Using ARCS Model to Promote Technical and Vocational College Students' Motivation and Achievement

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Abstract: Higher education remains highly competitive. For many students, attending university is stressful. Helping students to learn successfully is also a tough task for instructors. Academic success is strongly influenced by the motivation to learn and in-class and class-related achievement. Therefore, the purpose of this study was to use Keller's Attention, Relevance, Confidence, and Satisfaction (ARCS) model as a basis for developing and designing instruction for an Information Technology and Society course that would improve college students' motivation to learn and would promote their achievement. Participants were 220 technical and vocational college students from four Information Technology and Society classes and two teachers who taught these classes in southern Taiwan. Each teacher taught two classes, one experimental (ARCS) and one control (non-ARCS) class; assignment to the experimental and control groups was random. For the experimental class, teachers adopted Keller's ARCS model of motivational design, and for the control class, they used a non-ARCS model. Data were collected using the Learning Motivation Inventory (LMI), which was developed by the researchers. Additionally, students' midterm and final exam scores were collected. Our findings indicated that (a) there were no significant differences between students' motivation to learn and achievement in the experimental group and the control groups; (b) instructor characteristics, student characteristics, amounts and levels of motivational instructional strategies, and properties of the course influenced motivation to learn; and (c) achievement goals and the importance of exams played important roles influencing achievement in this study.

Keywords: ARCS Model, Motivation to Learn, Technical and Vocational College Students

Introduction

WE LIVE IN a competitive society where excellence is often defined in terms of an individual's achievement relative to others. In addition, higher education remains highly competitive (Harackiewicz, Barron, & Elliot, 1998). For many students, attending university is stressful. They not only pursue academic success but also take care of personal responsibilities and social needs (Mills, Pajares, & Herron, 2007). Therefore, helping students learn successfully in higher education is a tremendous task for instructors.

Many variables affect the quality of student learning, including instructors' characteristics, students' characteristics, and environmental characteristics (Lammers & Smith, 2008), but

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academic success is strongly influenced by motivation to learn and in-class and class-related achievements (Komarraju, Karau, & Schmeck, 2009). A particularly significant indicator of success in education is students' interest in instructional materials, and their interest endures beyond a particular educational experience (Harackiewicz et al., 1998). Hence, motivation to learn plays an important role in the practice of education (Maehr & Meyer, 1997).

Theories of motivation have defined motivation in a variety of ways and have offered different perspectives on the phenomenon, such as the hierarchy of needs, theory of achievement motivation, and the expectancy-value theory (Weiler, 2004). Motivation is variously conceptualized as students' drive, including motivation to achieve and the need to belong; as goals, including performance and mastery goals; and as expectancies, including self-efficacy and outcome expectations (Covington, 2000; Robbins, Lauver, Langley, & Carlstrom, 2004). Hence, the motivation to learn refers to students' willingness to participate in learning, and it affects students' interest in and effort toward learning (Alonso-Tapia & Pardo, 2006; Covington, 2000; Eccles & Wigfield, 2002).

College students differ greatly in their level of motivation to learn (Siebert, Litzenberg, Gallagher, Wilson, Dooley, & Wysocki, 2006), rendering instruction an indispensable factor that influences and improves students' motivation (Covington, 2000; Eccles & Wigfield, 2002; Elliot, McGregor, & Gable, 1999; Wigfield, 1994; Wigfield & Eccles, 2000). When an instructor utilizes appropriate instructional models to create a highly motivating learning environment, students are able to increase their engagement in class (Keller, 1983). In other words, instructional practices and interpersonal relationships with students are highlighted as potentially powerful factors influencing students' motivation and performance (Wentzel & Wigfield, 1998). Therefore, designing an effective instructional model not only improves students' achievement but also enhances their motivation.

Although many theories of motivation have suggested various definitions and offered different points of view, few studies have focused on students' motivation to learn in relation to teaching strategies and teaching materials. Starting with the theoretical basis for including instructional design in educational considerations, Keller (1983) developed the ARCS model to improve instructors' instructional design and teaching strategies.

Keller's Attention, Relevance, Confidence, and Satisfaction (ARCS) model is a macro theory that incorporates cognitive and environmental variables in relation to effort, performance, and consequences (Keller, 1983). It is also a means to improve the motivational appeal of instructional materials (Keller, 1987a; Shellnut, Knowlton, & Savage, 1999). According to the ARCS model, four factors motivate learning, namely attention, relevance, confidence, and satisfaction, and there are practical strategies for achieving each of the four components (Keller, 1987b). Keller (1987b) defines the four components as follows: A (attention) refers to capturing the interest of students and stimulating their curiosity to learn; R (relevance) refers to meeting students' needs and goals to effect positive attitudes; C (confidence) refers to helping students believe that they will succeed; and S (satisfaction) refers to reinforcing accomplishments with internal and external rewards.

Keller (1987b) designed three teaching strategies to address each component. For the attention component, the teaching strategies are A1. Perceptual arousal; A2. Inquiry arousal; and A3. Variability. For the relevance component, the teaching strategies are R1. Goal orientation; R2. Motive matching; and R3. Familiarity. For the confidence component, the teaching strategies are C1. Learning requirements; C2. Success opportunities; and C3. Per-

sonal control. For the satisfaction component, the teaching strategies are S1. Intrinsic reinforcement; S2. Extrinsic rewards; and S3. Equity.

Many researchers have confirmed the positive relationship between motivation and achievement in general (Covington, 2000; Eccles & Wigfield, 2002; Elliot, McGregor, & Gable, 1999; Eccles & Wigfield, 2002; Wigfield, 1994; Wigfield & Eccles, 2000). Motivation has also been found to predict academic performance (Mills, Pajares, & Herron, 2007). Keller's ARCS model was also confirmed by clinical validation. Many researchers have used the ARCS model to assess improvement in students' motivation; their results showed that using the ARCS model promoted students' attention and improved their achievement (Ainley, 2006; Carson, 2006; ChanLin, 2009; Means, Jonassen, & Dweyer, 1997). However, despite these positive results based on the ARCS model, some researchers have found different outcomes. Klein (1990) reported no significant correlation between the ARCS model and students' confidence and satisfaction. Price (1989) stated that the main factor influencing students' achievement was the way in which the instructors presented their teaching materials, which was not influenced by students' attention or confidence (Means, Jonassen, & Dwyer, 1997). Using online students as participants, Huett, Kalinowski, Moller, and Huet (2008) compared courses that used the ARCS model with those that did not and concluded that there were no significant differences between the two types of classes. This study found that participants could be a crucial factor.

Most of the previous studies were conducted in primary and secondary schools (Robbins, Lauver, Le, Langley, Davis, & Carlstrom, 2004). Research at the college level examining students' motivation and the correlation between motivation and achievement is still rare, as is the use of a valid strategy for promoting college students' motivation. Fenollar, Roman, and Cuestas (2007) suggested that high school students motivations for learning are different from those of college students. However, little integration or synthesis of the educational and psychological literature examining college students' achievements has been conducted. This lack of integration impedes a full understanding of the relative predictive validity across achievement, psychosocial, and motivational models (Robbins et al., 2004). To assess the effectiveness of the ARCS model in a college classroom, the present study applied the ARCS model to design a curriculum for assessing technical and vocational college students' motivation and achievement.

Research Questions

Based on the purpose of the present study as stated above, this study was guided by the following two research questions:

- Were there any significant differences in the motivation to learn between students who took a course that was designed employing the ARCS model and those who took a course that was not?
- Were there any significant differences in achievement between students who took the ARCS-based course and those who took the non-ARCS course?

Method

Participants

A total of 220 students (139 male, 81 female) and two instructors were recruited from a technical and vocational college in southern Taiwan in the fall of 2010. The students had different majors, including engineering, humanities, social sciences, and commerce and management. Students were 18 to 25 years of age. Each teacher taught two classes, one experimental (ARCS) class and one control (non-ARCS) class; students were randomly assigned to the two types of class, and classes were randomly assigned to the two teachers. The instructional experiment was conducted over 16 weeks for 2 hours per week.

Course Design

The instructional goals of the study were to enhance students' mastery of information technology in cognitive, psychomotor, and affective domains as well as to their grasp of information technology literacy and their understanding of information ethics. The instructional material consisted of 10 chapters: What Is Information Technology?; The Character of Information Society; How Does Information Technology Influence the World?; Information Technology Literacy; Licenses Related to Information Technology and Society; Information Technology Ethics; Information Technology Crimes; Laws of Information Technology; The Future of Information Technology; and Video Editing Software Skills.

This was a quasi-experimental study with two distinct instructional conditions. In the experimental class, the instructors taught by applying the motivational instructional strategies of the ARCS model. In contrast, in the control class, the instructors used non-ARCS instruction techniques. For the ARCS group, instructors' methods included showing PowerPoint presentations that included video clips, pictures, news, and stories; designing games relating to the instructional materials; inviting officers of the Internet police to lecture on Internet crimes; inviting professionals to discuss licensing related to information technology and society; maintaining blogs where students could share their feelings and comments with classmates and the instructors; walking around the classroom to check on students' individual learning; and praising students when they performed well. The instructors also encouraged students' participation by offering them bonus points as part of their final grade at the end of the semester as an incentive.

To protect students' learning rights and experimental ethics, the study did not revert to only didactic instruction in the control group. The instructors in the control group also used multimedia instruction with PowerPoint presentations that included video clips, pictures, news, and stories. The content of the PowerPoint presentations was similar to that used in the experimental group, but the amount and degree of interest of the media used were slightly different from the experimental group. In addition, the instructors utilized worksheets in all classes. Table 1 shows a sample comparison of the experimental group instruction and the control group instruction.

Table 1: Sample Comparison of the Experimental Group Instruction and the Control Group Instruction

Instructional Strategy	Experimental Group	Control Group
Attention	How do you think about Information Society? Let's play a game. If you think it has more positive effect in our life, please join the Angel group. If not, please join the Evil group. Then, you should be an advocator to promote your opinions. After finishing the game, we'll decide which group does the better job and give the group members extra bonus.	What is Information Society? Does it improve our life quality? Does it have negative effect to our life?
Relevance	We are pleasure to invite officers of the Internet police to lecture on Internet crimes. During his speech, he will use the cases which happened in our school to explain what Internet crimes is and how to prevent the crimes.	Today, I'll introduce the topic of Internet crimes. Not only to talk about what it is, but also tell you how to avoid doing illegal things.
Confidence	I'll help you to learn how to edit the video clip by movie maker software. If you have any questions, don't be shy and raise your hands to ask your questions. In the end of the course, we'll have a final presentation. I know all of you can do a great job, and expect your performance.	In today's lesson, you will learn how to edit the video clip by movie maker software. In the end of this course, you have to share your productions with classmates.
Satisfaction	This is a story about Information Technology Ethics. I need three volunteers to play the roles. I know you have ability to improvise. Of course, the volunteers will get extra bonus.	This is a story of Information Technology Ethics. After listening to this story, what do you think about this topic?

Procedure

Because the course was selected by students, participants were randomly assigned to one of two conditions: ARCS model (n = 110) and multimedia instruction (n = 110). To reduce experimental error, the study used a careful matching method after the experiment was finished to examine motivation to learn and achievement.

The matching method not only considered students' achievement but also took into account the motivation to learn. In the present study, we had three conditions for the matching method. First, researchers had to delete the data of participants who skipped the class more than five times. Second, the matching group was selected from an experimental group and a control group taught by the same teacher. Third, two rules were applied to construct the matching group. On the achievement scores, the difference between the experimental group

and the control group needed to be less than 4 points. On the Learning Motivation Inventory scores, the difference between groups needed to be less than 6 points. Based on these conditions, we were able to match 46 pairs.

After the end of semester, we randomly chose 18 students to be interviewed from the 220 participants. The interview questions were all concerned with students' thoughts in taking the course (e.g., How did you feel about the instructional materials? Are they interesting?) to enable the researchers to further understand students' opinions about the course.

Measures

Achievement

To assess students' achievement scores, the instructors and researchers developed an achievement exam based on the instructional materials and a two-way specification table. The questions were examined by item analysis, including difficulty index and discrimination index. The exam contained 50 questions, all of which were multiple-choice items. A pretest was administered before the experiment, and the post-test was split up into a midterm and a final exam.

Motivation to Learn

The motivation to learn was assessed using the Learning Motivation Inventory (LMI), which we developed. The LMI pretest was held before the beginning of the experiment, and the LMI post-test was held after the completion of the experiment.

The LMI was based on the ARCS model and comprised four subscales: attention (six items), relevance (six items), confidence (six items), and satisfaction (six items). Items were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standard Root Mean Square Residual (SRMR) were simultaneously examined to evaluate the model fit. In general, the first-order baseline model of this research was moderate: CFI = .92, RMSEA = .07, and SRMR = .05.

The internal consistency of scores on the four factors was estimated by the Cronbach's coefficient alpha. The alpha coefficients obtained in this study were quite high for these four factors: $\alpha = .92$ for the attention subscale, $\alpha = .89$ for the relevance subscale, $\alpha = .92$ for the confidence subscale, and $\alpha = .88$ for the satisfaction subscale. The total inventory's internal consistency alpha was .96, indicating that the LMI was reasonably reliable. The correlation between the LMI and Keller's (1987b) Instructional Materials Motivational Survey was $r = .87$, $p < .01$. The correlation between the LMI score and the motivation subscale of the Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich, Smith, Garcia, and McKeachie (1993) was $r = .84$, $p < .01$.

Results and Discussion

Overview of Analyses

The purpose of this study was to determine whether the two instructional methods affected students' motivation to learn and achievement. The study used *t*-tests to examine the difference in achievement between members of pairs on the pretest LMI. An absence of significant differences would indicate that the matching method was successful. The results of this *t*-test analysis revealed no significant differences between the experimental group and the control group in the pretest results on LMI ($t_{(91)} = -.22, p = .93$). The results of our *t*-test analysis of pretest results also revealed no significant differences between the experimental group and the control group in achievement ($t_{(91)} = -.10, p = .27$). Hence, the use of the 46 matched pairs in the present study was accepted. Table 2 shows the means and standard deviations of the pretests and post-tests of the experimental and control groups.

Table 2: Pretest and Posttest Scores of LMI and Achievement in the Experimental Group and the Control Group

	Pretest				**Posttest**			
	Experiment		**Control**		**Experiment**		**Control**	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
LMI	80.24	8.90	79.83	9.33	81.76	10.25	80.78	12.51
Achievement	60.39	7.60	60.22	8.49	63.70	8.46	65.30	7.41

Results of Analyses Addressing the Research Questions

1. Were there any significant differences in motivation to learn between students who took the course that was designed employing the ARCS model and those who took the course that was not?

The results of the post-test one-way ANOVA indicated no significant differences between the experimental group and the control groups ($F_{(1, 90)} = .17, p = .68$). Furthermore, the study examined the four subscales of the LMI and found no significant differences on any of the four subscales. This result was contrary to our expectations, which led us to re-examine the course design of the experimental group and the control group individually.

First, we re-examined the attention component. Compared with non-ARCS instruction (control group), in the ARCS-based course, the teacher used multimedia instruction techniques with a large amount of video clips, pictures, news, and stories; played games; asked more questions; walked around the classroom; had more interactions with students; invited special guests to give lectures; and used interesting instructional tools, such as a robot and a cell phone. Thus, the study used extensive and intense attention strategies in the experimental group.

Second, we re-analyzed the relevance component. To contrast ARCS teaching with non-ARCS instruction in the control group, the instructor in the ARCS class designed assignments or articles inviting students' feedback on the blog weekly; invited the Internet police to talk about Internet crimes and criminals at colleges; and advertised activities relating to the topics

in the experimental group. Thus, the instructors in the experimental classes utilized many relevance strategies.

Third, we reviewed the confidence component. Compared with non-ARCS instruction in the control group, the ARCS instructors told students that they had the ability to achieve the goals of the course and praised students when they performed well or encouraged students when they felt frustrated. In contrast to the two aforementioned components, the instructors applied relatively few confidence strategies in the control group.

Fourth, we re-examined the satisfaction component. To contrast ARCS with non-ARCS instruction, the ARCS instructors adopted a points system. When students answered questions and shared their opinions, the instructors gave them bonus points. Points were transferred to grades as an extrinsic reward at the end of the semester. Additionally, in one lecture course, the speaker gave away USB flash drives and MP3 players as presents to reward students who had answered questions. The instructors thus used some satisfaction strategies in the experimental group.

As the descriptions above demonstrate, many attention and relevance strategies were used in the course design of the experimental classes, but only a few confidence and satisfaction strategies. In this study, neither of the instructors was good at using satisfaction strategies. Although the instructors did praise and encourage students during the class, the amounts and strength of reinforcement and encouragement were not adequate to satisfy students' needs. Furthermore, the teachers could not change their basic instructional styles. From this observation, it is apparent that instructor characteristics were crucial factors in instruction, strongly affecting teaching excellence (Lammers & Smith, 2008).

In addition to instructor characteristics, other factors may explain the absence of differences between the groups. Huang, Huang, Diefes-Dux, and Imbrie (2006) found an interaction between attention and satisfaction, suggesting the need to adjust the theoretical constructs of the ARCS model. Moreover, Song and Keller (1999) indicated that appropriate amounts and levels of motivational instructional strategies used could promote students' motivation to learn. Too much or too little use of motivational strategies, on the other hand, could decrease students' motivation. The results might also be influenced by differences in the course design between the experimental group and the control group. In the present study, the control group was exposed to some attention and relevance strategies, such as video clips, news, and worksheets. This might be a crucial factor influencing the results of the two groups.

Apart from the above-mentioned reasons, students' characteristics and properties of the course also played essential roles in the outcomes of this study. Bohlin, Milheim, and Viechnicki (1993) demonstrated that the effects of using the ARCS model also depended on student characteristics. Participants in this study were technical and vocational college students, and their learning focus is on professional skills instead of scholastic material taught in general colleges in Taiwan. In addition, this was an elective rather than a required course. This may also have influenced students' attitudes toward learning. Our findings were consistent with those of Halawah (2006) and Clark and Schroth (2010). Halawah (2006) found a remarkably high correlation between the motivation to learn and students' characteristics. College students with different personality characteristics have different reasons for pursuing college degrees and different academic priorities (Clark & Schroth, 2010).

2. Were there any significant differences in achievement between students who took the course that was designed using the ARCS model and those who took the one that was not?

The result of the post-test one-way ANOVA showed no significant differences in achievement between the two groups ($F(1,90) = .94$, $p = .34$). This result ran contrary to our expectations. Comparing the pretest and post-test scores, both groups showed a slight increase in grades, but there were no significant differences between groups. In other words, the increase in grades was not due to the experimental manipulation.

Achievement is related to students' achievement goals. Whereas achievement goals are set in particular contexts, the motivation to learn represents an individual's general need to perform well, master his/her environment, work hard, and seek challenges (Durik, Lovejoy, & Johnson, 2009). Goals in general can be conceptualized as internal representations of desired outcomes (Karoly, 1999). When students face learning tasks, they behave according to their own thoughts and attitudes (Rachal, Daigle, & Rachal, 2007). Moreover, students regulate their motivation and behaviors depending on their goal orientation and their perceptions of task value (Pintrich, 2004). In the present case, given that the goals of learning were merely to pass the course and acquire credits, students regulated their motivation and did not study hard. Therefore, achievement goals and the importance of the exam were influential in determining students' achievement.

This finding drew our attention. To come to a deeper understanding of the underlying reasons for this outcome, we interviewed students to collect information about their learning situations and beliefs. These interviews indicated that students did not put much effort into this course. As noted above, the course that was the focus of the present study was an elective course, and students typically do not care about their grades in electives as much as in required courses. This stance influenced their preparation for the exam. The achievement goal of almost every student was merely to pass the course and get the credits rather than to earn high grades. Once students set a low achievement goal for this course, they did not tend to strive for excellence. Therefore, this result was reasonable in an elective course.

Conclusions and Future Directions

The main purpose of this study was to use the ARCS model to design a course that would promote students' motivation to learn and their achievement. The results of the study differed from the general theory of motivation and the ARCS model after both quantitative and qualitative data analysis.

Three main factors influenced the results of the study. The first was the participants. We chose technical and vocational college students as participants in the study for two reasons. Previously, few research studies have investigated the learning situation of technical and vocational college students in Taiwan. Additionally, compared with general college students, this group of students generally has a low motivation to learn. Because of their low motivation, they do not learn easily, and their post-test scores for motivation to learn were not sensitive enough to reveal any change in the level of motivation. To avoid this situation, researchers could either choose university students as participants or tailor motivational instructional strategies to fit technical and vocational college students' characteristics.

The second factor was the nature of the course. Choosing an elective course proved to be a limitation in the present study, as it actually affected students' learning goals and the im-

portance placed on the exams, resulting in students' putting little effort into their exams. This limitation was difficult to overcome with teaching practices alone.

The third main factor was instructor characteristics. The instructor is an essential element in the ARCS model. If the instructors are able to perform as actors, they can vary the tone of their voice and body movement to increase students' attention. Therefore, long-term training for instructors is necessary.

Although the results of the present study showed no significant differences between the ARCS and control groups, we still believe that it is important to revise course designs and the motivational instruction strategies used by instructors. Course instruction necessarily undergoes continual evolution and innovation, and, along with this, instructors must continue to acquire a repertoire of practical instructional strategies to promote technical and vocational college students' motivation to learn and become achievers.

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