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PROMOTING POSITIVE EMOTION IN MULTIMEDIA LEARNING USING VISUAL ILLUSTRATIONS

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The purpose of this article was to explore the concept of interest, one of the critical positive emotions in learning contexts and to investigate the effects of different types of visual illustrations on learning interest, achievement, and motivation in multimedia learning. The concept of interest was explored in light of positive emotion; an experiment was conducted to examine the effects of visual illustrations. In the experiment, participants were drawn from two classes of "Introduction to Educational Technology" and randomly assigned to one of the three conditions: (a) cognitive interest illustration condition, (b) emotional interest illustration condition, and (c) text-only condition. The cognitive interest illustrations were designed to promote learners cognitive interest by showing the scientific principle with corresponding illustrations. The emotional interest illustrations were designed to increase learners' emotional interest by providing interesting but peripherally relevant illustrations. The text-only condition presented text information only with no illustrations. Results revealed that the post interest was different between the cognitive interest group and the text-only group, and also between the emotional interest group and the text-only group. The study also revealed a significant difference in learners' motivation. The types of visual illustration, however, did not have an effect on learners' information recall or on comprehension.

The role of emotions^{1,2} in a learning situation has long been regarded as an ambiguous aspect to study. Several reasons have been indicated by previous studies. Price (1998) insisted that the concept of emotion has been defined inconsistently across various studies although the definition is a fundamental issue. Another major consideration was the inability of researchers to directly observe the dynamic emotional state of a subject. Finally, the parameters of the experiment often concealed the genuine emotional experience that occurred during the learning experience (Gadanhó & Hallam, 2001). Yet, even with these identified restrictions, explorative research to examine the role of positive emotions in the cognitive process has been conducted in various fields of study.

Positive emotions are usually considered as "pleasant" states of emotions that are distinguished from negative emotions regarded as "unpleasant" states of emotions (Gadanhó & Hallam, 2001). Multiple studies have provided evidence that positive emotions have crucial effects on diverse cognitive processes such as information processing, the communication process, the negotiation process, the decision-making process, category sorting tasks, and even the creative problem-solving process (Isen, Daubman, & Nowicki, 1987; Isen, Johnson, Mertz, & Robinson, 1985; Picard, 1997).

Isen and Baron (1991) emphasized the constructive role of positive emotions in the cognitive process as follows: "persons who are feeling happy are more cognitively flexible, more able to make associations, more able to see potential relations among stimuli than other persons in a neutral state" (Isen et al., 1987; Isen et al., 1985). Fredrickson (1998), in her Broaden-and-Build Model of Positive Emotions, identified four positive emotions such as joy, interest, contentment, and love, and she further suggested that positive emotions widen the scope of attention, broaden behavior repertoires, and increase intuition and creativity (Fredrickson & Losada, 2005). The theory holds that, over time, the broadening of behavior repertoires triggered by positive emotions builds a range of personal resources including physical resources (e.g., physical skills, health, longevity), social resources (e.g., friendships, social support networks), intellectual resources (e.g., expert knowledge, intellectual complexity), and psychological resources (e.g., resilience, optimism, creativity) (Fredrickson, 1998; Fredrickson & Losada, 2005). Forgas (1998) also showed in his experiment that business people in a positive mood formulated action plans more cooperatively in an integrative way and achieved the final product of higher quality than did neutral or negative mood participants. This line of studies shows that promoting positive emotions is an effective way to stimulate the active and flexible cognitive process.

Learning Interest

Among various positive emotions in a learning context, interest in learning has been recognized as a critical emotion for successful learning since the beginning of the 20th century (Dewey, 1913). Dewey was the first theorist who held that interest and effort are separate aspects of the learning process and that interest leads to deeper learning. Since then, research and theorizing regarding the role of interest in the learning process has rapidly increased until it reached its peak in the early and mid-1990s.

Many empirical studies have supported the importance of students' interest in a learning situation. From 1980 to 1990 many researchers who focused on conceptualizing interest as an emotion supported the following three general features of interest (Schraw & Lehman, 2001). First, interest is positively related to attention and learning. Second, interest level varies from person to person. Last, interest is elicited by both internal and external factors. Later, Renninger, Hidi, and Krapp (1992) provided an integrated theoretical framework based on the distinction between individual interest and situational interest in their book, *The Role of Interest in Learning and Development*. This framework implying the distinction between individual interest and situational interest has been used as theoretical ground for studies on learning interest.

Regarding the distinction between individual interest and situational interest, the focus of difference is on the source of interest. Individual interest is implied as a characteristic of a person. It is specific to an individual, develops slowly, tends to be long lasting, and is triggered by an individual's predisposition. For example, a learner who is interested in a specific topic or an activity pays more attention and acquires more knowledge than another learner who does not have such an interest. As this type of interest is formed differently by individuals, it is challenging to design a learning environment or instructional material by combining all learners' diverse individual interests. Situational interest, on the other hand, is generated as an outcome of interestingness. It is triggered by certain conditions or concrete objects embedded in a learning environment or in instructional material for the purpose of promoting interest from a specific situation. Therefore, situational interest is assumed to contribute to the interestingness of a situation. In summary, while individual interest is a relatively stable evaluative orientation towards certain domains, situational interest is an emotional state aroused by specific features of given activities or tasks.

Figure 1 illustrates the relationship between individual interest and situational interest. Both individual interest and situational interest are com-

bined together in certain learning circumstances to represent interest as a psychological state within a person.

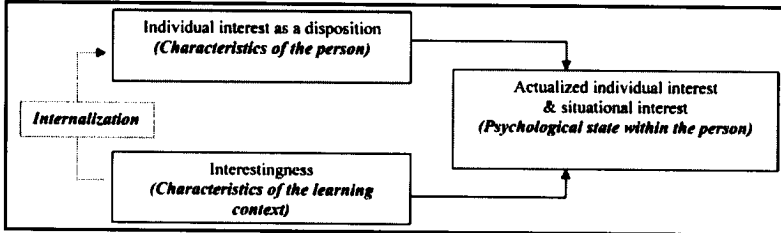


Figure 1. Three approaches to interest research (Krapp, Hidi, & Renninger, 1992)

This third concept of interest is referred to as a psychological state within a person, combining both concepts of interest as an individual disposition and interestingness of a learning situation. This third concept of interest is generally accepted and used in interest related research. Most of the research performed in past decades has defined interest as the third concept does because it represents the actualized interest within a person affected by internal factors and external factors (Krapp, 1999; Renninger, Hidi, & Krapp, 1992; Schiefele, 1998; Schraw, Flowerday, & Lehman, 2001; Schraw & Lehman, 2001). In addition, the third concept of interest can be traced back either to an “interesting” factor of the context (situation) or to an already existing (dispositional) interest. Therefore, interest, in this study, is defined as the third concept which is an actualized psychological state within a person.

Given a focus on interest as a psychological state, both characteristics of the person and the learning situation are critical factors that affect the actualized learner’s interest. Research on individual interest is mainly concerned with a person’s characteristics, which is the subject side of the “person-object relationship.” Conversely, research approaches engaged with the object side of this relationship is conceived as situational interest (Krapp, 1999). The study investigated in this article grounded its framework of inquiry in this second relationship.

It is notable, as mentioned earlier, that designing instructional material based on the factors affecting individual interest is challenging as it is practically impossible to collect interests that would apply to everyone and apply them into the design of instructional material. Besides, individual interest is the individual’s disposition developed over a period of time by the process of internalization of situational interest. Therefore, as an instructional

designer, how to improve situational interest in a learning environment becomes a fundamental question that needs to be answered.

Most previous research on situational interest has focused on the characteristics of academic tasks that create situational interest (Hidi & Baird, 1986). Features such as personal relevance, novelty, activity level, and comprehensibility have been found to arouse situational interest and further increase the level of comprehension and recall of text information. However, it has also been reported that some features of situational interest can possibly have unwanted “positive” effects (Garner, Brown, Sanders, & Menke, 1992). Harp and Mayer (1997) called these types of features “seductive details” to refer to interesting but peripherally relevant details that are added to a passage to make it more interesting. Researchers who examined the effect of seductive details used attractive pictures or anecdotes to increase the interestingness of learning material. Garner, Gillingham, and White (1989) found that adding “unrelated to the instructional objectives but interesting” sentences to expository texts inhibited the learning of the main points in the text. They labeled this finding the seductive detail effect, which is the term used to describe how added details seduce the readers away from the main idea in the text. However, the results of the seductive details effect were not consistent across the research. Thalheimer (2004) summarized research on seductive details in his meta-analysis study. He suggested that only the type of seductive details found in the text serve to shift the learner’s cognitive processing away from the information that should be learned inhibits learning rather than facilitating learning.

Seductive Augmentation

According to Gagne, Briggs, and Wager (1988), gaining the attention of the learner is suggested to be the “first event” of instruction. Many methods promoting learners’ interest have been suggested such as surprise-ending stories, interesting sentences in text, and seductive details (Harp & Mayer, 1997). As a matter of fact, various methodologies have been used to engage students in learning, such as telling stories, using case studies, walking around the classroom, using flipcharts, prompting group discussions, and asking questions. Similarly, instructional designers have augmented text-based learning materials by adding interesting elements such as stimulating stories, biographical details, clip art, photographs, sounds, and video (Thalheimer, 2004).

Seductive augmentation uses interesting segments that contain highly interesting, but unimportant information, to promote or help understanding

of the main topic. It has been suggested as a strategy to engage a learner's attention and promote interest (Schraw & Lehman, 2001). The term "seductive augmentation" is derived originally from "seductive detail" which has been a focus of studies on reading and interest (Renninger et al., 1992). Studies have used the term "seductive detail" to refer to interesting but unimportant details that are added to a passage to make it more interesting. It should be noted that seductive detail is not completely irrelevant but is peripherally relevant to main topic. This term has been used extensively in reading education to refer to the interesting yet unnecessary text segments added to expository texts in order to increase learners' interest.

The original focus of the research has recently evolved into broader learning contexts. In multimedia learning, seductive detail usually is called seductive augmentation because the term "seductive augmentation" refers not only to text but also to graphics, narratives, voice, animation, and text accompanied in multimedia learning environments with the purpose of increasing learners' situational interest (Thalheimer, 2004).

Comprised of seductive details, seductive augmentation is defined as a number of nonsupporting but vivid details embedded in and part of the instructional materials taking multiple forms of presentations (Thalheimer, 2004). Seductive augmentation is so highly memorable that it disrupts learning or even the identification of important ideas. It is most seductive when it is novel, active, concrete, and personally interesting (Garner et al., 1992).

As with the seductive details, there have been two opposite research findings regarding the usefulness of seductive augmentation. One group of researchers asserts that seductive augmentation energizes readers so that they pay more attention to learning material and learn more overall. They believe that it improves learners' positive emotion by promoting their enjoyment of the topic, causing learners to pay more attention and encode more of the information presented (Izard & Ackerman, 2000; Kintsch, 1980). The importance of perceptual arousal to increase learners' attention is suggested as one of the motivational design guidelines as well. The other group of researchers takes the opposite position. They emphasize that seductive augmentation disrupts learners' construction of the cause-and-effect chain, so that adding materials to it results in decreases in retention on tests and decreases in ability to develop solutions to transfer problems (Harp & Mayer, 1997).

The effective use of graphics in designing instructional material has been suggested as an important facet of instructional message design (Anglin, Towers, & Levis, 1996). Using graphics (images) in instructional materials is an effective method to support learning because it can be used as an

interest-getting device and use of graphics also helps learners interpret and remember the context of an illustrated text. In terms of affective function of illustration, Kintch (1980) insisted that visual illustrations have an effect on learners' emotional state in two different ways depending on the features of the graphics. According to his cognitive interest and emotional interest theory, a visual illustration could either improve learners' cognitive interest or emotional interest depending on the characteristics of the image. Cognitive interest improves learners' cognition by promoting structural understanding of an explanation. On the other hand, emotional interest energizes learners' arousal so that they will pay more attention and increase overall learning. Therefore, a cognitive interest illustration is defined as an illustration that graphically shows the structure of the explanation given. An emotional interest illustration is defined as an illustration which is interesting but irrelevant to the structure of text. However, it plays an important role from a motivational perspective, because it increases emotional arousal and further promotes learners' cognitive processes.

In the same vein, Levie and Lentz (1982) reviewed the previous research comparing three research areas concerning the role of illustration in learning. They concluded that learning is facilitated when the information in the written text is depicted in the illustrations and that learning of text material is neither helped nor necessarily hindered with illustrations that are not related to the text. However, they did not consider the affective function of illustrations separately from the cognitive function.

Harp and Mayer (1997) examined the effects of emotional interest adjuncts and cognitive interest adjuncts on information retention, learning transfer, and learning interest. The result was consistent with the prediction of cognitive interest theory and was inconsistent with the prediction of emotional interest theory. In their study, however, the learners' achievement was measured based on the procedural information of scientific phenomenon, not based on the factual information. In addition, the instructional material was paper-based and the participants were not allowed to read the passage more than once.

Therefore, two important issues can be raised. First, it is doubtful if the results of the study would be still consistent with the case of the print-based instruction if the instructional material was delivered in the form of multimedia presentations. In multimedia learning, an instructional material on the computer screen consists of texts, graphics, and video clips. In addition, learners can navigate the entire instructional material using the navigation buttons shown on each screen. Thus, the learner can go back to the previous contents text or go to the next contents text. He is also allowed to read

the text more than once. In short, learners have control over the process of learning with multimedia based material as opposed to learning with paper-based material. Second, learners' achievement scores might be different depending on the content of instructional material. If the content of instructional material contains factual information as well as procedural information, the learners who are given emotional interest illustrations may recall more concepts than learners who are given only cognitive interest illustrations, because the learner in the cognitive interest illustration condition will not be able to make full use of cognitive interest illustrations as do those who studied an instructional material containing illustrations representing only procedural information.

To answer this question, this study employed learner-controlled multimedia material that contains both factual and procedural information. Based on the concept of learning interest explored earlier, the study investigated the effects of different types of visual illustrations on learners' learning interest, motivation, and achievement.

METHOD

Participants

The participants in the study were a total of 36 college level students who were attending a four-year university in the southeastern area in the United States. The study took place during an *Introduction to Educational Technology* course, which is designed to teach students how to apply technology into learning and teaching in the classroom. Of 36 participants who agreed to participate in the study, 4 were male and 32 were female. All participants were sophomore- and junior-level students taking preservice teacher courses in the college of education. The participants were drawn from two classes of *Introduction to Educational Technology* and randomly assigned to one of the three conditions.

Materials

The multimedia instructional material used in this study was developed using Hyperstudio®, a multimedia authoring tool. The material was de-

signed to teach the “Life cycle of a hurricane,” a science principle. A total of 10 hyper-media cards were developed covering six concepts such as (a) Unit overview, (b) Origin of Hurricane, (c) Life Cycle of hurricane development, (d) Eye and Eye wall, (e) Hurricane rotation, and (f) Hurricane’s demise. Although a multimedia authoring tool was employed, only graphic and text displays were implemented in order to prevent the learner from being affected by other variables such as sound or animation. The illustrations were all color graphics depicting the hurricane development process. Three types of instructional materials were developed separately according to the independent variables. An example of the screen shot is shown in Figure 2.

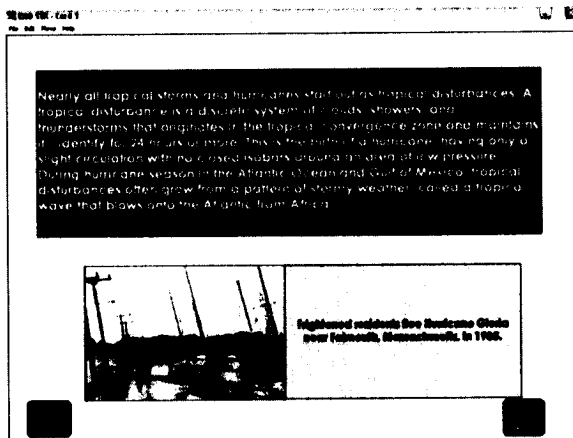


Figure 2. An example of instructional material

Independent Variables

The independent variable used for this study was the type of visual illustration with three levels: (a) cognitive interest illustration, (b) emotional interest illustration, and (c) text-only with no illustration. The topic of the visual illustrations was “The Life Cycle of a Hurricane.”

The instructional material containing the cognitive interest illustration consisted of a screen-based presentation on a topic of the life cycle of hurricane. The design of the cognitive interest illustration was centered on Kintch’s (1980) cognitive interest theory. According to Kintch, cognitive interest influences learners’ cognition by promoting structural understanding of the text content given. Therefore, the cognitive interest illustrations needed to be designed to signal the structure of the explanation to be given.

For example, Harp and Mayer (1997) used illustrations with an explanatory summary to promote learners' cognitive interest on the lightning process. In the present research, cognitive interest illustrations were designed to improve understanding of the four stages of hurricane development, the required ingredients for forming a hurricane, and the location of eye and eye wall as shown in Figure 3. The illustrations were presented adjacent to the text information in the instructional material. Therefore, the learners were able to read the text first and view the illustrations later. Six cognitive interest illustrations were used, each of which was placed on the screen adjacent to the corresponding text.

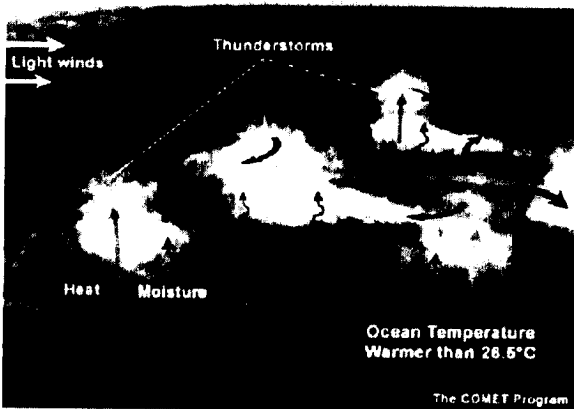


Figure 3. An example of the cognitive interest illustrations

The instructional material including emotional interest illustration also consisted of screen presentations on the topic of the life cycle of hurricane. The design of the emotional interest illustration was based on the emotional interest theory by Kintch (1980). According to the theory, the emotional interest energizes learners' arousal which helps learners pay more attention to the instructional material. Thus, the emotional interest illustrations are interesting but irrelevant to understanding the four stages of hurricane development. Harp and Mayer (1997) used the emotional interest illustration to compare its effect with that of the cognitive interest illustration. In the present study, the emotional interest illustrations were designed to improve learners' arousal toward the hurricanes as shown in Figure 4. As with the cognitive interest illustrations, the emotional interest illustrations were displayed adjacent to the text information in the instructional material. The position and the number of emotional interest illustrations were the same as those of the cognitive interest illustration condition.



Frightened residents flee Hurricane Gloria near Falmouth, Massachusetts, in 1985.

Figure 4. An example of the emotional interest illustrations

The instructional material containing text-only information consisted of a screen-based presentation on the same topic, that is, “The Life Cycle of a Hurricane.” However, no illustrations were included as shown in Figure 5.

Several important ingredients are needed for a tropical disturbance to become a tropical cyclone and later strengthen into a tropical storm or hurricane: (1) A tropical disturbance with thunderstorms, (2) A distance of at least 500 kilometers (300 miles) from the equator, (3) Ocean temperatures of 26.5°C (80°F) or warmer to a depth of at least 50 meters (164 feet) below the surface, (4) Lots of moisture in the lower and middle part of the atmosphere, finally (5) Low wind shear.

Figure 5. An example of the text-only information

Dependent Measures

Three dependent variables for the study include (a) postinterest, (b) achievement score, and (c) motivation. One postinterest question item was

used to measure learners' postinterest level. This postinterest item was used in the previous research designed to see the levels of interest that learners feel on the content given (Harp & Mayor, 1997). Participants were asked to reflect their interest level toward the instructional material provided, by selecting one of the five choices ranging from "not at all true" to "very true."

Achievement score was measured in two ways: recall test and comprehension test. The recall test was designed to assess learners' ability to recall hurricane-related terms based on the text they have read. A sheet of paper was distributed to each participant with the following instruction on it: "Please write down everything you can remember from the passage." The participants were given five minutes to complete the recall test. Learners' comprehension levels were measured using a post comprehension test. The comprehension test was designed to assess learners' ability to solve given problems based on what they have learned from the instructional material. The total number of items was ten including five short-answer items and five multiple-choice items. The items were designed to assess the following topics: (a) four development processes of hurricane, (b) meteorological factors necessary for forming hurricane, (c) identification of hurricane from actual weather pictures, and (d) the structure of a hurricane.

Learner motivation was measured using the Instructional Material Motivation Survey (IMMS) developed by Keller (1993). The survey, consisting of 36 items, was intended to be a situational measure of learners' motivational reactions toward the instructional material. The response scale ranged from 1 to 5 with 12 *Attention* related questions, 9 *Relevance* related questions, 9 *Confidence* related questions, and 6 *Satisfaction* related questions. The reliabilities based on the Cronbach's alpha for each subscale and the total scale were as follows: Attention: .89, Relevance: .81, Confidence: .90, Satisfaction: .92, and Total: .96.

Procedures

The instructional material was presented in a computer laboratory with 24 individual personal computers. Participants were drawn from two sections of an "Introduction to Educational Technology" course and randomly assigned to one of the three treatments conditions: (a) cognitive interest illustration condition, (b) emotional interest illustration condition, and (c) text-only condition. Participants were asked to complete a prior knowledge survey and a preinterest survey before processing instructional material. They were then informed that they would be studying multimedia instruc-

tional material on the life cycle of hurricane and that, after they finished reading, they would be asked a series of questions about what they had read. They were then instructed to read the material carefully at their normal reading rates. The instructor was present at all times to ensure that the participants were studying only the multimedia material. Each participant was given the material corresponding to his/her treatment condition and told to start studying for 10 minutes. They were not allowed to take notes or refer to other resources.

Upon completion of their studying, participants received the postinterest survey inventory and were asked to complete it at their own rate. After completing the postinterest inventory, the participants were given the recall test. The experimenter collected the recall sheet after six minutes had passed. Next, the participants were given the paper-based achievement test and allowed 10 minutes to work on the test. After the achievement test was collected, the participants were given the IMMS to measure their motivational level. The participants were then thanked for their participation.

The recall test was scored based on prepared criteria. Since the only differences among the three treatments were the types of illustrations presented on six out of ten screens, only the information recalled from those six screens were considered in the test score. When a participant described all four stages of hurricane development on the recall sheet, each stage was considered as one point. The five ingredients for a hurricane were also counted as one point each. Lastly, descriptions regarding the hurricane eye and the eye wall were computed as one point each. Therefore, the total score for the recall test ranged from 0 through 11.

The achievement test was graded based on predetermined criteria. The total number of the test questions was ten. Each question had a different weight, depending on the difficulty level of the question. Since there were correct answers for all of the questions, the answer sheet was prepared from information provided in the instructional materials. The total score for the achievement test ranged from 0 through 19.

RESULTS

The descriptive statistics for all dependent measures are presented in Table 1 according to the three conditions.

Table 1
Means (Adjusted Means) and Standard Deviations of Dependent Measures
Across Conditions

Measures	Maximum Score	Treatment conditions					
		Cognitive interest Illustration (n=12)		Emotional interest illustration (n=12)		Text-only (n=12)	
		<i>M (Adj. M)</i>	<i>SD</i>	<i>M (Adj. M)</i>	<i>SD</i>	<i>M (Adj. M)</i>	<i>SD</i>
Post interest*	5	3.75 (3.87)	.96	3.83 (3.87)	.83	3.33 (3.05)	1.15
Recall score	11	5.67 (5.64)	1.15	4.75 (4.71)	1.05	4.83 (4.90)	1.59
Achievement score	19	12.67 (12.78)	2.77	11.83 (12.00)	3.16	13.17 (12.88)	1.90
Motivation Total*	5	3.47 (3.52)	.60	3.65 (3.67)	.54	3.15 (3.08)	.70
Attention*	5	3.40 (3.48)	.71	3.72 (3.74)	.60	3.13 (3.04)	.88
Relevance*	5	3.10 (3.17)	.60	3.38 (3.40)	.63	2.81 (2.72)	.78
Confidence	5	4.11 (4.11)	.54	4.27 (4.27)	.32	3.86 (3.87)	.64
Satisfaction*	5	3.18 (3.28)	.87	3.21 (3.24)	.76	2.65 (2.52)	.91

* $p < .05$

Postinterest

The postinterest score was collected using one interest survey question item. A one-way between-groups analysis of covariance was conducted to compare the postinterest scores of three treatment conditions after adjustments were made for preinterest differences. Participants' preinterest scores were used as the covariate in this analysis. Table 1 presents the mean as well as the adjusted mean, and the standard deviation for postinterest scores across all three treatment conditions. With alpha set at .05, and the sample size of 36 (12 per cell), it was determined that the power for moderate effects was .54. Preliminary analyses were conducted to ensure that there was no violation of the assumptions of normality, homogeneity of variances, and equal regression slopes. After adjusting for preinterest scores, it was found that at least one pair of means was significantly different, $F(2,32)=4.95$, $p < .05$. A post hoc analysis using a bonferroni adjustment of alpha level (alpha = .017), showed that the postinterest score for the cognitive interest il-

illustration condition ($M=3.87$, $SD = .96$) was significantly higher than the post-interest score for the text-only condition ($M=3.05$, $SD = 1.15$), $F(1,32) = 7.56$, $p = .01$, showing a very large effect size, Cohen's $d = 1.29$. Also the post-interest score for the emotional interest illustration condition ($M=3.87$, $SD = .83$) was significantly higher than the post-interest score for the text-only condition ($M=3.05$, $SD = 1.15$), $F(1,32) = 7.42$, $p = .01$, showing a very large effect size, Cohen's $d = 1.29$. However, there was no score difference between cognitive interest illustration condition ($M=3.87$, $SD = .96$) and emotional interest illustration condition ($M=3.87$, $SD = .83$). Table 2 presents the analysis of covariance summary.

Table 2
The Analysis of Covariance Summary

Source	Sum of Squares	df	Mean Square	F Value
Preinterest	18.565	1	18.565	42.381*
Condition	4.340	2	2.170	4.954*
Error	14.018	32	.438	

* $p < .05$

Achievement Test

Recall test. Recall test data was collected by grading the number of hurricane related terms a learner wrote down in the limited time. A one-way between-groups analysis of covariance was conducted to compare the recall test scores of three treatment conditions after adjustments were made for prior knowledge scores. Table 1 presents the mean as well as the adjusted mean, and the standard deviation for recall test scores across all three treatment conditions. Preliminary analyses were conducted to ensure that there was no violation of the assumptions of normality, homogeneity of variances, and equal regression slopes. Even though the emotion interest condition was expected to show higher recall score than both cognitive interest condition and text-only condition, the result showed that the recall test score did not differ across three conditions, $F(2,32)=1.724$, $p>.05$.

Comprehension test. Comprehension test data was collected by grading the number of correct answers for the achievement test. A one-way between-groups analysis of covariance was conducted to compare the comprehension test scores of three treatment conditions after adjustments were made for prior knowledge scores. Table 1 presents the mean as well as the adjusted

mean, and the standard deviation for comprehension test scores across all three treatment conditions. Preliminary analyses revealed no violations. Although it was expected that the score of the emotional illustration condition would be higher than those of cognitive illustration condition and text only condition, the result revealed that the comprehension test scores did not differ across three conditions, $F(2,32)=.394, p>.05$.

Motivation

Motivation data was collected using IMMS developed by Keller (1993). A one-way between-groups analysis of covariance was conducted to compare the attention, relevance, confidence, and satisfaction scores of three treatment conditions after adjustments were made for prior interest differences. Table 1 presents the mean and the standard deviation for motivation scores across all three treatment conditions. Preliminary analyses revealed no violations. The results revealed that at least one pair of total motivation means was significantly different, $F(2,32)=3.56, p<.05$. A post hoc analysis using a bonferroni adjustment of alpha level ($\alpha = .017$), showed that the total motivation score for the emotional interest illustration condition ($M=3.67, SD = .54$) was significantly higher than the text-only condition ($M=3.08, SD = .70$), $F(1,32) = 6.64, p = .015$, showing a very large effect size, $\text{cohen's } d = 1.11$.

In order to examine the differences of each motivational component, four ANCOVAs were conducted for the three conditions. Prior interest served as a covariate. The results revealed that there was a significant difference among three conditions in terms of attention scores, relevance scores, and satisfaction scores with the exception of confidence scores: attention, $F(2,32)=3.47, p<.05$; relevance, $F(2,32)=4.07, p<.05$; and satisfaction, $F(2,32)=4.71, p<.05$. Further post hoc analysis with a bonferroni adjustment of alpha level ($\alpha = .017$) showed that the attention score for the emotional interest illustration condition ($M=3.74, SD = .60$) was significantly higher than the text-only condition ($M=3.04, SD = .88$), $F(1,32) = 6.83, p = .014$, showing a very large effect size, $\text{cohen's } d = 1.12$. In regard to the relevance, further post hoc analysis with a bonferroni adjustment of alpha level ($\alpha = .017$) showed that the total relevance score for the emotional interest illustration condition ($M=3.40, SD = .63$) was significantly higher than the text-only condition ($M=2.72, SD = .78$), $F(1,32) = 7.92, p < .01$, showing a very large effect size, $\text{cohen's } d = 1.2$. Finally, further post hoc analysis with a bonferroni adjustment of alpha level ($\alpha = .017$)

showed that the total satisfaction score for the cognitive interest illustration condition ($M=3.28$, $SD = .87$) was significantly higher than the text-only condition ($M=2.52$, $SD = .91$), $F(1,32) = 7.44$, $p = .01$, showing a very large effect size, Cohen's $d = 1.18$. In addition, the total satisfaction score for the emotional interest illustration condition ($M=3.24$, $SD = .76$) was significantly higher than the text-only condition ($M=2.52$, $SD = .91$), $F(1,32) = 6.80$, $p = .014$, showing a very large effect size, Cohen's $d = 1.11$.

DISCUSSION

In this study, the effects of three different types of instructional material were investigated in terms of learning interest, achievement, and motivation.

It was found that the level of post interest for learners in the emotional interest illustration condition was significantly higher than the text-only condition. In addition, the level of post interest for learners in the cognitive interest illustration condition was significantly higher than the text-only condition. These results indicate that the learners who were given any types of illustrations felt more interest than did the learners who were given text-only information. However, it is noticed that no significant difference was found between the cognitive interest illustration condition and the emotional interest illustration condition. This result affirms that learners are aroused to be in a positive emotion, interest in this study, toward instructional materials when any types of illustrations are given to them. These results are consistent with the findings of Harp and Mayer (1997) who found positive effects of illustrations on learning interest in their study when a scientific principle (The steps of electricity generation) was presented through paper-based instructional material. However, they also failed to find the difference between the emotional interest illustration condition and the cognitive interest illustration condition.

The failure of either of the illustration types to affect both the recall and comprehension tests can also be explained in the same grounds. Unlike Harp and Mayer's experiment (1997), learners were allowed to navigate the instructional materials freely using the navigation buttons provided. In other words, if the learners missed some information, they could go back to the screen to ensure that they understood the information correctly. Thus, the presented illustrations did not seem to play a strong role in enhancing learners' recall and comprehension of instructional material. Another possible reason for the nonsignificant difference in both the recall and comprehension tests could be because the seductive detail effect did not seem to occur

in this study. Previous research showed that seductive details hurt both recall and problem-solving transfer of critical information when seductive illustrations are added to an expository text (Harp & Mayer, 1997; 1998). Although the scores for the recall and the comprehension tests were almost the same between the two conditions in this study, it was found that the seductive illustrations did not disrupt students' learning. In other words, illustrations used in this study did not play a role as seductive details.

With regard to learner motivation toward the instructional material, the results indicate that the types of illustration had a significant effect on learners' motivation. As shown in Table 1, there were significant mean differences among the three conditions in the overall motivation score and the three sub-measures except for the confidence score. The findings suggest that learners pay more attention when emotional interest illustrations are presented than when text-only information is presented. In other words, the emotional interest illustrations easily grasp learners' attention when included in the instructional material. The result also showed that the emotional interest group had a significantly higher relevance score than did the text-only group. A possible reason for this can be explained by the learners' personal interest.

According to Keller's ARCS motivational model, one of the subcomponents of the relevance factor is motive matching (Keller & Kopp, 1987). Motive matching relates to how and when instruction can be linked to learners' learning style and personal interest. Therefore, learners feel that they are linked to the instructional content when they have a certain level of personal interest. The learners who participated in this study were found to possess significant amounts of personal interest in hurricanes. The reason for this may be because hurricanes are very crucial natural phenomena for learners' lives in the southeastern area of the United States. Thus, the illustrations used in this study may have stimulated learners' motivation toward the instructional material especially in terms of relevance.

There were several limitations to the findings of this study. First, the learner's individual characteristics regarding the preference to the illustration were not considered. Because the learners did not have the control over the illustration type, they had to receive the illustrations along with the text information without having any choice. Second, because the instructional material used in this study was lecture-based, there were limited interactions between the learners and the instructional material. Therefore, it is necessary to conduct a follow-up study with an interactive instructional module with which learners can interact. Lastly, it should be noted that the time taken to complete this study was 30 to 40 minutes depending on the condition. In regard to the measured time spent on studying the instructional materi-

als, the learners in the present study seemed to spend relatively reasonable time, compared to the previous studies, in which learners spent less than 10 minutes on studying text-based instructional materials. The longest time was shown in Schraw's study (1998), in which the learners spent 12.5 minutes on learning the material. Although the time taken in this study was relatively longer than other previous seductive augmentation studies, it would be important to have longer treatment times to ensure the treatment effect.

Future research is needed to fill the gaps in our understanding of the interaction between learners' characteristics and the type of illustrations in multimedia learning environments. In addition, we should also attempt to determine various functions of illustration in terms of cognitive function as well as those of affective function so that we could compare the different research results on the same topic based on the function of illustration.

The findings of this study have both theoretical and practical implications. On the theoretical side, the findings of this study illuminate the concept of learning interest as it relates to seductive augmentation. In addition, this study generalized the use of seductive augmentation in a multimedia learning context. Considering most of the previous research has been conducted with only paper-based instructional materials, this study investigated whether the "seductive detail/augmentation effect" is still evident in a multimedia learning environment. On the practical side, the important finding is the strategies employed to promote learners' interest and motivation in multimedia learning. The implication of this study involves the importance of visual illustration on learners' affect in multimedia learning, even though this study did not show a positive effect of visual illustration on learners' achievement. The findings of the study suggest that using illustration in multimedia instructional material increases learners' learning interest and motivation. Generally, emotional interest illustrations are considered not as important as cognitive interest illustrations because of "the seductive detail effects." However, this study demonstrated that both cognitive interest illustrations and emotional interest illustrations are important. Especially, emotional interest illustrations were found to have a positive impact on promoting learners' motivation. Therefore, educators, educational software producers, or instructional designers need to consider the potential benefits of using different types of illustrations when they develop multimedia learning materials.

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Notes

¹ Emotion is usually defined as feeling, mood, or affect state. Researchers use emotion, feeling, mood or affect interchangeably without clear distinction. In this article, the term emotion refers to the feeling state, which is a specific emotional state for specific objects. Mood usually refers to more general feeling state without any specific object. Affect refers to a more stable, dispositional feeling state.

² The plural form of emotion was used because there can be more than one positive or negative emotion. For example, Fredrickson (1998) chose joy, interest, contentment, and love as positive emotions. Ekman (1992) used the term “emotional families” to refer to this plural form of emotion.