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Use of Information Technology in Relation to Technology Beliefs and Attitudes

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Abstract—*This study explored teacher educators' pedagogical beliefs and technology uses in relation to preservice teachers' pedagogical beliefs and attitudes toward technology. Correlation and regression analysis were conducted to answer the research questions. The results revealed some relationships between the teacher educators' beliefs and their uses of technology. In addition, it was found that the teacher educators' learner centered beliefs could influence the preservice teachers' learner-centered beliefs. The frequency that the teacher educators had the preservice teachers use technology in both constructivist and traditional way could influence the preservice teachers' attitudes toward technology.*

Keywords—teacher educators' beliefs, technology, preservice teachers' beliefs, technology attitudes

1 Introduction

The rapid development of information technology has made computers and computer-related technology an integral part of teaching and learning. According to Glenn (1997), computers have advanced from simple machines with limited functions and capabilities to powerful machines with sophisticated applications and high-speed networking capabilities. Since the mid -1970s, schools districts have raced to keep up with the rapid growth and change of technologies. Under such conditions, it is necessary for teachers to learn new pedagogical and technological skills to better facilitate students' learning in classrooms (Glenn, 1997). To better prepare teachers to integrate technology in their K-12 classrooms, teacher educators should take the responsibility to prepare future teachers by infusing technology in their education courses (Vannatta & O'Bannon, 2002; Willis & Tucker, 2001).

Faculty members should be prepared to model, support, and require technology use by students (Cuban, 1995). Ertmer (1999) described two barriers to technology integration: firstorder barriers and second-order barriers. First-order barriers are extrinsic to teachers and include lack of access to hardware and software, time, and necessary support. Second-order barriers are intrinsic to teachers, including teachers' belief systems about teaching and learning and practices in teaching. Since the second-order barriers are more ingrained and personal, they may cause more difficulties to overcome. Furthermore, second-order barrie rs can affect meaningful technology integration. Therefore, as a second-order barrier, teachers' pedagogical beliefs may play an important role in the ways in which technology gets used in classrooms. Richardson (1996) defined beliefs as "psychologically held understandings, premises, or propositions about the world that are felt to be true" (p. 103). Some previous studies (Becker, 1999; Bigatel, 2002; Niederhauser & Stoddart, 2001) have suggested that inservice teachers' beliefs about teaching and learning had impact on their uses of technology in the classroom.

Compared to the teachers who had traditional beliefs about teaching and learning, the teachers who had constructivist beliefs were strong computer users, they used computers frequently and powerfully in their teaching. Instead of emphasizing the impact that teachers' beliefs on their uses

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of technology, some researchers (Hadley & Sheingold, 1993, Woodrow, et al., 1996) found that technology can influence teachers' beliefs and attitudes.

Many of these teachers incorporated technology into their teaching practices, which deeply affected their teaching and the students' learning. Regardless the report on the relationship between inservice teachers' pedagogical beliefs and their uses of technology, little is known about the relationship between teacher educators' pedagogical beliefs and their technology uses. The examination of such relationship in this study is an exploratory effort to fill the gap in literature and contribute to our growing knowledge about faculty development in technology use in teacher preparation programs. Such exploration is also important in the efforts to prepare preservice teachers to effectively use technology in their future teaching.

Teacher educators shoulder the responsibility for educating technology-using preservice teachers. Since teachers' beliefs exert a powerful influence on teachers' instructional decisions and classroom practices (Pajares, 1992), it is reasonable to expect that teacher educators who have different pedagogical beliefs will deliver instruction in different ways, which in turn, may have differential influences over preservice teachers' beliefs about teaching and learning. Therefore, the exploration of teacher educators' pedagogical beliefs in relationship to preservice teachers' pedagogical beliefs is necessary educational inquiry in teacher education programs. It will help us learn about the influence that teacher educators may have on preservice teachers' beliefs and add to our knowledge about how to broaden preservice teachers' pedagogical beliefs to encompass beliefs about meaningful uses of technology.

The introduction of computers and related technologies into schools makes it necessary for teachers to take advantage of technology in instruction. Preservice teachers need to be well prepared in using technology in teacher education programs. Beliefs about teaching and learning play an important role in transforming classrooms with the use of technology (Ertmer, 1999). Understanding how preservice teachers' pedagogical beliefs relate to teacher educators' pedagogical beliefs may help to predict their technology uses in future teaching. In addition to examining preservice teachers' beliefs about teaching and learning, it is also important to consider preservice teachers' attitudes toward technology use in education.

According to Aiken (1980), attitudes "may be conceptualized as learned predispositions to respond positively or negatively to certain objects, situation, concepts, or persons" (p. 2). Attitudes had influence on teachers' uses of technology in classrooms (Boone & Gabel, 1994; Levine & Donitsa-Schmidt, 1998; Piper, 2003). Being familiar with technology does not necessarily mean preservice teachers perceive that technology has a use in the classroom, and therefore, they may not be willing to teach with technology in the classroom (Ropp, 1999).

Attitudes toward technology did not only influence the student's initial adoption of computer technology, but also their future uses (Selwyn, 1997). Teachers' positive attitudes toward technology will make them likely to use it in the future (Yildirim, 2000). Thus, it is important to understand the factors related to preservice teachers' attitudes toward technology. Some researchers (Abbott & Faris, 2000; Kumar & Kumar, 2003) have suggested that preservice teachers' attitudes toward technology could be improved by integrating technology into teacher education course work.

However, few studies have been conducted to directly connect teacher educators' uses of technology and preservice teachers' attitudes toward technology. "Teachers teach as they have been taught, and it is unlikely that computer skills will be transferred to students and encouraged by teachers unless the teachers have positive attitudes toward computer use" (Yildirim, 2000, p. 481). Thus, it is necessary to explore how teacher educators, as models of teaching and technology use in classrooms, influence preservice teachers' attitudes toward technology. Aiken (1980) used modeling theory to analyze the development and the change of attitudes.

Many attitudes are not the result of direct reinforcement but are learned by observing the activities of people who are perceived as significant. As a person grows to maturity, numerous individuals – parents, peers, and television stars, among others – serve as models of attitudes and behavior. In the process of modeling the behavior of people who are important to her or him, a person makes provisional attempts to act and believe as the model is perceived to act and believe (p. 16). Therefore, it is a worthwhile effort to examine the relationship between teacher educators' technology uses in instruction and preservice teachers' attitudes toward technology.

This effort is important in identifying the factors that have influence on preservice teachers' attitudes toward technology and facilitating preservice teachers' positive attitudes toward using technology in their future teaching.

2 Method

2.1 Overview of Design

This study employed a correlational research design. To answer the first question on the relationship between teacher educators' beliefs and their technology uses, bivariate correlational study method was used. To answer the second question on the relationship between teacher educators' beliefs and preservice teachers' beliefs, prediction study method was employed by using multiple regression technique. To answer the third research question on the relationship between teacher educators' uses of technology and preservice teachers' attitudes toward technology, the same study method used to answer the second question was applied.

2.2 Participants and Site

This study was conducted with the instructors and the students in School of Education at a large mid - western university in a spring semester. Convenience sampling method was used. The preservice teacher participants were 100 students who enrolled in two beginning teacher education courses, course A and course B. Students in these two courses formed a cohort, which meant all those who attended one section of course A also took the corresponding section of course B. Of these 100 students, 59 of them were also taking an introductory educational technology course, course C. A total of 24 teacher educators took part in this study, 18 of them were graduate instructors and 6 of them were faculty members. Of the 24 instructors, 7 instructors were teaching course A, 9 were teaching course B, and 1 was teaching course C.

2.3 Variables and Instruments

In general, a total of four variables were examined to answer the research questions, including 1) teacher educators' pedagogical beliefs, 2) preservice teachers' pedagogical beliefs, 3) teacher educators' uses of technology in instruction, and 4) preservice teachers' attitudes toward technology use in instruction. Teacher educators' beliefs and preservice teachers' beliefs were measured by Teacher Beliefs Survey (McCombs & Whisler, 1997). This original survey contained 35 four-point rating scale items (from 1-strongly disagree to 4-strongly agree). The factor analysis yielded three factors and 29 items (6 items from the original survey were dropped). The three factors were consistent with the factors defined by the authors: 1) learnercentered beliefs about learners, learning, and teaching (LB), such as the item "Students have more respect for teachers they see and can relate to as real people, not just as teachers", 2) non-learner-centered beliefs about learners (NLB-L), such as the item "There are some students whose personal lives are so dysfunctional that they simply do not have the capability to learn", and 3) non-learner-centered beliefs about learning and teaching (NLB-TL), such as the item "I can't allow myself to make mistakes with my students". The reliability coefficient alpha for the three factors were 0.71, 0.70 and 0.71 respectively. Preservice teachers' technology attitudes (TA) were measured by computer technology attitude survey that was developed by Francis -Pelton and Pelton (1996).

There were originally 42 five-point Likert scale items (from 1-strongly disagree to 5-strongly agree), such as "Students who use computer will have difficulty learning basic skills". The factor analysis identified five factors. A total of 38 items were retained. The reliability alpha of the 38 items was 0.94. The alpha for the five factors was 0.93, 0.87, 0.87, 0.72 and 0.76 respectively. Teacher educators' technology uses in instruction were measured in two parts. One part was the frequency of using a variety of computer tools and application (software), such as "Word Processing" and "Database". The other part was about how the instructors had students use computer technology. This part contained 12 items that fell into two subscales. One subscale included 8 items that reflected using technology in constructivist way. They were adapted from the objectives for computer use by teachers who had constructivist teaching philosophy (Becker, 1998) and from constructivist instructional goals (Niederhauser and Stoddart, 2001). The items were such as "expressing themselves in writing" and "learning to work collaboratively". The other subscale contained 4 items that reflected using technology in traditional way of learning. They were adapted

from the objectives for computer use by those who had traditional transmission teaching philosophy (Becker, 2000). The items were such as "mastering skills just taught" and "learning to work independently". Specifically, the part of how computer technology used measured the frequency that the instructors have students use computer technology either in constructivist way (CW) or in traditional way (TW). All the items were in the form of rating scale (from 1 - None to 4 - High).

2.4 Data Collection

At the beginning of the spring semester, preservice teachers' pre-survey was administered to student participants to pretest their pedagogical beliefs and attitudes toward technology. At the end of the semester, a post-survey that was similar to the pre-survey was administered. At the end of the semester, a survey was administered to instructor participants to examine their pedagogical beliefs and technology uses in instruction. All the surveys were put online. The participants were informed of the web address of the surveys.

2.5 Data Analysis

In examining the relationship between teacher educators' beliefs and their technology uses, the Pearson product-moment correlation coefficient r was measured between each of the three beliefs scores (LB, LB-L, LB-TL) and the score for each subscale of computer technology uses (software, CW, TW). Positive r value shows positive relationship between two variables, while negative r value shows negative relationship between two variables. P value was reported. The significance level was set at .05.

When examining the relationship between teacher educators' beliefs and preservice teachers' beliefs, data collected from 100 student participants and the instructors (N = 17) in course A, B and C was analyzed. Sequential multiple regression analysis was conducted to examine each beliefs score separately. To control the influence of student participants' pre-existed beliefs prior to coming to teacher education program, their beliefs score in the pre-survey was used as covariate in the regression analysis. The students' post-survey beliefs score was regressed as functions of instructors' beliefs score with the students' pre-survey beliefs scores as covariate. Since not all the student participants took course C, dummy variable was used to indicate course C instructor, with "1" indicating having this instructor and "0" indicating not having this instructor.

3 Findings And Discussion

3.1 Relationship between Teacher Educators' Beliefs and Technology Use

An ANOVA examination found that graduate instructors and faculty members were different in learner-centered beliefs (LB), relationship between instructors' beliefs and their technology uses was examined with the two groups of instructors separately. For graduate instructors (N = 18), their learner-centered beliefs (LB) were positively related to their software use ($r = .47$, $p = .05$), the frequency that they had students use technology in both constructive way (CW) ($r = .57$, $p = .01$) and traditional way (TW) ($r = .54$, $p = .02$). Their non-learner-centered beliefs about learners (NLB-L) were negatively related to their software use ($r = -.51$, $p = .03$). Since there were only 6 faculty member participants, only one significant result was found. The frequency that these faculty members had students use technology in traditional way (TW) was positively related to their non-learner-centered beliefs about learners (NLB-L) ($r = .89$, $p = .02$).

3.2 Relationship between Teacher Educators' Beliefs and Preservice Teachers' Beliefs

When examining the three beliefs models, the regression analysis of the learner-centered beliefs (LB) produced a model of two variables that best predicted students' learner-centered beliefs: students' pre-survey beliefs and course A instructors' learner-centered beliefs (LB); $R2 = .13$, $F(2, 97) = 7.15$, $p = .0013$. This model accounted for 13% of variance in students' learner-centered beliefs. Since students' pre-survey beliefs score was used as covariate, the prediction of course A

instructors' learner-centered beliefs was the focus of examination. That semi-partial correlation was 0.04 indicated that course A instructors' beliefs can help to explain 4% variance in the students' learner-centered beliefs. A summary of the model is presented as the follows:

Table 1. A summary of the model

Step	R^2	df_1	df_2	p	β	sr
Students' LB in pre -survey	0.09	1	98	.001*	0.32	0.1
Course A instructors' LB	0.13	1	97	.048*	0.19	0.04

*Note. df=degree of freedom; b=standardized regression coefficient; sr=semi -partial correlation *p<.05*

Relationship between Teacher Educators' Technology Uses and Preservice Teachers' Technology Attitude When regressing the students' technology attitudes score as functions of the instructors' using of software and having students use technology in constructivist way (CW), the regression analysis produced a model of two variables that best predicted students' technology attitude: students' pre-survey attitudes score and course A instructors' having students' use technology in constructivist way (CW); R2 = .62, F (2, 97) = 80.52, p < .0001.

This model accounted for 62% variance in students' technology attitudes. When regressing the students' technology attitudes score as functions of the instructors' using of software and having students use technology in traditional way (TW), two variables were significant predictors of students' technology attitudes: students' pre-survey score and course A instructors' having students use technology in traditional way (TW); R2 = .62, F (2, 97) = 79.64, p < .0001.

This model also accounted for 62% variance in students' technology attitudes. Since students' pre-survey attitudes score was used as covariate, the prediction of the course A instructors' having students use technology in constructivist way and traditional way was the focus of interests. The semi -partial correlation was 0.02 for the two significant variables, which indicated that the frequency of the instructors' having students use technology in either constructivist way or traditional way accounted for 2% variance respectively in students' technology attitudes. The following tables presented the summary of the regression analysis.

Table 2. Model 1. Students' technology attitudes were predicted by the frequency that instructors use software and their having students' use technology in constructivist way (CW)

Variables	R^2	df_1	df_2	p	β	sr
Students' technology in pre -survey	0.60	1	98	.00*	0.78	0.61
Course A instructors' CW-Frequency	0.62	1	97	.03*	0.14	0.02

Table 3. Model 2. Students' technology attitudes are predicted by the frequency that instructors use software and their having students' use technology in traditional way (TW)

Step	R^2	df_1	df_2	p	β	sr
Students' attitude in pre -survey	0.60	1	98	.00*	0.78	0.61
Course A instructors' TW-Frequency	0.62	1	97	.04*	0.13	0.02

*Note. df=degree of freedom; b=standardized regression coefficient; sr=semi -partial correlation *p<.05*

4 Discussion and Implication

The findings of this study revealed that graduate instructors who had more learner-centered beliefs tended to use various software programs more frequently and have students use technology more frequently in constructivist ways. The graduate instructors who had more non-learner-centered beliefs about learners tended to use software programs less frequently. It is interesting to note that those who had more learner-centered beliefs also tended to have students use technology more frequently in traditional ways. This indicated that teacher educators' use of technology was not in a simple dimension. For some reason, those who have more learner-centered beliefs would have students use technology not only in constructivist way but also in traditional way. The inconsistency

between teachers' beliefs and their use of technology was reported in Ertmer, Gopalakrishnan and Ross's study (2001).

In this study, the researchers conducted an exploratory study with seventeen school teachers who considered themselves to be exemplary technology users to examine their pedagogical beliefs and classroom practices. It was found that although most of the teachers reported to have constructivist pedagogical philosophy, only five of them implemented in terms of best practice identified by the literature. They articulated constructivist views on technology integration, however, they used both constructivist and traditional methods to implement their teaching practice. The reason that there is inconsistency between teachers' beliefs and practice is the complexity in the classroom situation.

The contextual factors in the classroom teaching may prevent teachers from transforming their beliefs into practice and implementing what they would do theoretically (Fang, 1996). Graduate instructors shared the responsibilities of educating preservice teachers in teacher education program and could be major resources of candidates of faculty members in teacher education field. As such, the examination of this group of participants was very important in the exploration of teacher educators' beliefs and technology use. Due to the small number of faculty member participants, only one significant result was found in faculty member participants' data. Those who had more non-learner-centered beliefs about learners tended to have students use technology more frequently in traditional way. To further explore the relationship between teacher educators' beliefs and technology uses, in future study, it is necessary to include more instructor participants, especially faculty member participants.

In the examination of the relationship between teacher educators' beliefs and preservice teachers' beliefs, this study revealed that teacher educators' learner-centered beliefs could be able to influence preservice teachers' learner-centered beliefs over a semester, which was found between student participants and the instructors in course A. Richardson (1996) commented that when preservice teachers first came into teacher education program, they already had certain form of beliefs based on their own previous experience as students. These beliefs were deep-seated, therefore, it was hard to have their beliefs be impacted. This is true in the aspect that in current study, students' pre-survey beliefs scores were always the predictors of their post- survey beliefs scores. Since their pre-survey was conducted at the very beginning of the semester, the pre- survey scores can reflect their beliefs prior to their coming to the teacher education program. In addition, the students' non-learner-centered beliefs were not found to be influenced by the instructors' beliefs.

However, if previous instruction that students received could help in the development of their beliefs, there is no reason to deny that the instruction that preservice teachers receive in teacher education program could have influence on their beliefs about teaching and learning. In addition, their study in teacher education program and their status of being future teachers could make them think about teaching and learning more seriously and systematically.

In this study, In comparison with the fact that students' pre- learner-centered beliefs accounted for 10% variance in their post- learner-centered beliefs (sr = .10), the 4% (sr = .04) variance accounted by course A instructors' learner-centered beliefs in one semester did indicate that teacher educators' learner-centered beliefs can have influence on preservice teachers' learner-centered beliefs.

This study revealed that the student participants' attitudes toward technology could be predicted by the frequencies of course A instructors' having students use technology in constructivist way and traditional way. Although these two aspects of technology use accounted for just 2% variance respectively in students' technology attitude (sr = .02, sr = .02), they were significant and did help to explain the students' attitude score in post-survey. The examination of the descriptive data of the instructors' technology use indicated that the frequency of their having students' use technology for either constructivist way or traditional way of obtaining knowledge was barely moderately (several times a semester). Given this , the 2% variance cannot be discounted. Aiken (1980) pointed out that many attitudes were "learned by observing the activities of people who are perceived as significant" (p. 16).

Thinking about the fact that course A instructors had influence on the students' learner-centered beliefs, one can say that course A instructors' instruction impressed the students more than the other instructors' instruction. Therefore, it is reasonable to think that the development of students' attitudes toward technology was more the result of observing how course A instructors used technology. In other words, course A instructors' use of technology can predict students' attitudes toward technology. According to Wetzel (2002), "For instructional technology to be successfully

implemented, teacher beliefs and values need to shift. If they do not, the desired implementation and integration of instructional technology in education will not occur on a broad scale" (p. 46).

To better facilitate professional development for teacher educators and better prepare tomorrow's teachers to integrate technology effectively in classrooms, it is necessary to examine teacher educators' beliefs and their uses of technology, and how the two variables are related to preservice teachers' beliefs and attitudes toward technology use. As an exploratory effort, this study helped to enrich our knowledge about helping teacher educators to use technology in teacher preparation courses and engage in preparing technology-using prospective teachers.

Due to the limit of time and resources, this study was conducted in one semester period. In the future when time and funding permitting, further study can be conducted to explore how preservice teachers' pedagogical beliefs and their attitudes toward technology develop over the whole period in teacher education program. This may help the researchers and practitioners to learn more about the growth of preservice teachers and better prepare them for their future teaching.

5 References

[1] Abbott, J. A., & Faris, S. E. (2000). Integrating technology into preservice literacy instruction: A survey of elementary education students' attitudes toward computers. Journal of Research on Computing in Education, 33, 149-161.

[2] Aiken, L. R. (1980). Attitude measurement and research. In D. A. Payne (Ed.). Recent development in affective measurement (pp. 1-24). San Francisco: Jossey-Bass.

[3] Becker, H. J. (1999). Internet use by teachers: Conditions of professional use and teacher directed student use. Retrieved December 16, 2002, from http://www.crito.uci.edu/TLC/findings/Internet-Use/startpage.htm

[4] Becker, H. J. (2000) Findings from the teaching, learning, and computing survey: Is Larry Cuban right? Retrieved October 30, 2002, from http://www.crito.uci.edu/tlc/questionnaires/teachers_qs.pdf

[5] Bigatel, P. (2002). What effects do beliefs about teaching and learning, and attitudes about technology use have on level of technology implementation for elementary teachers in K-5 school settings. Paper presented at the annual meeting of the Association for Educational Communications and Technology, Dallas, TX.

[6] Boone, W., & Gabel, D. (1994). Computers and preservice elementary science teacher education. Journal of Computers in Mathematics and Science Teaching, 13(1), 17-42.

[7] Ertmer, P. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. Educational Technology Research and Development, 47(4), 47-61.

[8] Ertmer, P., Gopalakrishnan, S., & Ross, E. M. (2001). Comparing perceptions of exemplary technology use to best practice. Journal of Research on Computing in Education, 33. Retrieved November 8, 2002, from http://www.iste.org/jrte/33/5/ertmer.cfm

[9] Fang, Z. (1996). A review of research on teacher beliefs and practices. Educational Research, 38(1), 47-63.

[10] Francis -Pelton, L., & Pelton, T. W. (1996). Building attitudes: How a technology course affects preservice teachers' attitudes: Attitudes about technology. Technology and Teacher Education Annual, 1996, 167-172.

[11] Glenn, A. D. (1997). Technology and the continuing education of classroom teachers. Peabody Journal of Education, 72, 122-128

[12] Hadley, M., & Sheingold, K. (1993). Commonalities and distinctive patterns in teachers' integration of computers. American Journal of Education, 101, 261-315.

[13] Kumar, P., Kumar, A. (2003). Effects of a web-based project on preservice and inservice teachers' attitude toward computers and their technology skills. Journal of Computing in Teacher Education, 19, 87-92.

[14] Levine, T., & Donitsa-Schmidt, S. (1998). Computer use, confidence, attitudes, and knowledge: A causal analysis. Computers in Human Behavior, 14, 125-146.

[15] McCombs, B. L., & Whisler, J. S. (1997). Learner-centered classroom and school: strategies for increasing student motivation and achievement. San Francisco, CA: Jossey-Bass.

[16] Niederhauser, D. S., & Stoddart, T. (2001). Teachers' instructional perspectives and use of educational software. Teaching and Teacher Education, 17, 15-31.

[17] Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. Review of Educational Research, 62, 307-332.
[18] Richardson, V. (1996). The role of attitudes and beliefs in learning to teach. In J. Sikula, T. J. Buttery, & E. Guyton (Eds.). Handbook of Research on Teacher Education (2rd Ed.) (pp. 102-119). New York: Macmillan.
[19] Piper, D. M. (2003). The relationship between leadership, self-efficacy, computer experience, attitudes, and teachers' implementation of computers in the classroom. Paper presented at the annual meeting of Society for Information Technology and Teacher Education, Albuquerque, NM.
[20] Ropp, M. M. (1999). Exploring individual characteristics associated with learning to use computers in preservice teacher preparation. Journal of Research on Computing in Education, 31, 402-419.
[21] Selwyn, N. (1997). Students' attitudes toward computers: Validation of a computer attitude scale for 16-19 education. Computers Education, 28(1), 35-41.
[22] Vannatta, R. A., & O'Bannon, B. (2002). Beginning to put the pieces together: A technology infusion model forteacher education. Journal of Computing in Teacher Education, 18, 112-123.
[23] Wetzel, D. R. (2002). A model for pedagogical and curricular transformation with technology. Journal of Computing in Teacher Education, 18, 43-49.
[24] Willis, E. M., & Tucker, G. R. (2001). Using constructionism to teach constructionism: Modeling hands-on technology integration in a preservice teacher technology course. Journal of Computing in Teacher Education, 17, 4-37.
[25] Woodrow, J. E. J., Mayer-Smith, J. A., & Pedretti, E. G. (1996). The impact of technology enhanced science instruction on pedagogical beliefs and practices. Journal of Science Education and Technology, 5, 241-252.
[26] Yildirim, S. (2000). Effects of an educational computing course on preservice and inservice teachers: A discussion and analysis of attitudes and use. Journal of Research on Computing in Education, 32, 479-495.