Investigation of Student-Centered Teaching Applications of Physics Student Teachers

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Abstract

The purpose of this study is to evaluate the effects of teaching materials in physics, based on Context-Based Instruction, REACT [Relating, Experiencing, Applying, Cooperating, and Transferring] and Computer-Assisted Teaching methods, on the academic success, interests and attitudes of student teachers. This study was conducted with 159 ninth and tenth graders in three different Anatolian high schools in Trabzon that were chosen as field sites in the Spring semester in the context of Faculty-School Partnership. The results of the pre-and post-test that were applied to a single group were compared, and the effects of Computer-Assisted Teaching, REACT and Context-Based Instruction on the attitudes, interests and academic success of the students toward physics were considered. Based on the findings, it was concluded that REACT, the Content-Based Approach, and Computer-Assisted Learning Method were effective in increasing the student success, interest and positive attitude.

Key words: Computer-Assisted Teaching; Context-Based Instruction; Physics Student Teachers; REACT; Student-Centered Teaching

Introduction

The quality of an educational system depends in large part on the effectiveness of pre-service teacher education. In order to meet the needs of a growing student population, it is necessary to emphasize the importance of teacher education, as student teachers will eventually take responsibility for educating the country's students (Kavcar, 1999). There is a consensus that the main deficiency in physics teaching is the result of instructors' inability to adequately implement the teaching skills they have been taught (Bencze & Hodson, 1999), relying primarily on traditional teacher-centered instruction rather than utlilizing the more effective model of student-centered learning (Azar & Çepni, 1999; Bencze & Hodson, 1999; Kocakülah, 2000; Saka, 2004a). Physics student teachers have reported that, during the course of their practical field work, the classroom teachers with whom they are training do not apply the techniques and professional skills they have learned during their coursework. This situation limites the ability of pre-service physics teachers to observe the practical application of professional skills that they have learnt in vocational education and training lessons,

resulting in feelings of inadequacy, shyness and skepticism when they, in turn, are given the responsibility of leading a classroom (Kete, Özdemir, & Ok, 1998).

In order to ensure that student teachers have the opportunity to apply newly-learned teaching strategies, methods and theories during their field experiences, the faculty in charge of coordinating fieldwork should communicate with mentor and schools to clearly define the needs and expectations of the program (Saka, 2005). Even with reformed teaching programs and newly designed textbooks and materials, teachers who have not had the opportunity to apply their teaching skills adequately during the course of fieldwork are unlikely to adapt to new teaching methods (Moore & Watson, 1999). In order for a physics teacher to choose to implement a particular teaching technique, he or she should not only have the theoretical knowledge, but the practical experience to do so (Bedweel, Hunt, Touzel & Wisaman, 1991). The inability of teachers to create an effective learning environment is one of the main reasons that students have a negative attitude toward learning physics (Uzuntiryaki & Geban, 1998). Because of this, it is necessary to create teacher training programs in which pre-service physics teachers can track their improvement by applying different student-centered teaching approaches; by improving the professional skills of teachers through effective training programs, the quality of physics teaching will be improved (Trumbul & Kerr, 1993; Saka, 2004b, Springer, Stanne & Danovan, 1999). The REACT, Context-Based Instruction and Computer-Assisted Teaching methods are among the most effective and popular teaching approaches currently in use. These methods should be examined in terms of application process and academic success of students by student teachers in the process of pre-service teacher education within the context of professional skills training.

The purpose of this study is to evaluate the effects of teaching materials in physics, based on Context-Based Instruction, REACT (Relating, Experiencing, Applying, Cooperating, and Transferring) and Computer-Assisted Teaching methods, on the academic success, interests and attitudes of student teachers.

Method

The study was conducted according to a constructive action research method for the purpose of evaluating the contributions of student-centered teaching applications to the development of professional skills (Yıldırım & Şimşek, 2005). In this study, concept achievement tests were used in conjunction with participant interviews. Pre-and post-test results applied to a single group were compared, and the effects of Computer-Assisted Teaching, REACT and Context-Based Instruction on the attitudes, interests and academic success of physics students were considered.

I. Sample

This study was conducted with 159 (80 females and 79 males) ninth and tenth graders in three different Anatolian high schools in Trabzon, which were chosen as field sites in the Spring semester in the context of Faculty-School Partnership.

II. Application Process

During the application process of the research, the student-centered teaching approach was evaluated by student teachers conducting physics lessons at their field sites. The application process was conducted as follows:

- Before application, for each teaching approach used in the study (Context-Based Instruction, REACT, and Computer-Assisted Teaching method), two different materials as teacher guidelines were prepared.

- After referring to other studies in the relevant literature, six different achievement tests were prepared for the purpose of determining general information about physics subjects.

- Within the research, a before-application pre-test, an after-application research post-test and an interview were conducted with student participants.

- The pre-test phase was used to evaluate a student's background knowledge, misconceptions and interest concerning physics; after application, the same test was given as a post-test, and the effect of student-centered teaching approaches was evaluated.

- Six teacher guideline materials were prepared according to Computer-Assisted Teaching methods concerning specified physics subjects; REACT and Context-Based Instruction were applied by the researcher.

- The teaching materials, which were prepared according to specified physics topics, were used by three pre-service physics teachers at three different field sites within the teaching practice course.

- For the purpose of evaluating the application and examining the changes in attitude and achievement in physics, half-structured interviews consisting of 4 questions were conducted with 40 students from the group of participants.

III. Data Analysis

Quantitative data from the study was analyzed according to SPSS 15.00 with the help of the dependent t-test; data from the interviews was evaluated according to interpretation and consensus. The aim was to determine whether new teaching approaches have any significant correlation with academic success through comparing grades from achievement tests.

Findings

I. Findings of the Achievement Test

The Wilcoxon signed-ranks test of student's pre-test and post-test analysis was given in Tables 1-4. The REACT and Wilcoxon signed-rank test analysis of student's pre-test and post-test scores in the conducted applications on teaching strategies from a sample group of 28 students from the Tevfik Serdar Anatolian High School 9B Class and 21 students from the Akcaabat Anatolian High School 10 Science C Class are provided in Table 1 below.

Table 1. The analysis of the Wilcoxon signed-ranks test of student's pre-test and post-test application findings based on REACT strategy.

	REACT	Post-test/Pre-test
Z Dual (2-variant)	*Tevfik Serdar A.H.L (N=28)*	3.269[a] 0.001[b]
	Akçaabat A.H.L. (N=21)	3.627[a] 0.000[b]

a. Negative Values Range   b. Wilcoxon Signed-Rank Test

As indicated in Table 1, a meaningful difference favouring the post-test has been detected between the post-test and pre-test as a result of the pre/post-test analysis of the applications based on the REACT strategy ($Z_1=3.269$, $Z_2=3.627$, $p<0.001$). In this case, it can be argued that REACT-based applications are effective in increasing students' academic

success. The Wilcoxon signed-ranks test analysis of the findings of applications based on the Context-Based Instruction approach with a sample group of 26 students from Tevfik Serdar Anatolian High School 10 Science B class and 27 students from Trabzon Anatolian High School 9E Class is given in Table 2.

Table 2. The analysis of the Wilcoxon signed-ranks test of student's pre-test and post-test application findings based on Content-Based Instruction strategy

	Context-Based Instruction	**Post-test/ Pre-test**
Z Dual (2-variant)	*Tevfik Serdar A.H.L (N=26)*	3.704[a] 0.000[b]
	Trabzon A.H.L. (N=27)	4.417[a] 0.000[b]

a. Negative Values Range   b. Wilcoxon Signed Rank Test

As can be seen in Table 2, the pre/post-test analysis results of applications based on Context-Based Instruction, a significant difference between the post-test and pre-test favouring the post-test has been determined ($Z_1=3.704$, $Z_2=4.417$, $p<0.001$). In this case, it can be argued that Context-Based Instruction strategy is effective in improving the students' academic success. The t-test analysis of the findings of applications based on the Computer-Assisted Teaching strategy with a sample group of 30 students from Akcaabat Anatolian High School 9B class is provided in Table 3.

Table 3. The analysis of student's pre-test and post-test application findings based on Computer-Assisted Teaching strategy findings

Measurement (CATS)	N	X	Ss	df	t	p
Pre-test	30	37.78	15.121	29	-7.047	0.00
Post-test	30	65.56	18.012			

p<0.001

As can be seen in Table 3, a significant difference favouring the post-test between the pre-test and post-test results of applications conducted based on the Computer-Assisted Teaching method was determined ($\overline{X}_s=65.56$, $\overline{X}_ö=37.78$, $t=-7.047$, $p<0,01$). This underlines the fact that applications conducted based on the Computer-Assisted Teaching method have a positive effect on student success. The Wilcoxon signed-ranks test analysis of the findings of applications based on the Computer-Assisted Teaching method with a sample group of 27 students from Trabzon Anatolian High School 9C class is given in Table 4.

Table 4. The analysis of the Wilcoxon signed-ranks test of student's pre-test and post-test application findings based on Computer-Asssisted Teaching strategy.

	Computer-Asssisted Learning	**Post-test/Pre-test**
Z Dual (2-variant)	*Trabzon A.H.L. (N=27)*	2.972[a] 0.003[b]

a. Negative Values Range   b. Wilcoxon Signed-Rank Test

As seen in Table 4, it was determined that there was a significant difference favouring the post-test between the analysis of pre-test and post-test results of applications based on the Computer-Assisted Teaching method (Z=2.972, p<0.01) In this case, it can be said that the Computer-Asssisted Teaching method is effective in increasing the students' academic success.

Interview Findings

Regarding the implication of Computer-Assisted Teaching: most of the students stated that, thanks to the visual nature of learning with computers, they were happy with the use of computers and they never felt bored, and that they have reinforced their previous learning by learning what they have learnt before in a greater detail and by acquiring new knowledge due to the fact that the more senses they use, the more long-lasting the new information is. They emphasized that computers increased their attention to lessons, but at the same time they decreased the role of the teacher and the classroom, and thus, they should be integrated into teaching and learning only when needed. Students remarked that computers grabbed their attention in the classroom, but they did not believe their attitude towards physics had changed. However, it was observed that the attitudes of some students towards physics improved, while some developed a more negative point of view.

Regarding the implementation of the REACT teaching strategy: most of the students, even though they stated they were already familiar with the material, noted that they enjoyed the lesson more because they had the opportunity to work in a hands-on setting. They indicated that they liked the circuits they made, because they were analogous to a real computer; they enjoyed the stories, as examples from daily life helped them keep interested in the classroom; they liked having visual equipment as part of the lessons as they understood the lesson better through observing and experimenting on their own; and that their complaining about the interruptions and problems during the application in the classroom had an adverse effect on their attention toward the class activities . However, most of the students stated that their interest towards physics changed positively after the class. Almost all students pointed out that they could easily teach the subject to a friend who did not know the topic.

Regarding the implementation of Context-Based Instruction: most of the students stated that they liked starting a lesson with a story in the Context-Based Instruction model, and they enjoyed the use of visual materials; they appreciated that the subjects were simplified and transmitted associatively; they enjoyed the activities in the classroom; they did not get bored in the classroom; they enjoyed the stories; and that doing the activities on their own helped them focus more on the lesson. Boys, in particular, appeared to have developed a more positive attitude toward physics. Most of the students emphasized that they would be able to teach the subject matters to others, and they held the view that the lessons were, in general, interesting and diverse. Some of the students were happy with not doing dictation in the classroom, while others were not pleased with it.

The students' views regarding the applications conducted for the purpose of this research underscored that the utilization of visual materials increased their attention and interest a great deal as it turned the class time into something pleasurable and not boring; teaching of the topics in a simplified matter and with associations, and enjoying the activities in the classroom helped them learn the concepts better, and thus, they would be able to easily reflected their knowledge to a friend who did not know the topic.

Results

It is important to ensure that student-centered teaching methods in physics courses are not ignored in favour of theory and textbook rhetoric (Hodson & Bencze, 1999). At this stage of learning, it is necessary to relate different aspects of physics to real-life situations and current events. Within the study, it is indicated that the REACT teaching strategy, Context-Based Instruction and Computer-Assisted Teaching methods have made significant contributions to the academic success of physics students with the most positive results occurring as the result of Computer-Assisted Teaching applications. The student teachers themselves felt that applying the student-centered teaching approach and methods helped to improve their teaching skills. Student-centered teaching methods increase the quality of physics teaching; thus, further examination of the effects on developed teaching materials for student-centered teaching is important in terms of creating a mutual interaction learning environment between instructors and student teachers (Pinnegar, 1995; Hamilton, 1998; Rice & Roychoudhury, 2003; van Zee et al., 2003; Loughran et all., 2004).

In order to correct the failure of teachers to use student-centered teaching methods, rather than traditional teacher-centered instruction, it is necessary to examine the effectiveness of in-service training seminars and the ability of instructors to apply student-centered teaching methods (Prosser & Trigwell 2002). In this respect, this study is important for pre-service physics teachers who want to apply student-centered teaching methods in order to improve their professional skills. It also provides a model for instructors to fill in the gaps on student-centered teaching methods with the appropriate educational resources and tools (Hall & Saunders, 1997; Kember, 1997; Lea et al. 2003; Kember, 2009). Thereby, the long-anticipated contribution to the development of the individuals' physics literacy levels will be accomplished by helping students achieve the targeted learning outcomes in physics teaching.

Suggestions

Implementing student-centered teaching methods such as Computer-Assisted Teaching, Context-Based Instruction, and REACT teaching strategies will provide students with the tools they need to succeed in physics class; teaching programs should be established and guideline materials should be provided in order for instructors to properly utilize these resources in their classrooms. In this way, guiding materials crafted for teachers should be submitted for teachers' use, and by doing so, effective practices should be extended. In addition, the quality of physics education should be increased by improving pre-service training for student-teachers and in-service education for practicing teachers through an expansion of implementations that contribute directly to the development of skills to practice student-centered teaching methods.

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