, 713-729.

[29] Litzinger, T. A., Lee, S. H., Wise, J. C. & Felder, R. M. (2007).A Psychometric Study of the Index of Learning Styles. *Journal of Engineering Education; 96*(4), 309-319.

[30] Mbarika, V., Bagarukayo, E., Shipps, B. P., Hingorani, V., Stokes, S., Kourouma, M. & Sankar, C. (2010). A Multi-Experimental Study on the Use of Multimedia Instructional Materials to Teach Technical Subjects**.** *Journal of STEM Education, Special Edition* 2010, 24-37.

[31] Pass, F., Van Gerven, P. W. M. & Wouters, P. (2007). Instructional Efficiency of Animation: Effects of Interactivity through Mental Recontruction of Static key Frames. *Applied Cognitive Psychology, 21*, 783-793.