Hacettepe Üniversitesi Eğitim Fakültesi Dergisi (H. U. Journal of Education) 41: 219-230 [2011]

# FACTORS INFLUENCING EXEMPLARY SCIENCE TEACHERS' LEVELS OF COMPUTER USE*

# ÖRNEK FEN ÖĞRETMENLERİNİN BİLGİSAYAR KULLANIM DÜZEYLERİNİ ETKİLEYEN FAKTÖRLER

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**ABSTRACT**: The purpose of this study was to examine exemplary science teachers' use of technology in science instruction, factors influencing their level of computer use, their level of knowledge/skills in using specific computer applications for science instruction, their use of computer-related applications/tools during their instruction, and their students' use of computer applications/tools in or for their science class. The sample for this study includes middle and high school science teachers who received the Presidential Award for Excellence in Science Teaching Award (sponsored by the White House and the National Science Foundation). Award-winning science teachers were contacted about the survey via e-mail or letter with an enclosed return envelope. This study found female exemplary science teachers have more knowledge of computer applications/tools than male exemplary science teachers. On the other hand, study findings revealed female science teachers used technology in their classroom less than male science teachers.
**Keywords:** Exemplary science teachers, level of computer use, factors influence teachers' computer use

**ÖZET:** Bu çalışmanın amacı, Üstün Başarı Ödülünü alarak örnek öğretmen unvanını almış ilköğretim ikinci kademe ve lise fen bilgisi öğretmenlerinin fen öğretiminde kullandıkları bilgisayar ve bilgisayara bağlı teknolojiler ve uygulamalar, öğretmenlerin bilgisayar kullanım seviyelerine etki eden faktörler, öğretmenlerin bilgisayar kullanımındaki bilgi/yeterlilik düzeyleri, öğretmenin bilgisayarı sınıf içinde kullanım düzeyi ve öğretmenlerin öğrencilerinin sınıf içinde bilgisayar kullanımlarını incelemektir. Bu çalışmaya, Amerika Birleşik Devletlerinde, White House ve National Science Foundation tarafından Matematik ve Fen Öğretiminde Üstün Başarı Ödülü (Presidential Award for Excellence in Matematics and Science Teaching) almış 355 öğretmen katılmıştır. Çalışmanın sonuçları, üstün başarılı bayan öğretmenlerin bilgisayar kullanımındaki bilgi/becerilerinin erkek öğretmenlerden fazla olmasına rağmen örnek bayan öğretmenlerin bilgisayarı sınıf içinde erkek öğretmenlere oranda daha az kullandıkları tespit edilmiştir.
**Anahtar sözcükler:** Örnek fen öğretmeni, teknoloji kullanım düzeyi, bilgisayar kullanımını etki eden faktörler

## 1. INTRODUCTION

The use of technologies in teaching and learning is recommended in the National Science Education Standards (National Research Council [NRC], 1996), Project 2061: Science for All Americans (Rutherford & Ahlgren, 1989), the National Educational Technology Standards (NETS) (ISTE, 2000), the International Society of Technology in Education (ISTE, 2008) and British Educational Communications and Technology Agency (BECTA) (2010). The International Society for Technology in Education (ISTE) also led a federally funded initiative to develop National Educational Technology Standards (NETS) for teachers, students, and administrators. The NETS initiative aimed at teachers is referred to as NETS*T (ISTE, 2008). The NETS*T project states that to provide a technology-supported learning environment for students, teachers must be prepared to teach and create a technology-rich learning environments (NETS*T, 2008).

As mentioned by Ertmer (1999); some of the factors influence teachers' use of technology although those teachers recognized the importance of integration of technology in program while they were teaching. Brickner (1995) categorized those barriers as first- and second-order barriers. Ertmer (1999) described those barriers as;

> Thus, first-order barriers to technology integration are described as being extrinsic to teachers and include lack of access to computers and software, insufficient time to plan instruction, and

* This research is the part of the first author's dissertation study.
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inadequate technical and administrative support. In contrast, second-order barriers are intrinsic to teachers and include beliefs about teaching, beliefs about computers, established classroom practices, and unwillingness to change. While many first-order barriers may be eliminated by securing additional resources and providing computer-skills training, confronting second-order barriers requires challenging one's belief systems and the institutionalized routines of one's practice. (p. 48)

A teacher's beliefs regarding pedagogy and the practice of teaching have been related to second-order barriers. Because of these individual differences, teachers' belief systems which are related to technology use and factors affecting their belief systems need to be studied. Second-order barriers are related to teachers' internal variables. Teachers' internal variables have proven to be helpful in understanding their behavior or performance (Coovert & Goldstein, 1980). Examples of internal variables with respect to the use of technology are teachers' attitudes toward computer use, teachers' self-efficacy related to computer use, the locus of control, and innovativeness. Hence, it is necessary to study teachers' beliefs regarding computer use to understand why some science teachers use computers and others do not use them.

Research indicates that some of the internal and external factors influencing teachers' use of computers include: personal self-efficacy in teaching with computers (Aşkar & Umay, 2001;Hasan, 2003; Kutluca & Ekici, 2010; Pamuk & Peker, 2009; Potosky, 2002; Yılmaz, Köseoğlu, Gerçek, Soran, 2006; Wilfong, 2006); outcome expectancy; pupil control ideology (Enochs et al., 1995; Niederhauser & Perkmen, 2010); age (Becker, 1999; Jennings & Onweuegbuzie, 2001); gender (Akkoyunlu & Orhan, 2003; Isılsal & Aşkar, 2003; Loyd & Gressard, 1984; Murphy, Coover,& Owen, 1989; Roussos, 2007; Sam, Othman, & Nordin, 2005; Seferoğlu, & Akbıyık, 2005), teaching experience; personal computer use; professional computer use; and science teachers' level of knowledge/skills in using specific computer applications/tools for science instruction.

Research studies revealed that while some of the external and internal factors hinder teachers' use of technology during teaching, some other teachers use technology as an exemplary way. Many researchers have examined the characteristics of exemplary technology-using teachers to understand how they differ from other teachers (Becker, 1994; Ertmer, Gopalakrishnan & Ross, 2001). According to Ertmer et al. (2001), exemplary technology-using teachers are motivated, energetic, and dedicated teachers. These teachers have gone beyond the usual responsibilities to design activities and create learning environments that engages their students in meaningful technology use.

While some researchers (Becker, 2000; Brickner, 1995; Ertmer, 1999; Mitchell, 2000) examined the factors affecting teachers' use of computers in their instruction and the characteristics of exemplary technology-using teachers, other researchers have conducted studies to identify overall exemplary teaching practices and the constructs of effective teaching (Allington, Johnston & Day, 2002; Covino & Iwanicki, 1996). Further, other researchers have focused specifically on science teaching and have examined the teaching and learning strategies used by exemplary science teachers (Bonnstetter, Penick, & Yager, 1983; Fraser & Tobin, 1989; Penick & Yager, 1993; Tobin & Fraser, 1987; Treagust, 1991; Waldrip & Fisher; 2001; Weiss & Raphael, 1996). The main purpose of those studies was to identify the characteristics of exemplary science teachers. Nevertheless, none of those studies examined exemplary science teachers' use of technology in teaching science.

Exemplary technology-using teachers share the same general characteristics of effective teaching and in turn characteristics of exemplary science teaching. The report of the President's Committee of Advisors on Science and Technology (PCAST, 1997) asserted that the use of computer technologies by teachers facilitates their adoption of constructivist pedagogy. Researchers who studied technology integration by teachers reported that if there is no conflict between teachers' current pedagogy and new pedagogy related to the implementation of a new innovation, the process of implementation of new innovation proceeds much faster than for others (Becker, 1999; PCAST, 1997). We know that exemplary science teachers are already in favor of using constructivist pedagogy in their classroom. With this assumption, could we assume that exemplary science teachers use computer technology in their classrooms in an exemplary way? Yet another question remains: Is there a minimum level of computer use required to be an exemplary science teacher? If exemplary teachers do not use computer technology in exemplary ways, the reasons that hinder their technology use should be identified and described.

Currently, there is no known study examining exemplary science teachers' use of technology and factors influencing their use of technology. This study examines exemplary science teachers' use of technology in science instruction, factors influencing their level of computer use, their level of knowledge/skills in using specific computer applications for science instruction, their use of computer-related applications/tools during their instruction, and their students' use of computer applications/tools in or for their science class. This study investigated the relationship among factors affecting exemplary science teachers' levels of computer use. The following research questions guided this study:

1. Are exemplary science teachers' level of knowledge/skills in using specific computer applications for science instruction associated with the following explanatory variables: personal self-efficacy in teaching with computers, outcome expectancy, pupil control ideology, level of computer use, age, gender, teaching experience, personal computer use, professional computer use and teachers' use of computer related application/tool during class?
2. Are exemplary science teachers' uses of computer related applications/tools during their instruction associated with the following explanatory variables: personal self-efficacy in teaching with computers, outcome expectancy, pupil control ideology, level of computer use, age, gender, teaching experience, personal computer use, professional computer use and science teachers' level of knowledge/skills in using specific computer applications for science instruction?
3. Are exemplary science teachers' students use of computer applications/tools in or for their class associated with the following explanatory variables: personal self- efficacy in teaching with computers, outcome expectancy, pupil control ideology, level of computer use, age, gender, teaching experience, personal computer use, professional computer use, computer access in the classroom and science teachers' level of knowledge/skills in using specific computer applications for science instruction?

## 2. METHOD

### 2.1. Selection of the Participants

The sample for this study included middle and high school science teachers (7 through 12) who received the Presidential Award for Excellence in Science Teaching (PAEST) from the White House and the National Science Foundation from all 50 states and U.S territories. Award winning science teachers were contacted via e-mail or a letter about the survey (with a return envelope). Findings of research studies (Cronk, & West, 2002; Lewis et al., 2009) suggested that the reliability and the effectiveness of paper-and pencil versus computer methodologies have found no differences or only few differences between the two methodologies. Based on those findings, this study collected the data through online and a paper and pencil survey. Before data collection, opinion of eight experts (one instructional technology professor, three science education professors, three instructional technology doctoral students with a science background, and one science education doctoral student with instructional technology emphasis) were taken to validate the content and face validity of the both version of the instrument. Based on the expert opinions, modified version of the instruments was pilot tested by administering to the science teachers (29 paper version and 45 web-version). The survey instrument was revised based on findings of the pilot study. The survey was posted online and an e-mail message was send to all exemplary science teachers requesting that they follow the included URL address to access the web-based survey. After one week, a reminder e-mail was sent to all exemplary science teachers who had yet to respond. Award-winning science teachers who did not provide their e-mail contact information were sent a packet via U.S. mail that included a hard copy of the questionnaire, a cover letter explaining the purpose of the study, Information Consent Form, and a postage-paid return envelope. A total of 355 middle and high school science teachers have been awarded the Presidential Award for Excellence in Science Teaching (PAEST) in the last five years when the study was conducted.

### 2.2. Data Collection

Award-winning science teachers' names were obtained from the PAEMST. Most of these 355 teachers were e-mailed a request to participate in the study. Sixty-two of awardees did not provide their e-mail address on the web-page and could not be contacted via e-mail. After the first e-mail request (n = 293), 58 of these messages were returned to the sender due to inactive e-mail accounts. A second e-mail message was sent to those science teachers after verifying each address. As a result of the second e-mail, 41 message addresses were returned as invalid. A total of 67 teachers responded to the first request and, of those, 57 award winning science teachers' surveys were valid. Those science teachers with valid e-mail addresses who had not responded to the first e-mail request to participate were sent a second message requesting their participation. Fifteen awardees responded to the reminder e-mail making a total of 72 (28.6%) who responded completely to the questionnaire.

Because 62 of the award-winning science teachers did not provide their e-mail address and 41 of the e-mail addresses were returned as invalid, a total of 103 packets were mailed to them via U.S. postal service. The packets included questionnaire, a cover letter explaining the purpose of the study, and a postage-paid return envelope. Eleven envelopes were returned as undeliverable. A total of 20 responses (24.4%) were received from these teachers. Of the 334 award-winning science teachers, usable responses were received from a total 92 science teachers.

### 2.3. Instrumentation

Along with the demographic information collected, this study used the Level of Computer Use Assessment (Marcinkiewicz & Welliver, 1993), Microcomputer Utilization in Teaching Efficacy Beliefs Instrument (MUTEBI) (Enochs, Riggs, & Ellis, 1993), The Pupil Control Ideology (PCI) (Willower, Eidell and Hoy, 1973) and the Technology Use in Science Education Scale (TUSES) (developed for this study). The number of items and reliability coefficients are summarized for each component of the survey in Table1.

Table 1: Descriptive Statistics of Explanatory and Outcome variables

| | N | #of items | Min score | Max Score | Mean | Std. Dev. | Reliability |
|---|---|---|---|---|---|---|---|
| Level of computer use (LCU) | 89 | 4 | 4 | 8 | 6.4 | 1.81 | 0.95 |
| Self-efficacy in Teaching with Computers (MUTEBI) | | | | | | | |
| Personal self-efficacy (SE) | 90 | 14 | 21 | 69 | 57.3 | 1.04 | 0.92 |
| Outcome expectancy (OE) | 90 | 7 | 9 | 33 | 20.9 | 0.54 | 0.84 |
| Pupil control ideology (PCI) | 90 | 10 | 10 | 35 | 21.1 | 0.58 | 0.75 |
| Technology Use in Science Education Scale (TUSES) | | | | | | | |
| Teachers' knowledge/skills | 92 | 34 | 0.21 | 3.68 | 1.87 | 0.086 | 0.96 |
| Teachers' instructional use | 92 | 34 | 0.09 | 2.06 | 0.81 | 0.046 | 0.90 |
| Student use of technology | 92 | 34 | 0.09 | 1.97 | 0.76 | 0.045 | 0.92 |

## 3. FINDINGS

### 3.2. Demographic Characteristics

Demographic information about the participants represented at the Table 2. Ninety of the respondents reported information about their gender, 55(38%) were male and 55(59.8 %) were female. The age of the respondents ranged from 33 to 65 years.

### 3.4. Regression Analysis

A multiple regression analysis was conducted to examine the degree of association between the outcome variables and the explanatory variables. Analysis was performed by using SPSS REGRESSION. Results of the evaluation of the assumptions for linear regression analysis led to deletion of the variable "Teaching Experience" to reduce the multicollinearity. Five cases with missing data were deleted from the regression analysis, n= 87 for each analysis.

Table 2: Some Demographic Characteristics of the Participants

| | | n | % |
|---|---|---|---|
| Gender (n=90) | male | 35 | 38.0 |
| | female | 55 | 59.8 |
| Age (n=89) | 33-39 | 10 | 10.9 |
| | 40-49 | 37 | 40.2 |
| | 50-59 | 37 | 40.2 |
| | 60-69 | 5 | 5.4 |
| Personal use of computers (n=90) | 6 to 9 years | 5 | 5.4 |
| | 10 to 19 years | 49 | 53.3 |
| | 20 to 29 years | 34 | 37.0 |
| | 30 to 35 years | 2 | 2.2 |
| Professional use of computers (n=90) | 0 to 9 years | 20 | 21.7 |
| | 10 to 19 years | 54 | 58.7 |
| | 20 to 25 years | 16 | 17.4 |

The first regression model consisted of nine explanatory variables (personal self-efficacy in teaching with computers, outcome expectancy, pupil control ideology, level of computer use, age, gender, personal computer use, professional computer use and teachers' use of computer related application/tool during class) and the outcome variable--"teachers' level of knowledge/skills in using specific computer applications for science instruction." Results showed that $R^2$ of .639 was statistically significant, $F$ (9, 73) = 12.866, $p$ = .000. This model indicates that the explanatory variables are jointly associated with 63.9% of the teachers' level of knowledge/skills. Four of the nine variables were statistically significant at 0.05 levels: personal self-efficacy, age, gender, and teachers' use of computer-related applications/tools during class.

Table 3: Regression Analysis Summary for Teachers' Level of Knowledge/Skills in Using Specific Computer Applications for Science Instruction

| Variable | *b* | *β* | *t*-values | *p*-values |
|---|---|---|---|---|
| Constant | 0.583 | | 0.935 | 0.353 |
| SE | 2.063E-02 | 0.251 | 3.001 | 0.004* |
| OE | -3.656E-03 | -0.024 | -0.309 | 0.758 |
| PCI | 1.056E-02 | 0.073 | 0.965 | 0.338 |
| LCU | -4.405E-02 | -0.104 | -1.353 | 0.180 |
| Age | -1.973E-02 | -0.187 | -2.414 | 0.018* |
| Gender | 0.260 | 0.166 | 2.257 | 0.027* |
| Personal computer use (PerCU) | 1.712E-02 | 0.116 | 1.221 | 0.226 |
| Professional computer use (ProCU) | -1.387E-02 | -0.096 | -1.021 | 0.310 |
| Teacher Instructional use (TInstUse) | 1.173 | 0.655 | 7.808 | 0.000* |

Note. $R^2$ = .639 (N= 87, $p$ = .000)
*$p$< .05.

Table 3 indicates that teachers' use of computer-related applications/tools during class, teachers' personal self-efficacy, age, and gender are highly related with the outcome measure of teachers' level of knowledge/skills in using specific computer applications for science instruction ($p < .000$, $p < .004$, $p < .018$ and $p < .027$, respectively). In this regression equation, no other variable was significant at the $p < .05$ level. This observation is interpreted to mean that as teachers' use of computer-related applications/tools during class and teachers' personal efficacy increased, it is likely that teachers' level of knowledge/skills in using specific computer applications for science instruction increased as well. Female science teachers have a higher level of knowledge/skills in using specific computer applications for science instruction. As exemplary science teachers get older, it is likely that their knowledge/skills in using specific computer applications for science instruction decreased.

A second multiple regression analysis was conducted to examine the degree of association between the outcome variable (teachers' use of computer related applications/tools during their instruction) and the explanatory variables (personal self-efficacy; outcome expectancy; pupil control ideology; level of computer use; age; gender; personal computer use; professional computer use; and science teachers' level of knowledge/skills in using specific computer applications for science instruction). Results showed that $R^2$ of .618 was statistically significant, $F$ (9, 73) = 13.105, $p$ = .000. This model indicates that the explanatory variables are jointly associated with 61.8% of science teachers' use of computer-related applications/tools during their instruction. Two of the 10 variables were statistically significant at 0.05 levels: science teachers' level of knowledge/skills in using specific computer applications for science instruction and gender.

Table 4 indicates that teachers' level of knowledge/skills in using specific computer applications for science instruction and gender are related with the outcome variable measuring science teachers' use of computer-related applications/tools during class instruction ($p$ < .000 and $p$ < .020, respectively). In this regression equation, no other variable was significant at the $p$ < .05 level. This observation is interpreted to mean that as teachers' level of knowledge/skills in using specific computer applications for science instruction increased, it is likely that teachers' use of computer-related applications/tools during class increased as well. Male science teachers more often used computer-related applications/tools during class.

Table 4: Regression Analysis Summary for Use of Computer Related Applications/Tools during Class

| Variable | *b* | *β* | *t*-values | *p*-values |
|---|---|---|---|---|
| Constant | -0.808 | | -2.321 | 0.023 |
| SE | 8.723E-04 | 0.019 | 0.208 | 0.836 |
| OE | 1.029E-02 | 0.119 | 1.534 | 0.129 |
| PCI | 3.201E-04 | 0.004 | 0.051 | 0.960 |
| LCU | 3.214E-02 | 0.136 | 1.730 | 0.088 |
| Age | 8.720E-03 | 0.148 | 1.825 | 0.072 |
| Gender | -0.158 | -0.180 | -2.385 | 0.020* |
| Personal computer use (PerCU) | -5.447E-03 | -0.066 | -0.671 | 0.504 |
| Professional computer use (ProCU) | 1.277E-02 | 0.158 | 1.653 | 0.103 |
| Teachers' knowledge/skills (TKnow) | 0.388 | 0.695 | 7.808 | 0.000* |

Note. $R^2$ = .618 (N= 87, $p$ = .000)
*$p$< .05.

A third multiple regression analysis was conducted to examine the degree of association between the outcome variable (students' use of computer-related applications/tools in or for their science class) and the explanatory variables (personal efficacy; outcome expectancy; pupil control ideology; level of computer use; age, gender; personal computer use; professional computer use; science teachers' level of knowledge/skills in using specific computer applications for science instruction; and numbers of computers in science classroom/science labs). Results showed that $R^2$ of .504 was statistically significant, F (10, 63) = 6.389, p = .000. This model indicates that the explanatory variables are jointly associated with 50.4% of students' use of computer-related applications/tools in or for their science class. Two of the 10 variables were statistically significant at 0.05 level: "science teachers' level of knowledge/skills in using specific computer applications for science instruction and gender."

Table 5: Regression Analysis Summary for Students' Use of Computer Related Applications/Tools

| Variable | *b* | *β* | *t*-values | *p*-values |
|---|---|---|---|---|
| Constant | -0.327 | | -0.769 | 0.445 |
| SE | 1.533E-03 | 0.031 | 0.267 | 0.790 |
| OE | 6.809E-03 | 0.084 | 0.872 | 0.387 |
| PCI | -8.083E-03 | -0.104 | -1.057 | 0.295 |
| LCU | 2.841E-02 | 0.122 | 1.221 | 0.227 |
| Age | 4.252E-03 | 0.075 | 0.745 | 0.459 |
| Gender | -0.204 | -0.241 | -2.418 | 0.019* |
| Personal computer use (PerCU) | -2.515E-03 | -0.031 | -0.261 | 0.795 |
| Professional computer use (ProCU) | 1.134E-02 | 0.139 | 1.200 | 0.235 |
| Teachers' knowledge/skills (TKnow) | 0.337 | 0.621 | 5.499 | 0.000* |
| Number of computers in science class | 1.108E-04 | 0.002 | 0.022 | 0.982 |

Note. $R^2$ = .494 (N= 87, $p$ = .000)
*$p$< .05

Table 5 indicates that teachers' level of knowledge/skills in using specific computer applications for science instruction and gender related with the outcome variable measuring students' use of computer-related applications/tools in or for science class ($p < .000$ and $p < .019$, respectively). In this regression equation, no other variable was significant at the $p < .05$ level. This observation is interpreted to mean that as teachers' level of knowledge/skills in using specific computer applications for science instruction increased, it is likely that students' use of computer related applications/tools increased as well. The negative effect in gender reveals that male teachers are more likely than female teachers to require their students to use computer applications/tools.

## 4. DISCUSSION AND CONCLUSIONS

Exemplary science teachers' have teaching strategies that enable them to create an inquiry-based learning environment, and their students are more likely to use technology in the classroom (Weiss & Raphael, 1996). Its' already known that exemplary science teachers are already in favor of using constructivist pedagogy in their classroom. It was not expected that exemplary science teachers has any problem in creating constructivist learning environment for their students. However, this study was concern about what is the situation when teachers' use the technology in their classroom. As mentioned in the Hooper-Rieber Model of Technology Adoption in the Classroom, when teachers begin to use technology in the classroom, they started to use technology in traditional instructivism paradigm of schooling. As they developed their knowledge and skills to use technology, they started to use technology as a cognitive tool in constructivist paradigm of teaching and learning (Hooper & Rieber; 1995). As stated at the Table 1, study findings revealed that mean score for exemplary science teachers' level of computer use is 6.4 out of 8. This findings shows that most of the exemplary science teachers are in the integration level of Hooper-Rieber Model of Technology Adoption in the Classroom and they started use technology in the constructivist paradigm of teaching and learning. This finding can be interpreted as some of the teachers has problem in integration of the technology in the constructivisim paradigm of schooling although they do not have any problem teaching science as constructivist way.

Resulting model for the science teachers' current level of knowledge/skills in using specific computer applications for science instruction revealed that science teachers' use of computer application/tools in their instruction, teachers' personal computer self-efficacy, age and gender has impact on the model. This study finding suggests that as teachers' use of computer related applications/tools for science instruction increased, it is likely that teachers' level of knowledge/skills in using specific computer applications/tools for science instruction increased as well. The increased personal computer self-efficacy can be expected to positively influence the amount of teachers' knowledge/skills in using specific computer applications for science instruction. This study show that for the sample of exemplary science teachers, female teachers can be expected to have a higher level of knowledge/skills in using specific computer applications for science instruction.

Age has a significant negative contribution to the model. Negative effects in age reveal that younger exemplary science teachers are more likely to have more knowledge/skills with technology. This finding is consistent with the study findings of Russell, Bebell, O'Dwyer, and O'Connor (2003). It may be important to give additional assistance to older science teachers to improve their level of knowledge/skills in computer applications/tools.

Researchers mentioned the importance of personal experience with technology and positive effects of professional development programs on knowledge /skills in using computer applications (Foon, Hew & Brush, 2007; Mueller et al., 2008; Wells, 2007). This study did not show any significant relationship between exemplary science teachers' level of knowledge/skills in using specific computer applications and personal computer use, professional computer use in their classroom for professional purposes, and their participation in the professional development related to the use of computers. The lack of a significant relationship between teachers' experience and knowledge level of computers may be due to the lack of differences between the teachers' experience. Participants in this study are recipients of the Presidential Award for Excellence in Science Teaching. These award winners have more teaching experience than the national science teachers (Weiss, Smith,

& Malzahn, 2001). This might influence the result of the study. With a more diverse group of science teachers, the result of the study might be different.

Findings from the study suggested that as the teacher's level of knowledge/skills in using computer applications for science instruction increased, it is likely that the teacher's use of computer-related applications/tools during class increased as well. This finding is consistent with Inoue's study (1998). Inoue found that knowledge of Computer Assisted Instruction (CAI) is the only variable that indicated a significant direct effect as to whether or not the teacher was using CAI. Another important finding revealed that males were associated with more frequent use of computer applications/tools for science instruction. This finding is consistent with other studies that found more male teachers use computers in teaching than female teachers (Becker, 1994; Chiero, 1997; Durndell & Haag, 2002; Hermans et al., 2008; van Braak et al., 2004). Becker (1994), and Hadley and Sheingold (1993) found more male teachers were represented as the exemplary technology-using teachers. Gender differences are a significant predictor of the teachers' use of technology in the classroom for teaching science. On the basis of those researches it is not surprising to find out male teachers are more likely than female teachers to require their students to use computer applications/tools in or for their science class. This finding is also consistent with existent research.

This study found female exemplary science teachers have more knowledge of computer applications/tools than male exemplary science teachers. On the other hand, study findings revealed female science teachers used technology in their classroom less than male science teachers. This contradiction between knowledge and use deserves further attention. Female science teachers should be strongly supported to help them gain confidence in using technology in their science classroom. This provides additional evidence of the need for training programs targeting female science teachers to not only improve their knowledge but also encourage them to develop implementation plans for technology use in their classrooms. Providing sample technology-integrated lessons for science instruction might help those female teachers in implementing such lessons.

Teachers are the decision-makers about the use of computers in the classroom, and whether they will require students to use that technology in or for their science class. Their decisions are likely to be influenced by many factors. This study shows exemplary science teachers beliefs of their capability to use technology influence their level of knowledge/skills in using computer applications for science instruction. This in turn influences their use and their students' use of that technology in the classroom. Findings revealed that importance of teacher education program. While they were teaching how they teach, they need to show seminal works for how to integrate technology in their teaching and how to teach with technology (Sandholtz & Reilly, 2004; Chen& Ferneding, 2003; Franklin, 2007). This also mean that the faculty's at the universities need to use technology as an constructivist way while they were teaching to show them a model how technology can be integrated in the science area in teaching and learning.

Findings from the study revealed that exemplary science teachers need assistance in learning and using technology in their science classes. Professional development activities might help them to improve their knowledge/skills. Literature shows that exemplary science teachers spend extra time in improving their knowledge/skills in teaching science. If those teachers have problems in using technologies, other teachers might have more problems. Another finding of this study is gender differences exist for exemplary science teachers' use of technology. Study findings revealed that female science teachers have more knowledge of computers than male science teachers have. On the other hand, male science teachers use computer-related applications/tools more often than female science teachers do. This study suggests that gender is an important factor in technology use. Further research is necessary to find what might cause this difference.

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## Genişletilmiş Özet

Amerika Birleşik Devletleri'nde gerçekleştirilmiş olan iki önemli ulusal projenin amacı fen eğitimini yeniden yapılandırmak ve fen okuryazarlığını geliştirmektir. Bu önemli iki proje: Ulusal Fen Eğitimi Standartları (National Science Education Standards (National Research Council [NRC], 1996) ve Proje 2061:Tüm Amerikalılar için fendir (Rutherford & Ahlgren, 1989). Her iki proje de ortak amaçlar ve tavsiyeler içermektedir. Çalışmaların sonuçlarında paylaşılan ortak temalar: eğitim teknolojileri, yapılandırmacı eğitim, öğrenme stilleri, sınıf yönetimi, ölçme değerlendirme, eşitlik, fen teknoloji ve toplum, işbirlikli öğrenme ve bilimin doğasıdır.

Bazı araştırmacılar (Becker, 2000; Brickner, 1995; Ertmer, 1999; Mitchell,2000) öğretmenlerin sınıf içinde bilgisayar kullanımına etki eden faktörleri ve bilgisayar kullanımındaki örnek öğretmenlerin karakteristik özelliklerini araştırırken, diğer araştırmacılar genel olarak örnek öğretmenlerin sınıf içindeki öğretimlerini ve etkili öğretim yöntemlerini ortaya çıkarmak amacıyla araştırmalar yapmışlardır (Allington, Johnston & Day, 2002; Covino & Iwanicki, 1996). Bunun yanı sıra, fen öğretimiyle ilgili çalışmalar yapan araştırmacılar ise örnek fen bilgisi öğretmenlerinin fen öğretiminde kullandıkları öğrenme ve öğretme stratejilerini incelemişlerdir (Bonnstetter, Penick, & Yager, 1983; Fraser & Tobin, 1989; Penick & Yager, 1993; Tobin & Fraser, 1987; Treagust, 1991; Waldrip & Fisher; 2001; Weiss & Raphael, 1996). Buna rağmen, örnek fen öğretmenlerinin teknoloji kullanımlarına yönelik bir çalışma yapılmamıştır.

Bu çalışmanın amacı üstün başarılı/örnek fen öğretmenlerinin teknoloji kullanım düzeylerini; bilgisayar ve bilgisayara bağlı teknolojileri/uygulamaları hakkında bilgi/yeterlilikleri; bilgisayar ve bilgisayara bağlı teknolojileri/uygulamaları sınıf içinde kullanım düzeyleri ve öğrencilerinin bilgisayar ve bilgisayara bağlı teknoloji/uygulamaları kullanım düzeylerini etkileyen faktörleri araştırmaktır.

Bu çalışmada veriler örnek öğretmenlere uygulanan anket aracılığıyla toplanmıştır. Anket 5 genel bolümden oluşmaktadır: 1)öğretmenlerin demografik bilgileri; 2) Bilgisayar Kullanım Düzeyleri (Level of Computer Use )(LCU) (Marcinkiewicz & Welliver, 1993); 3)Bilgisayar kullanımındaki öz-yeterlilik inancı (Microcomputer Utilization in Teaching Efficacy Beliefs Instrument) (MUTEBI) (Enochs, Riggs, & Ellis, 1993); 4) Öğrenci Kontrol İdeolojileri (Pupil Control Ideology (PCI) (Willower, Eidell and Hoy, 1973); 5) Fen Öğretiminde Teknoloji Kullanın Ölçeği (Technology Use in Science Education Scale (TUSES)) (bu çalışma için geliştirildi).

Amerika Birleşik Devletlerinde, 1983 yılından itibaren White House ve National Science Foundation tarafından Matematik ve Fen Öğretiminde Üstün Başarı ödülü (Presidential Award for Excellence in Matematics and Science Teaching) verilmeye başlanmıştır. Bu ödülün amacı Amerika Birleşik Devletleri'ndeki üstün başarılı fen ve matematik öğretmenlerini belirlemektir. Bu ödül yılda bir kez olmak üzere her eyaletten sadece bir matematik ve bir fen bilgisi öğretmenine verilmektedir. Çalışmanın yapıldığı dönemde toplam 355 fen bilgisi öğretmeni (7 sınıf ve 12 sınıf arası) White House ve National Science Foundation tarafından Fen Öğretiminde Üstün Başarı Ödülünü (Presidential Award for Excellence in Mathematics and Science Teaching) almaya hak kazanmıştır. Ödül kazanan fen öğretmenlerinin e-mail adresleri ve ulaşım bilgileri Internet'teki sayfada yayınlanmaktadır. 62 öğretmen İnternetteki web sayfasında e-mail adreslerini vermemiştir. Çalışma aracı olarak hazırlanan veri toplama aracı İnternette yayınlandıktan sonra ödül kazanan fen öğretmenlerine(n=293) çalışmaya katılmaları için e-mail aracılığıyla bir mesaj gönderilmiştir. İlk mesaj gönderildikten sonra 41 öğretmenin e-mail adresi yanlış olarak araştırmacıya tekrar geri dönmüştür. Bir hafta sonra çalışmaya cevap vermeyen üstün başarılı fen öğretmenlerine hatırlatma mesajı gönderilmiştir. 62 öğretmen e-mail adreslerini web sayfasında vermediği ve 41 öğretmeninde e-mail adresleri yanlış olarak araştırmaya döndüğü için bu öğretmenlere posta aracılığı ile ulaşılmaya çalışılmıştır. Araştırmaya erişim adreslerini doğru olarak veren toplam 334 ödül kazanan fen öğretmeninden 92si cevap vermiştir.

Çalışma sonucu göstermiştir ki örnek öğretmenin bilgisayarı sınıf içinde kullanım düzeyi artıkça öğretmenlerin bilgisayar kullanımındaki bilgi/yeterlilik düzeyleri de artmakta. Aynı zamanda öğretmenin bilgisayar kullanımındaki öz-yeterlilik inancı artıkça öğretmenlerin bilgisayar kullanımındaki bilgi/ yeterlilik düzeyleri de artmaktadır. Yaşla öğretmenlerin bilgisayar kullanımındaki bilgi/ yeterlilik düzeyleri arasında negatif bir ilişki bulunmuştur. Bu da yaş ilerledikçe öğretmenlerin bilgisayar kullanımındaki bilgi/yeterlilik düzeyleri azalmaktadır şeklinde yorumlanabilir. Başka bir deyişle yaşı büyük olan fen öğretmenlerinin bilgisayarı sınıf içinde kullanmalarını desteklemek istendiğinde onlara genç öğretmenlere nazaran daha fazla destek sağlanması gerekmektedir.

Çalışmaya katılan erkek örnek öğretmenlerin bilgisayar kullanımındaki bilgi/yeterlilik düzeyleri de bayan öğretmenlerin bilgisayar kullanımındaki bilgi/yeterlilik düzeylerinden daha azdır. Üstün başarılı/örnek bayan öğretmenlerin bilgisayarı sınıf içinde kullanım düzeyine bakıldığında ise erkek öğretmenlere nazaran bilgisayarı sınıf içinde daha az sıklıkla kullandıkları gözlenmiştir. Aynı farklılık bayan örnek öğretmenlerin öğrencilerinin sınıf içinde bilgisayar kullanımlarında da gözlemiştir. Bu sonuçlar, bayan örnek öğretmenlerin bilgisayar kullanımındaki bilgi/yeterlilik düzeylerinin erkek öğretmenlerden daha fazla olmasına rağmen sınıf içinde bilgisayar kullanımlarının ve öğrencilerinin bilgisayar kullanması için yaratıkları ortamda erkek öğretmenlerden daha az olanak sağladığını göstermiştir. Bayan öğretmenlerin bilgi sevilerinin daha fazla olmasına rağmen erkek öğretmenlere nazaran bilgisayarı neden daha az kullandıkları ve bunun sebepleri başka bir çalışmada araştırılmalıdır.

Bu çalışmanın sonucu göstermiştir ki bilgisayar kullanımında cinsiyet önemli bir fark oluşturmaktadır. Erkek örnek öğretmenler bilgisayarı daha sıklıkla sınıf içinde kullanmaktadırlar. Yapılan başka çalışmalar, erkek öğretmenlerin daha sıklıkla bilgisayarı kullandığını göstermektedir (Becker, 1994; Chiero, 1997; Durndell & Haag, 2002). Ama ilk kez bu çalışmada bayan öğretmenlerin bilgi seviyeleri daha fazla olmasına rağmen bu bilgilerini bilgisayarı sınıf içinde kullanmada kendilerini yeterli görmedikleri saptanmıştır. Ayrıca bu çalışma göstermiştir ki, bayan öğretmenlerin bilgisayar kullanımında bilgi seviyeleri artıkça kendilerine olan güvenleri artmakta ve ancak kendi bilgileri yeterli derecede olduğu sürece bilgisayarı sınıf içinde kullanmaktadırlar. Erkek öğretmenler ise bilgi seviyeleri bayan öğretmenlere nazaran az olmasına rağmen bilgisayarı sınıf içinde kullanmada her hangi bir rahatsızlık duymamaktadırlar.

Bayan öğretmenlerle erkek öğretmenlere arasındaki bu bilgi ve uygulama farklılıkları hazırlanacak olan hizmet içi eğitimlerde göz önüne alınmalı ve bu doğrultuda hizmet içi eğitimler hazırlanmalıdır. Bu çalışmanın sonuçları göstermiştir ki bayan öğretmenler ve yaşı ileri olan öğretmenlere sunulacak hizmet içi programında daha fazla bilgi sunulmalı ve onların kendilerine olan güvenleri artırılmalıdır.