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ABSTRACT

The purpose of this paper is to report specific motivational requirements within each motivation category of Keller's ARCS (Attention, Relevance, Confidence, Satisfaction) model (1991) based on data collected on students' reactions to a computer-assisted learning lesson that incorporated motivational strategies in its design. Interview techniques were used to capture the perceptions of the subjects as well as observation by the researcher. The computer-based instruction used in the study was developed for a parasitology course for veterinary students using HyperCard 2.1. Motivational strategies included using eye-catching graphic representations to capture the students' attention; endowing cartoon characters with students' characteristics and relating graphics to their interests to increase the relevance of the information; allowing students to study at their own pace with appropriate challenge level and full interaction with the learning materials to enhance their confidence; and encouraging students to apply what they were studying to real world situations to establish learning satisfaction. Analysis of data from the interviews supports the assumption that instructional treatments for motivating learning require consideration of the four motivational categories, and that strategies based on these categories are all essential in the process of learning. Discussions of implications of these findings for instructional design and areas where future research is needed conclude the paper. (Contains 28 references.) (BBM)

A Case for Assessing Motivation from Learning A Computer-Assisted Instruction

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Abstract

The paper reports a case study in employing Keller's motivational design (1991) strategies in a computer-assisted interactive lesson. Designing instruction that appeals to learners aims to encourage their active involvement and facilitate the persistency of effort exerted in learning. Through the motivational requirements specified by Keller's ARCS model, students' reactions toward the computer-based learning experience were gathered and analyzed. Design implications revealed from the data are also summarized and reported.

A Case for Assessing Motivation from Learning

A Computer-Assisted Instruction

Introduction

In a general sense, motivation can be characterized as affect, value, goal, and self-regulation that aspire students to actively engage learning tasks. Motivation also creates new incentives for individuals, provides impetus for cognitive engagement. There is a large body of research documenting how knowledge and experience are dynamically related to motivation, and the notion of motivation refers to how students regulate or deploy their own cognitive strategies to achieve learning goals (e.g. Ames & Archer, 1988; Graham & Golan, 1991; Harald & Sovik, 1994). Educational settings tries to incorporate theoretical frameworks to manifest students' intrinsic learning interest, learning curiosity, and learning involvement in classrooms (e.g. Ames, 1992; Deci & Rayan, 1985, 1992). The approach underlines that appropriate conditions set up for learning is essential for triggering students' motive in challenging given learning tasks.

To cope with the increasing attention on the issues of motivation, instructional technologists also try to incorporate instructional treatments to create an interesting learning environment for the learners (Alesandrini, 1985; Hannifin & Peck, 1988; Keller & Suzuki, 1988). The use of technology for providing various stimuli visually and verbally to create a appealing learning environment becomes possible. However, the merits of these instructional innovations often require assessment through the interactions with learners. Motivation in learning computer or instructional materials, for learners, is the initial indicator influencing a learning process in a given task (Keller, 1988; Keller & Burkman, 1993; Litchfield, 1993). How students approach, interact, and perceive computer or interactive learning materials is directly related to how they perceive the task and the situation given (Litchfield, 1993).

Motivating learning is an important issue that has been too little explored in research and theory during the past (Reigeluth, 1993). Researchers have recognized that

different motivation influence achievement (Mizelle, Hart, & Carr, 1993). However, how instruction should be designed in order to encourage students' involvement in learning requires further exploration. "More work is needed in this area, especially regarding motivational strategies which are uniquely possible with advanced technologies" (Reigeluth, 1993, pp. 53) .

In this case study, an instructional development incorporating Keller's Motivational Design (Keller, 1991) is emphasized. To implement motivational elements into instruction, four important aspects are addressed: gaining and maintaining students' attention, relating to their interests, building up their confidence in understanding, and satisfying their learning curiosity to encourage learners' involvement in learning from computer-based materials. From a motivational aspect, to be interactive and motivating, instructional setting should be able to mimic the real world interaction, and encourage learners to think and to capture their imagination, and to help them move through their own creative ideas more easily (Wileman, 1993). If designed treatments well capture what students desire to learn, students' achievement and motivation are expected to be enhanced. With this in mind, a piece of computer-assisted learning lesson was developed following the notions addressed in Keller's motivational design (1991). The instructional materials were evaluated among target learners to study future design implications for motivating learning.

The major purpose of the paper is to report specific motivational requirements within each motivation category (Keller, 1991) based on the collected data. The knowledge from this assessment is expected to embellish the motivational design approach and to extend the understanding of a student's perspective about what constitutes motivational requirements for learning. The primary questions addressed by this study through interview approach are: What reactions did students have to the computer-based lesson? To what extent did students perceive the motivational impact of the instructional approach? and How did the students' perceive motivation from a computer-based learning experiences align with the components of Keller's ARCS model?

Applications of ARCS Model

The ARCS model was tested in two teacher training workshops in 1982-1983 (Keller, 1984) The results of these two field tests provide support for the comprehensibility and utility of the ARCS model as a means of assisting in the motivational design of instruction. The data collected from teachers at the end of the projects indicated that many teachers accomplished the motivational goal they had set, and they felt that the ARCS model was helpful to them. This provided support for the model at both the objective and affective levels.

In a case study that focused attention on the clinical use of motivational messages, Visser (1990) used a set of strategies based on Keller's (1984, 1987b) ARCS model in a staff development course for professionals in the Mozambique Ministry of Education. Through a naturalistic case study approach, learners were prompted with messages designed according to a systematic process to adjust their disposition to undertake learning tasks. The research intent was to find out how and why the motivational messages worked. Based on the results gathered from observation and self report, of a total of ten propositions regarding the interaction between the messages, the learners, the instructor, and the environment, nine were substantiated.

To provide specific guidance for implementing the ARCS motivational model and to improve the feasibility and acceptability of the motivational design procedures (MDP), Farmer (1989) utilized a formative evaluation methodology and case study in which a group of instructional designers were involved. The process involved redesigning instructional materials to be more motivating. The study was intended to refine the procedures for implementing ARCS through a two-phase design process. It was found that the subjects in Phase I virtually ignored the original MDP and relied solely on their own intuition for the redesign task. Low feasibility and acceptability ratings were gathered in the Phase I. In Phase II, subjects were given the same task but with revised

MDP. The results indicated that subjects followed the MDP very closely and rated the revised motivational design procedures significantly more feasible and acceptable.

Elements of the ARCS model have been used as a set of criteria to measure motivational levels of instructional materials. For example, Gallagher (1989) used the ARCS model as the theoretical framework to identify possible motivational factors that might contribute to the motivational problems among nursing students. To investigate the effects of attitude modeling and skill modeling on learner instructional motivation, Ley (1989) used the Instructional Motivational Measurement Survey (IMMS) which is a set of questionnaires derived from the ARCS model (Keller, 1987) for analyzing the motivational level of instructional materials. In investigating the motivational level through providing a graphic illustration of concept trees, Hirumi and Bowers (1991) also used the ARCS model and IMMS to examine instructional materials.

At an application level, the ARCS model prescribes how instruction can be designed to help students develop competence and feelings of efficacy. When used in instruction, it provide a means of encouraging effort in learning instructional content. The model is not just a set of strategies to make instruction appealing to the eye. More importantly, it is a set of strategies aimed at satisfying learners' cognitive curiosity with consideration of learners' characteristics, interests, knowledge, and experience.

The test of the ARCS model has primarily been conducted based on its adoption in the classroom setting. How the ARCS model can be actually employed in designing self-paced computer-assisted learning materials and how the strategies can be incorporated into designing motivational graphics requires further exploration. Research efforts are also needed to analyze students' reactions in reference to this approach.

Research Approach

This study employed a case study approach to gather data for assessing how students reacted to and interacted with instructional materials developed using

motivational strategies in instruction. The approach relied on interview techniques designed to capture the perspectives of participants. Through interacting with participants in the context of where they used the computer-based lesson, a more in-depth understanding of the students' responses could be assessed.

An important aspect of employing interview strategies is carefully listening to what participants have to say about their learning experience. For example, what does the computer-based lesson look like and feel like to the participants? What are their learning strategies as they interact with the lesson? What are their thoughts as they use the lesson? What features of the developed materials are most salient to the participants? The approach demands carefully examining, elaborating, and reporting the interview data.

If a certain dimension of computer-assisted instruction is to be meaningfully examined, the students should be engaged in learning that is personally meaningful and that has real consequences for them (Reeves, 1992). With this in mind, the instructional lesson developed for this study was relevant to the course in which subjects were enrolled. The instructional treatment did not deviate widely from the actual learning activities these students experience in their general learning program. CAI materials are a normal part of the curriculum for veterinary students. The content (life cycle of coccidia) used in the study was also among the topics these students must study to fulfill their course requirements.

Observation by the researcher was used in combination with the aforementioned interviewing strategies to obtain a more complete understanding of the participants' viewpoints about the roles that graphics played in motivation and learning. The themes and patterns about how students interacted with the instruction materials were studied from three perspectives. First, what was observed about how the students navigated the instructional materials? Second, what reactions did students express toward the instructional in the computer-based lesson? Third, what reactions did students express toward this computer-based lesson in and of itself and in relation to other computer-based lessons they have used? The approach was expected to obtain a representation of

how students interacted with and felt about the value of the materials in which the motivational strategies were embedded. It was also expected that from assessing these responses one could understand how the motivation strategies (attention, relevance, confidence, and satisfaction) employed in designing computer assisted had an impact on motivation and learning.

The Contents

The computer-based instruction used in this study was developed using HyperCard 2.1. The lesson was designed for use in a parasitology course, among veterinary students. The content of the computer-assisted instruction was based on the lecture notes from the instructor. Within the Parasitology course, the computer-assisted instruction was focused only on a particular portion, life cycles of coccidia. Through the use of graphic representations, motivational strategies are implemented.

Since the graphics were designed for presenting instructional messages, well-conceived graphics need to embody good qualities as well as inspire learning (Wileman, 1993). Integrating different techniques and design principles addressed in the literature (e.g., Alesandrini, 1987; Hannafin & Peck, 1988; Pettersson, 1989; Rieber, 1989a; Wileman, 1993), the graphic design approach was to address several major motivational aspects: attention, relevance, confidence, and satisfaction. In order to make students attend to the important information, eye-catching graphics were used for initiating and maintaining attention. To increase the relevance of the information for the learners, the lesson related cartoon characters with students' characteristics, the graphics were also used to related what was important to students. To enhance the learner's confidence in given learning tasks, the system allowed student to study the lesson with their own pace and permitted appropriate challenge level and full interaction with the learning materials. Graphics were used to guide comprehension and memory processes. To establish learning satisfaction, the lesson encouraged students to apply and relate what they study from the lesson to real world situations. The lesson used

many clinic examples to relate the concepts learned. Graphics were also used to encourage positive feelings from the learning experience.

A lesson with clear direction has a better chance to succeed (Hannafin & Peck, 1988). The direction guide used in this lesson was very straightforward and concise. During the lesson, a lesson map always appeared on the bottom of every screen for providing direction and navigation purposes (Figure 1). Various visual effects were used to accompany navigation to vary the interactions. Students could click on the section they needed to work on at any time. The lesson map also highlighted the section being studied, so that the student knew his/her location within the lesson. At the end of the lesson, test items were given by the computer. The test results were gathered through computer to measure students' achievement.

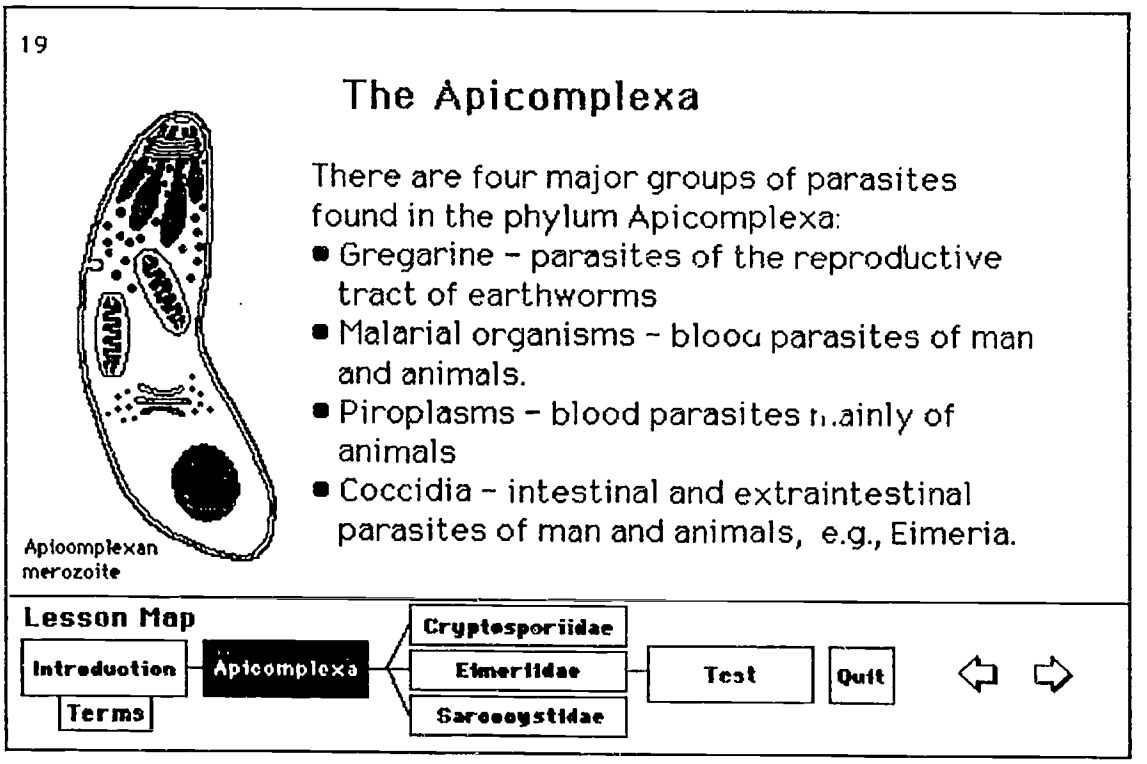

Figure 1. A screen example highlighting the section being studied and providing the choices for navigation.

Interviews

Anecdotal records were gathered through observation notes by recording important incidents occurred as students worked with the computer materials. The observations were focused upon the problems students encountered during interaction with the computer-based instructional materials and thus might serve as a means to identify possible design considerations to improve the way the information was presented.

The interview employed was a standardized open-ended interview format, which consisted of a set of questions carefully worded and arranged (Patton, 1990). To obtain a whole picture of the learning environment, the questions were drawn from three major areas: (a) navigation of the computer-based materials, (b) interactions between students and graphics, and (c) experiences with other computer-based learning materials. The sample questions used in interviews that get at these three major concerns and how these questions were asked and what other material was available as the questions were asked are shown in Table 1.

Table 1.
Standardized Open-ended Questions Examples.

Major Area	Question Examples
(a) navigation of the computer-based materials	• Tell me about the strengths and weaknesses of the computer program. • When you were working with the lesson, I found....(describe the incidents from observation sheet). Why is .....?
(b) interactions between students and graphics	• Describe the importance of viewing graphics during working with the computer learning materials. • Suppose you are working in an area you are not interested in, what role do you think graphics should play to motivate your interest?
(c) experiences with other computer-based learning materials	• How do the computer learning materials used in this class differ from the computer learning materials used for other classes. • Tell me more about the other CAI programs you used before in terms of presenting information and helping or not helping you learn.

Analysis of Interviews:

All the interview data were transcribed, coded, and analyzed. To guide the coding, a three-dimensional approach was used. The first dimension of the coding indicated the

attitude of a respondent, either positive, negative, or neutral. The second dimension indicated the motivational category and subcategory for a specific response. The third dimension indicated the area, such as program, subject, experience, or curriculum. Students' motivational responses were mixed with their personal preferences, interests, study experience, and the curriculum that was set for them. The students' elaboration about their attitudes toward learning the specific subject, and indirectly their assumptions about learning or instruction, sometimes occurred in answer to any of the interview questions. Three categories of value were used for guiding analysis of the responses. In the first dimension (attitude dimension) codes, the "(+)" was used for a positive attitude. [e.g., "The cartoons put smiles on my face" is coded as "(+)"] The "(-)" was used for a negative attitude. [e.g., "I don't like the computer as I like the written notes" is coded as "(-)"] When no (+) or (-) was indicated, the response was referred as "neutral", which meant it did not indicate whether she/he liked or did not like something. [e.g., No value code is used in "I usually started with sporozoites in every graphic"]

In the second dimension (motivational categories), the use of the categories and the subcategories in the ARCS Motivational Model were employed to categorize the responses (Table 2). The first capital letter in the code referred to the motivational category . The number following the capital letter was referenced to the subcategory within that category. In the third dimension, the area of specific response was referenced to the computer program, the subject, the curriculum, or their experience in general (see Table 3).

Based on the three dimensional coding scheme, a student's response such as the following could be coded. "The use of the laser disk image is one of the strengths. I like it, and I have been impressed with all the programs like that. It's harder to see the image from the microscope than the laser disk. If you have an idea what you are looking for, that helps you." Codes for this statement were "(+)•C1•Pro", "(+)•S3•Pro" and "(+)•C1•Exp" because it referred to learning requirements and satisfaction accomplished through the use of the laser disk, and also referred to the

learning from the program or experience in general. The use of this coding approach helped facilitate the initial sorting task. Following the codes, a key idea that came from the statements was listed. For example, if the statement referred to a laser disk, the idea "laser disk" was indicated at the end of coding (Table 4).

Table 2
Codes Referencing Motivational Categories in Students' Comments

Code	Motivation Category	Subcategory	Code	Motivation Category	Subcategory
A1	Attention	Perceptual Arousal	C1	Confidence	Learning Requirement
A2	Attention	Inquiry Arousal	C2	Confidence	Positive Consequences
A3	Attention	Variability	C3	Confidence	Personal Control
R1	Relevance	Goal Orientation	S1	Satisfaction	Intrinsic Reinforcement
R2	Relevance	Motive Matching	S2	Satisfaction	Extrinsic Reward
R3	Relevance	Familiarity	S3	Satisfaction	Equity

Table 3
Codes Referencing Areas of Concern in Students' Comments

Area Code	Area	Remarks
Pro	Program	The statement refers to the computer program .
Cur	Curriculum	The statement refers to the vet school curriculum.
Sub	Subject	The statement refers to the Coccidia.
Exp	Experience in general	The statement does not indicate any specific area. It infers general experience of the learner.

Table 4
Example of Coding

Statements	Classification	Codes / Key Idea
The use of the laser disk is one of the strengths. I like it.	Related to the program	(+)•C1(S3)• Pro(Exp)/ Laser Disk
I have been impressed with all the programs like that.	Related to his experience in general.	
It's harder to see the image from the microscope than the laser disk. If you have an idea what you are looking for, that helps you.	Related to what needs to be learned.	

Based on the codes that were assigned to the given interview responses, the processes required for sorting tasks depended on the specific aspect needed to be analyzed. If overall reactions regarding the program were examined, all the codes

containing "(+)", "(-)", and "pro" were selected, because the codes referred to the positive and negative attitudes about the program. Ideas following the codes could be grouped and clustered. For example, "self review", "ask questions", "clinical questions", and "self test" were all considered the same thing. They were clustered together and used for the frequency count by summing up the interviews that reflected the same ideas.

Different from examining the overall responses, if a broad motivational aspect analyzed, the sorting process used the ARCS Motivational Model (the second dimension code) as the basis. For example, all the responses containing "A" codes were grouped together. That is, all the items related to "Attention" were grouped together. Each motivation category then branched into different areas such as curriculum, program, subject, or experiences in general. To summarize students' motivational responses toward the materials or toward the graphics, their reactions from these various areas (curriculum, program, subject, or experiences in general) were all considered important to reach a conclusion. A brief example demonstrating the entire process is shown in Table 5.

Table 5
Selected Interview Examples

Interview Data	Codes	Summaries
I am not fond of seeing the same life cycles over and over again. It would be better if you can go back later if you want to, but not look at it every single time....	(-)•A3•Pro/ Repetition in graphics	**Positive and negative comments:** Negative Responses: • Seeing the repetition of the life cycle diagrams was boring. **Motivational requirements:** **A3**: Seeing the same life cycle diagram over and over did not maintain a student's interests.

Following the initial coding and sorting were regrouping and recoding; a process derived from specific themes that were to be examined. For example, it was observed that students used different strategies to understand and learn graphical information. Related data could be obtained from responses regarding "learning & graphics" in "C1". The regrouping process then was followed by identifying codes of referenced

areas of concern, such as "Exp","Pro", "Sub" or "Cur". That is, students' learning strategies used in the program or other resources were gathered together. All pertinent information associated with their experience in learning the subject from graphics or how the curriculum affected their way of interacting with graphics was extracted, grouped, and analyzed. New codes were used for the regrouping and recoding processes. The regrouping and recoding process was repeated as required.

Motivation Responses

From the interview data collected regarding students' experience with the program and other computer programs, their reactions to the use of different sources of visualization, and other related responses were summarized. The issues that students addressed regarding the curriculum, the instructional materials, and their learning experience, which are pertinent to understanding motivation and learning, are organized based on the four motivational categories, attention, relevance, confidence, and satisfaction.

Attention: The major motive to learn was driven by the course requirements. However, having the motive to learn did not guarantee that they would attend to all important information. Students said that they often had some attention problems especially when learning computer lessons independently. Unlike having a group lecture, working with a computer was not always an interesting experience for every student since some students were not so computer literate. Besides, working with a computer lesson was not like attending a lecture where every student had to follow an instructor all the time. It became a drawback for some students to attend to the important information in the computer lesson. "You need something to help you pay attention. It is too easy to think about other things while going through the lesson." Many students responded in a similar way.

Students considered information presented by using the bullets helped them see the important points right away. They considered concise writing to be very desirable when presenting information through computers. Textual information presented in a list format was easier to attend to than in a paragraph format. Students also said that the use of animation helped break the monotony of reading the text screens. It not only provided interest but also drew their attention and informed them where to start. However, using animation in an uninteresting area or when learning a concept that was difficult to perceive, such as differentiating stages of life cycles, was considered more valuable.

For recognition tasks, using labels helped students attend to the important information they needed to know. Textual description of an organism was not as efficient as adding a label to the organism for helping in identification. Students did not appreciate the video images as much as they appreciated the computer graphics because they were not well informed about what to attend to on the video. They preferred to see the organisms on the video being pointed out so that they could focus on the key elements in the pictures.

Students considered that the use of cartoons created a theme of interaction that stimulated their inquiry about the information given. However, the key feature underlining this approach were the questions that came together with the cartoons rather than the cartoons themselves. The questions made them pay more attention to the information they read, and helped them attend to what needed to be focused upon. Many students considered this an important way to get their attention, and they frequently provided a positive reaction from a computer program used in the pathology course, where the instruction was structured in a question-answer type format. Posing a clinical question made them attend to some information they did not pay attention to in the first place.

To students, using cartoon objects provided different interests. "Cartoons make a nice version of relaxation points especially for the area where you repeated graphics information that is vital and important". For students, seeing one life cycle diagram

after another life cycle diagram was like seeing a page of text after another page of text. Because they both were important information to attend to, student required substantial mental effort to absorb them. At some points, they needed something different from the information itself to keep their interest and lighten up their mood. When using graphics for this purpose, a potential precaution to prevent distraction might be needed. A student reacted "I can't remember the organism, but I remember the chicken swallowing the oocysts." The student could clearly recall the animated cartoon, and couldn't recall what the information was about. Graphics attracted students' attention and made the themes memorable. However, not every student perceived equally from the graphics. For some students, graphics helped their attention, while for other students, they were a distraction.

Relevance: Students considered the materials relevant to what they needed to know although in fact students in the same class had different career and personal interests, and it was not possible to tailor the design to everyone's own special interest. Since the courses were set up to have students go through the same prerequisite knowledge they needed before learning a more advanced area, they considered what they were taught was what they needed to know. Although some students had clinical experience or had treated sick animals of their own, the majority of the students were not familiar with the subject area. Because of the unfamiliarity with this area, most students studied the lesson only for fulfilling the class requirement.

Learning an uninteresting or unfamiliar area requires potential learning aids to make the learning task more meaningful to students. To encourage students' learning interest, almost every student suggested making the lesson interactive rather than presenting information screen by screen like reading a book. They preferred having some action and responses to keep them from passive learning. They liked having some interactive questions at the end of each small section that could keep them on track about what they were learning. Such questions could help them relate what they had just read with what they would be asked in the future or on the test. For them, giving

questions relating the situation to what they would see in clinics was a more direct way to state the goals rather than giving a list of learning objectives.

Motive in learning a subject area can also be encouraged through an association with a specific personal interest. For example, relating the contents of the lesson to animals and problems that students cared about made them feel the need for obtaining the knowledge. "I usually have trouble getting interested in disease itself, but if you show me the problem with the animal, I am more interested to know". Students who had their own companion animal or who were interested in working with small animals, liked to see more about small animals in the lesson. For students who were interested in working with large animals or live stock animals, they liked to see more information related to their area of concern. Relating the subject to a wide variety of animals rather than focusing only an specific animals was more likely to accommodate the diverse needs and interests among students.

Together with presenting a specific disease, students liked to have a picture of the animals affected to help them relate to the information; although it was not considered to directly affect how much students learned, it had some impact on viewer's feeling of relevance about the given information. Similar reactions were stated regarding the use of the veterinarian cartoons. Having the pictures of veterinarians at some points during the lesson helped students project themselves into the situations given. However, if their personal identities were ignored in the pictures given, they might not feel comfortable with the learning situation. Students suggested more veterinarian cartoons should be used. Although a negative reaction to the gender bias in the cartoons was not held by the majority of the students it was a point worth considering.

Confidence: Students' confidence about their learning was related to knowing that they could accomplish the learning task and to being clear about what they were learning. Students felt they were usually given so much information to remember that a structure to help organization was essential. They also required information presented in a clear and straightforward way so that they did not need to spend time trying to

understand the meaning of it. Information that was confusing, overwhelming, or not clear to them was not expected to motivate them to learn the area.

Although most students had used computer lessons before, not every student was comfortable working with computers. Some students did not like computer lessons because they felt it was possible to get lost and not know where they were or what they were reading about. They wanted to know every piece of information they were supposed to know, and they were afraid of not knowing specific information due to their unfamiliarity with computers. Unlike reading from printed materials, some students expressed that they got easily frustrated not knowing where they were in the lesson, because they often focused so much on the information itself that they sometimes lost track of the structure that the computer provided. When this situation occurred, they often backed up or went forward for a few screens to the point where they were sure what to do. To them, the navigation map was essential for this purpose. They considered that if the direction was clear and straightforward, then they could focus more on the information rather then spending time on figuring out how to access specific information.

Whether the subject area was motivating or not was also related to whether it was easy or difficult to understand or remember. "Anything that makes it more understandable may not make the course or the subject more interesting, but it makes it less work, and that is very helpful." If information was difficult to understand, providing guidelines to help comprehension and memorization through the instruction was expected to make the learning task more manageable.

Although students reacted that graphics helped in learning important concepts, they helped at various levels. The feature that underlined the use of graphics in explaining concepts was the clarity of the graphics and accurate labeling in each detail to point out what was supposed to be seen in the real image. However, learning from graphics was not always interesting if too much information was presented at the same time or if the graphics were not free from ambiguity. To help in learning, starting with the

assumption that they did not know anything about the area and explaining everything in detail was desired by the students.

Learning in this subject area requires much organization in sorting out the similarities and differences among different species of coccidia. It was not so easy to see the differences or similarities among various species of coccidia just by reading about them. Students preferred having charts or tables to guide their process of organizing the information so that they did not have to spend time and effort in making charts and tables of their own. From what they had experienced in many situations, learning parasitology often involved contrasting one species with another. Charts and tables helped them summarize the features and characteristics of the organisms they studied.

Satisfaction: Students' satisfaction about instructional materials not only came from enjoying their learning experience, but also knowing how much they learned from the instruction. Students liked to feel that they had gained something from the materials, and it was not wasting their time. The major enjoyment that students perceive from learning most parasitology lessons, was the provision of the interactive learning environment that allowed them not only to read the information but also to see clear pictures from the laser disk and interact with the materials. However, whether students felt satisfaction about the use of high technology was also determined by whether the computer-assisted interactive learning environment actually make them feel that they learned what they needed to know.

Most students enjoyed working with computers because they liked reading the information, seeing the pictures, and at the same time, being able to interact with the materials. They appreciated that the use of the technology provided them knowledge and skills in a way that they could not have obtained from books or other resources alone. However, some anxiety was also found among students who were not familiar with computers. Unfamiliarity with computers, to some extent, might degrade the enjoyment in learning, especially when experiencing not knowing where they were and what they were reading. To provide a more enjoyable learning environment, designing

materials that are easy-to-access and easy-to-follow was desired, especially for the students who had limited experiences working with computers.

Frequently providing interactive situations was considered by students as a way to take them away from passive learning and move them to active learning. Students liked being questioned or taking some actions rather than just reading the text through and seeing the pictures. They enjoyed every interactive spot provided, and they considered it was easier to remember the concepts through the presented themes. They suggested that the clinical situations and related questions helped them to absorb the information in a more meaningful way so that they could remember it better.

Students' satisfaction from the program also came from the feeling of knowing that the skills and knowledge they obtained were sufficient to deal with future tasks. Many students considered the content area difficult. They did not consider that just going through the materials once or twice would make them become an expert in this area. A student also mentioned that the images on the video disk were always much easier to view because the magnification of the images was good. While in the clinics or in the laboratory, they did not usually have "ideal images" to see. To be proficient in this area, they considered that much more knowledge from other resources and experiences from clinics was needed. It was also suggested by learners that to encourage satisfaction from learning, more opportunities for them to practice in a more realistic environment are desired.

Design Implications for Motivation

In summary, this study supports the assumption that instructional treatments for motivating learning requires consideration of the four motivational categories (attention, relevance, confidence, and satisfaction). The findings suggest that strategies for gaining and maintaining students' attention, increasing relevance of the lesson for them, enhancing their confidence of success in the learning task, and augmenting their satisfaction with the learning experience are all essential in the process of learning.

These considerations can be used as future design framework to approach motivational instruction. Although the motivational treatments used in this study, such as personalizing the design for veterinary students, might not be generalizable to other target audiences, the notion supporting the motivational treatments, i.e., personalizing the design for a particular target audience, is generalizable to other groups. The guidelines are used to prescribe motivational requirements for design. A specific motivational treatment requires instructional designers to use their own creativity with their understanding about the target audience and the learning tasks in order to apply the approach. To be more specific to reflect the data obtained, the major categories in the ARCS Model were used to draw conclusions related to issues and considerations for future design of instruction.

ATTENTION: To encourage students to attend to the important information in the lesson, capturing their attention through the visualizations (PERCEPTUAL AROUSAL) is as important as stimulating their learning curiosity (INQUIRY AROUSAL). Associating problems occurring with a specific animal to the learning of new knowledge or new skills is a way to get students to attend more to the information. Attention getting was done by using cartoons and animation in this case, others could also be considered and integrated in future designs (VARIABILITY). Since students attend more to the situation-related problems, the use of video clips might be employed to provide scenarios to provoke students' learning curiosity and interactions with the materials in a way they perceive as more meaningful (SITUATED APPROACH).

RELEVANCE: To increase the relevance of the information, the instruction should somehow relate to their learning interest. Associating the information with what students are interested in knowing is more likely to get them involved in learning it. If information can be tied to students' experience (FAMILIARITY), personal interest (INTEREST MATCHING), or what they need (GOAL ORIENTATION), students will be more willing to spend time on the given task. Students' suggestions about using clinical questions and showing pictures of animals to go with the life cycles reflect the needs for associating the information with what they wished to see.

Matching the design of the instruction with students' characteristics is important to making the materials more adaptable to individuals. Students enjoyed the use of the individualization approach by incorporating themselves into the themes provided in the self-review tasks. This approach made them feel the interaction was more personalized and made them more involved in the learning task. In future designs, it is also desirable if this approach can be elaborated to some extent to differentiate students with their gender and personal interests (PERSONALIZATION).

CONFIDENCE: In the case, students felt "CONFIDENCE" was associated with what they felt about themselves rather than the instruction itself. "CONFIDENCE and SATISFACTION are more like if you have these questions, and you answer them correctly, that builds up your confidence and you feel satisfied. But if you did not answer them correctly, you won't have confidence and satisfaction. So it depends."

Although confidence is rather a internal indicator which depends on how students evaluate themselves; instruction plays an important role in facilitating their feeling of certainty about what they learn. If instruction is organized in a way that makes it easily understood, or if the direction is straightforward and easy to follow, the less time and effort students need to spend on making the program work which allows them to focus more on the substance they will get from the learning tasks (GUIDED LEARNING). Those requirements are essential ingredients for comprehension and memorization before they can actually apply their knowledge and feel confident about what they learn (LEARNING REQUIREMENTS). The design of instruction should always take into considerations whether the learning experience supports or enhances the students' beliefs in their competence by providing sufficient practice (MENTAL ELABORATION). Allowing sufficient time for interaction and clear direction for navigation enhances students' certainty in handling their learning materials the learning task (PERSONAL CONTROL).

SATISFACTION: students' satisfaction from the learning experience is determined by whether working with the materials supports their purposes of learning. If the materials is too confusing, or if they feel they the information did not support

what they have to do in the future, then they would not gain satisfaction from the learning. Frequent questioning helps students reinforce that they have learned from the information (INTRINSIC REINFORCEMENT). They also like to see that what they have learned is what they should perform in the future (PRACTICALITY), and to feel capable of handling the realistic situations (EQUITY).

The use of a motivational approach to instruction not only aims to make students feel that they need to learn and they actually learn from the program, but also aims to provide students with enjoyable experiences from the program. Student like the instruction that employ a humorous or interesting approach. They need something to occasionally make them laugh and lighten their mood. However those motivational treatments are far more needed for the tasks that are uninteresting and require much mental effort (EXTRINSIC REWARDS).

Conclusion

From a design aspect, the case suggests that a motivational innovation should try to adapt to the variations among learners to meet individual interests, for example, their preferences or their learning styles. The design should also take into account the identities of various learners without ignoring specific sexual, racial, or socioeconomic groups. Employing a motivational approach in computer-assisted instruction is also to make the learning materials more humanized and personalized. The feelings of enjoyment and fulfillment from learners are both anticipated from future designs that employ the motivational strategies.

When considering the issues of learning and motivation, students' views of how the information should be organized and presented plays an important role in what they can actually learn. Often the process employed in designing motivational materials is from a designer perspective about what should be included in motivational instruction in order to motivate students to learn the material. Through an assessment of students' reactions toward the learning material, a learner's perspective about what should be included in

instruction and what can be done to make instruction more motivational to the learners can be better understood.

In summary, although an effective design was the eventual design goal, the study was not done to conclude how effective the design approach was. Since students' motivation toward the materials is related to how they can actually learn, suggestions and implications from what learners think and perceive are considered more essential to embellish the approach. Keller's ARCS model "does typically not provide a standard answer to questions about what should be done to provide motivation, nor is it a model that provides its users with a simple algorithm to find such an answer" (Visser, 1990). Contrary to that position, the model assumes that instructional designers take on a continuous examination and review to analyze what should be required to achieve the motivational requirements specific to a piece of computer-based instruction designed.

This study points to exploring the issues of design and assessment from a case study approach. It is hoped that the findings of this study will lead to other case studies about how the motivational strategies for graphics can be applied and refined in other learning situations. We do need guidelines and a basis for design decisions about motivational treatments. Furthermore, it is also hoped that the impact of this study may encourage instructional designers to pursue more creative approaches in examining and refining the guidelines to adjust to the motivational purposes in specific computer-based learning materials.

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