# The Effects of Technology-Based Activities on Science, Technology, Engineering and Math (STEM) Major Choices

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## ABSTRACT

This study examined the extent to which technology-based activities, inside and outside of the classroom, affect students' STEM major choices in two and four-year colleges based on the Educational Longitudinal Study of 2002, considering the well-known learning predictors for STEM major choices (i.e., math achievement scores, math self-efficacy, and taking advanced math courses) and students social economic status and gender. The major findings were as follows: using logistic regression analysis, (a) students who have a high tendency of using computer and video game activities for their leisure activities are more likely to choose STEM majors in four-year colleges; (b) female students who frequently play video games and computers for leisure activities are more likely to enroll STEM majors in 4-year colleges; and (c) chi-square analysis showed that female students are substantially less inclined to play video games and computers compared to male students. The results of this study suggest that educators and policy makers should consider adopting technology-based learning environments that are relevant to the nature of STEM occupations, inside and outside of the classroom, to inspire more students to pursue STEM careers and help students become proficient at technological skills and knowledge that is demanded in the global economy.
Keywords: STEM, Higher Education ,Technology

## LITERATURE REVIEW

The decline of STEM degree recipients over the past three decades (U.S. Census Bureau, 2010) has encouraged many educational scholars to study factors that affect students' STEM major choices. Research has found that math performance (Astin & Astin, 1992; Besterfield-Sacre, Arman, & Shuman, 1997; French, Immekus, & Oakes, 2005; Levin & Wyekoff, 1988; Nicholls et al., 2007; Veenstra, Dey, & Herrin, 2008), math self-efficacy(Betz & Hackett, 1983; Hackett, 1985; Hackett & Betz, 1981; Hackett & Campbell, 1987; Lent, Lopez, & Bieschke, 1991; O'Brien, Martinez-Pons, & Kopala, 1999), and taking advanced math courses (ACT, 2004; Adelman, 2006; Csikszentmihalyi & Schneider, 2000; Lee & Frank, 1990; Noble, Davenport, & Sawyer, 2001; Noble, Robert, & Sawyer, 2006; Noble & Schnelker, 2007; Riegle-Crumb, 2006; Teta, 1997) are strong predictors for students' STEM major choices in postsecondary education. However, beyond these factors, there may be more potential learning factors that affect students' STEM major choices that need to be explored. Particularly, learning factors that are relevant to STEM tasks would play an important role in increasing student interest in pursuing STEM careers. However, little is known about the effects of learning factors based on STEM contexts such as technology-based learning activities on STEM career choices. Additionally, underrepresentation of women in STEM fields has been a longstanding critical problem in the U.S. (National Science Foundation, 2011). Accordingly, this study aims to investigate how STEM-based learning activities contribute to students' STEM major choices in postsecondary education, with particular attention on gender. For STEM-based learning activities, this study selected technology-based learning activities, specifically, computer and video game activities. These activities were chosen, because the U.S. Bureau of Labor Statistics (2010) predicted that nearly three out of four new STEM occupations in the U.S. will demand computing skills through 2020. Playing video games is a major leisure activity of engineering students in college (Veenstra, Dey, & Herrin, 2008); therefore, this study assumed that the tendency to play video games would be associated with the pursuit of STEM careers. In fact, it has been well documented in the literature that the use of computer and video game can improve students' visual spatial abilities (Subrahmanyam, Greenfield, Kraut, & Gross, 2001; Cherney, 2008) necessary for succeeding in STEM fields (Cherney, 2008; Cid & Lopez, 2011; Wai, Lubinski, & Benbow, 2009). However, the relationship between STEM major choices and students' frequent use of computer and video games has been less known. As such, this study proposed the following research questions: (a) to what extent do technology-based learning activities affect students' STEM major choices in two and four-year colleges, after controlling for math performance, math self-efficacy, enrollment in advanced math classes, social economic status (SES), and gender? (b) to what extent does the use of technology affect female students' STEM major choices in two and four-year colleges? and (c) to what extent do differences between male and female students exist in using technology for leisure activities and own learning? The results of this study suggest new learning environments where students can become motivated to pursue STEM careers. The next section will describe method used in this study.

## METHODS

The sample was drawn from nationally represented recent high school graduates who enrolled in either two or four-year postsecondary institutions and disclosed their college majors by 2006. Using logistic regression, this study investigated the effects of technology-based activities on students' STEM major choices in postsecondary institutions. Logistic regression was an appropriate method to examine predictors that affect students' STEM major choices because the dependent variable – students' STEM major choices – is a dichotomous variable that should be measured based on the probability of students' STEM and non-STEM major choices. Additionally, this study examined whether differences between male and female students exist in using technology for leisure activities and own learning employing chi-square test. Chi-square test was appropriate to investigate whether there was a significant difference in distribution of categorical variables between two groups. The following section details how the sample was extracted and which variables were selected from the Educational Longitudinal Study of 2002 (ELS 2002).

## Sample

A total of 5,917 students, who disclosed their college majors in either two or four-year postsecondary institutions, were extracted from the ELS 2002. These students responded to all survey questions that were selected for independent and dependent variables in this study. Among the 5,917 students, 4,391 students (1,895 male; 2,496 female) were enrolled in four year postsecondary institutions and 1,526 students (599 male; 927 female) were enrolled in two year postsecondary institution. Of the 4,391 students who enrolled in four year postsecondary institutions, 947 students (approximately 21.5%) chose STEM majors. Of the 1,526 students enrolled in two year postsecondary institutions, 196 students (approximately 12.84%) selected STEM majors. The classification of STEM majors is provided in Appendix A. Regarding gender proportion, in four year institutions, 593 male students (31.29%) chose STEM majors and 354 female students (14.18%) enrolled in STEM majors. Accordingly, among the 947 STEM students at four year institutions, approximately 62.62% students were male. In two year institutions, 130 male students (21.70%) and 66 female students (7.12%) selected STEM majors. With these samples, this study aimed to examine how technology-based activities affect students' STEM major choices. The next section describes procedures for selecting the independent and dependent variables that articulate the purpose of this study.

## Variables

This section describes the independent and dependent variables that were selected from the ELS 2002. Independent variables included technology-based activities, math self-efficacy, math performance, level of advanced math courses, SES, and gender. The dependent variable was students' STEM major choices. A detailed description of each variable is as follows.

### *Technology based activities*

From the ELS 2002, this study chose the student survey questions that were relevant to technology-based activities. The following two survey questions represented technology-based activities: (a) how often uses computers to learn on own and (b) hours of playing video and computer games on weekends. Survey item (a) is rated on a 5-point Likert scale (i.e., 1 = Never, 2 = Rarely, 3 = Less than once a week, 4 = Once or twice a week, and 5 = Everyday, Almost every day). Survey item (b) is scaled using a 6-point Likert scale that is anchored by 0 hour to 6 hours or more. Survey items (a) and (b) were labeled as BYS45C and BYS49B, respectively.

### *Math Self-Efficacy*

Students' math self-efficacy was a pre-existing variable within the ELS 2002 that was measured in the base year 2002. This variable is a continuous variable with a minimum of – 1.831 and a maximum of 1.772. The mean value and standard deviation of this variable was 0.0276 and 1.003, respectively. In the dataset, this variable was labeled as BYMATHSE.

*Math Performance*

For students' math performance, this study used students' math IRT scores in the base year 2002 which was a pre-existing variable in the ELS 2002 dataset. The mean value of this variable was 43.21 with a minimum of 13.74 and a maximum of 82.03, and a standard deviation of approximately 14. In the dataset, this variable was labeled as F1TXMBIR.

*The level of advanced math courses*

Regarding the level of advanced math courses, this study used the pre-existing variable, which described the "highest math course of a half year or more" in the first follow up study on 2004 of the ELS 2002. This variable consisted of student responses regarding enrollment in math courses based on a 5-point ordinal scale (1= no math course; 2 = pre-algebra, general or consumer math; 3 = algebra 1; 4 = geometry; 5 = algebra II; 6 = trigonometry, pre-calculus, calculus). In the dataset, this variable was labeled as F1HIMATH.

*Social Economic Status (SES)*

Students' social economic status (SES) was included as an independent variable, with the assumption that SES would determine students' STEM major choices. SES had a 4-point ordinal scale (1 = low SES; 2 = middle SES; 3 = upper middle SES; 4 = upper SES).

*Gender*

As a student characteristic, gender was included in the study to assess whether there is a significant difference in the use of technology for learning and leisure activities between male and female students. This variable was also used to determine the effects of other learning factors on students' STEM major choices, after controlling for gender. Female students were coded as 1 and male students were coded as 0.

*STEM major choices*

STEM major choice was a dichotomous dependent variable and referred to student major as of 2006. Students who selected STEM majors were coded as 1 and non-STEM students were coded as 0. In the dataset, the variable was labeled as F2MJR2_P.

Based on these variables, this study focused on investigating the effects of technology-based activities on students' STEM major choices in two and four year postsecondary institutions, taking into account for gender, SES, math self-efficacy, math performance, and level of taking advanced math courses. The next section discusses the results.

## FINDINGS

In this section, I respond to the three research questions proposed at the end of the literature review section. First, I will show the effects of technology-based activities on students' STEM major choices in two and four year colleges, after controlling for math performance, math self-efficacy, level of advanced math courses, SES, and gender. The second part demonstrates that the effect of the use of technology on female students' STEM major choices. In the last part, the differences in using technology- based activities between male and female students are shown.

**Research Question 1. To what extent do the technology-based learning activities affect students' STEM major choices in two and four-year colleges, after controlling for math performance, math self-efficacy, the level of taking advanced math courses, and gender?**

Regardless of gender, students who are frequently involved in technology-based activities for their own learning and leisure activities are more likely to choose STEM majors in four-year colleges and universities (see **Table 1**)

**Table 1: Logistic Regression Analysis of 4,391 Students in 4-Year Postsecondary Institutions.**

| Predictors | β | SE β | Wald's $X^2$ | df | p | $e^{\beta}$(odd ratio) |
|---|---|---|---|---|---|---|
| Constant | -6.212*** | .666 | 87.071 | 1 | .000 | .002 |
| Hours of using video and computer for leisure activities during weekend | .172*** | .024 | 51.193 | 1 | .000 | 1.187 |
| Frequency of using computer for own learning | .068* | .037 | 3.286 | 1 | .070 | 1.070 |
| Math self-efficacy | .381*** | .051 | 55.261 | 1 | .000 | 1.464 |
| Math Performance (Base Year Math IRT scores) | .029*** | .005 | 37.914 | 1 | .000 | 1.030 |
| Level of taking advanced math courses | .451*** | .115 | 15.363 | 1 | .000 | 1.569 |
| SES | .006 | .049 | .014 | 1 | .907 | 1.006 |
| Test | | | $X^2$ | *df* | *P* | |
| Goodness-of-fit test | | | | | | |
| Hosmer & Lemeshow | | | 13.891 | 8 | .085 | |

*Note*. *** p<.001; ** p<.05; *p<.1

Findings yielded that students' STEM major choices in four-year colleges and universities was positively related to hours of video gaming and computer use for leisure activities during weekend ($p$ <.001) and frequency of computer use for own learning ($p$ <.1), after controlling for math self-efficacy, math performance, level of advanced math courses, and SES. Namely, the more students engaged in video gaming and computer use for leisure activities and learning, the more likely they were to select STEM majors. Not surprisingly, math self-efficacy, math performance, and level of advanced math courses were strong positive predictors for students' STEM major choices, which is consistent with previous studies. In terms of goodness-of-fit statistics, the Hosmer-Lemeshow (H-L) test, which is an inferential goodness-of-fit statistics, yielded an $X^2(8)$ of 13.891 with the insignificant $p$-value ($p$ >.05). This finding suggests that there was no significant difference between observed and expected values and the model was fit to the data well.

Similar results were revealed for students in two-year colleges. As shown in **Table 2**, the more frequently students engaged in video gaming and computer use for leisure activities, the greater the likelihood that they would choose STEM majors. The odds ratio for "hours for using video game and computer during weekend" was 1.128, which suggests that students who frequently accessed video games and computers for leisure activities were 1.128 times as likely to choose STEM majors in two-year colleges. However, the level of frequency of computer use for learning was not a significant predictor for students' STEM major choices in two-year colleges. This result is contrary to that of four-year colleges and universities. Regarding goodness of fit statistics, H-L test was not significant (p>.05) with an $X^2(8)$ of 6.955, which suggests that the model was fit to the data well.

**Table 2: Logistic Regression Analysis of 1,526 Students in 2-Year Postsecondary Institutions**

| Predictor | B | SE β | Wald's $X^2$ | df | p | $e^{\beta}$(odd ratio) |
|---|---|---|---|---|---|---|
| Constant | -4.127*** | .700 | 34.753 | 1 | .000 | .016 |
| Hours of using video and computer for leisure activities during weekend | .121** | .047 | 6.482 | 1 | .011 | 1.128 |
| Frequency of using computer for own learning | -.046 | .075 | .369 | 1 | .544 | .955 |
| Math self-efficacy | .285*** | .102 | 7.740 | 1 | .005 | 1.329 |
| Math Performance (Base Year Math IRT scores) | .028*** | .009 | 9.869 | 1 | .002 | 1.028 |
| Level of taking advanced math courses | .236** | .125 | 3.548 | 1 | .060 | 1.266 |
| SES | -.120 | .093 | 1.688 | 1 | .194 | .887 |
| Test | | | $X^2$ | *df* | *P* | |
| Goodness-of-fit test<br>Hosmer & Lemeshow | | | 6.955 | 8 | .541 | |

*Note*. *** p<.001; ** p<.05; *p<.1

As shown in **Table 3**, the results, which considered gender in four-year colleges showed the similar pattern with those of two-year colleges (which did not consider gender). Students who frequently accessed video games and computers for their leisure activities were more likely to select STEM majors in four-year colleges. The odds ratio of .593 for gender informs us that female students were 40.7% (100 x [odd ratio -1] = - 40.7) less likely to choose STEM majors compared to male students in four-year colleges and universities, when all other variables were constant. As noted earlier, the independent variable, gender was coded 1 if the student was female and 0 if the student was male. The goodness of model fit was not significant ($X^2$= 6.955, *df* = 8, *p* =.541), which suggests that there was no significant difference between observed and expected values and the model fit to the data well.

**Table 3: Logistic Regression Analysis of 4,391 Students in 4-Year Postsecondary Institutions Controlled by Gender**

| Predictor | β | SE β | Wald's $X^2$ | df | p | $e^{\beta}$(odd ratio) |
|---|---|---|---|---|---|---|
| Constant | -5.707*** | .675 | 71.513 | 1 | .000 | .003 |
| Hours of using video and computer for leisure activities during weekend | .107*** | .027 | 15.229 | 1 | .000 | 1.113 |
| Frequency of using computer for own learning | .050 | .038 | 1.740 | 1 | .187 | 1.051 |
| Math self-efficacy | .351*** | .052 | 46.039 | 1 | .000 | 1.421 |
| Math Performance (Base Year Math IRT scores) | .027*** | .005 | 31.703 | 1 | .000 | 1.027 |
| Level of taking advanced math courses | .472*** | .116 | 16.667 | 1 | .000 | 1.603 |
| Gender | -.523*** | .106 | 24.246 | 1 | .000 | .593 |
| SES | -.008 | .049 | .029 | 1 | .864 | .992 |
| Test | | | $X^2$ | *df* | *P* | |
| Goodness-of-fit test Hosmer & Lemeshow | | | 11.671 | 8 | .166 | |

*Note*. *** p<.001; ** p<.05; *p<.1

Controlling for gender, in two-year postsecondary institutions, technology based activities were not significantly associated with the likelihood of students STEM major choices (see **Table 4**). However, as with the case of four-year colleges, math self-efficacy, math performance, and level of advanced math courses were significant positive predictors for students' STEM major choices. Similar to four-year postsecondary institutions, the significant underrepresentation of women also emerged in two-year colleges. The odds ratio of .403 for gender suggests that female students were 59.7% (100 x [odd ratio – 1] = -59.7) less likely to select STEM majors compared to male students in two-year colleges, when all other variables were constant. The goodness-of-fit test showed that the model fit into the data well ($X^2$ = 11.671, *df* = 8, p=.166).

**Table 4: Logistic Regression Analysis of 1,526 Students in 2-Year Postsecondary Institutions Controlled by Gender**

| Predictor | β | SE β | Wald's $X^2$ | df | p | $e^{\beta}$(odd ratio) |
|---|---|---|---|---|---|---|
| Constant | -3.136*** | .736 | 18.183 | 1 | .000 | .043 |
| Hours of using video and computer for leisure activities during weekend | .027 | .054 | .252 | 1 | .616 | 1.028 |
| Frequency of using computer for own learning | -.059 | .075 | .622 | 1 | .430 | .943 |
| Math self-efficacy | .243** | .105 | 5.360 | 1 | .021 | 1.275 |
| Math Performance (Base Year Math IRT scores) | .023** | .009 | 6.596 | 1 | .010 | 1.023 |
| Level of taking advanced math courses | .218* | .127 | 2.968 | 1 | .085 | 1.244 |
| Gender | -.909*** | .225 | 16.361 | 1 | .000 | .403 |
| SES | -.163* | .095 | 2.965 | 1 | .085 | .850 |
| Test | | | $X^2$ | *df* | *P* | |
| Goodness-of-fit test | | | | | | |
| Hosmer & Lemeshow | | | 2.753 | 8 | .949 | |

*Note*. *** p<.001; ** p<.05; *p<.1

**Research Question 2**. **To what extent does the use of technology affect female students' STEM major choices in two-year and four-year colleges?**

To respond to this research question and investigate the effects of technology-based activities on STEM major choices, I extracted female students who enrolled in either two-year (N = 927) or four year (N = 2,496) postsecondary institutions and disclosed their majors.

As shown in **Table 5**, female students who had a tendency to play video games and computers for leisure activities were more likely to choose STEM majors than were female students who did not enjoy these activities. Specifically, the odds ratio of 1.102 for the variable, "hours of using video games and computer for leisure activities during the weekend" suggests that female students who spent more than one hour accessing technology for leisure activities were 10.2% (100 x [odd ratio -1]) more likely to select STEM majors in four-year postsecondary institutions when all other variables were constant. The goodness-of-fit showed non-significant difference between expected and observed values ($X^2$=7.472, *df*=8, *p*=.487), which suggests that the model fit into the data well.

**Table 5: Logistic Regression of 2,496 Female Students in 4-Year Postsecondary Institutions**

| Predictor | β | SE β | Wald's $X^2$ | df | p | $e^{\beta}$(odd ratio) |
|---|---|---|---|---|---|---|
| Constant | -6.210*** | 1.050 | 34.959 | 1 | .000 | .002 |
| Hours of using video and computer for leisure activities during weekend | .097* | .055 | 3.154 | 1 | .076 | 1.102 |
| Frequency of using computer for own learning | .049 | .059 | .700 | 1 | .403 | 1.050 |
| Math self-efficacy | .338*** | .075 | 20.454 | 1 | .000 | 1.402 |
| Math Performance (Base Year Math IRT scores) | .024*** | .007 | 11.380 | 1 | .001 | 1.025 |
| Level of taking advanced math courses | .480** | .184 | 6.835 | 1 | .009 | 1.616 |
| SES | .092 | .114 | .648 | 1 | .421 | 1.096 |
| Test | | | $X^2$ | *df* | *P* | |
| Goodness-of-fit test | | | | | | |
| Hosmer & Lemeshow | | | 7.472 | 8 | .487 | |

*Note*. *** p<.001; ** p<.05; *p<.1

As shown in **Table 6**, there were no significant effects of technology-based activities on female students' STEM major choices in two-year colleges. Moreover, unlike the four-year postsecondary institutions, only the level of advanced math courses showed significant effects on female students' STEM major choices in two-year colleges. The goodness-of fit test ($X^2$=3.439, *df*=8, *p*=.904) indicated that the model fit into the data well.

**Table 6: Logistic Regression of 927 Female Students in 2-Year Postsecondary Institutions**

| Predictor | β | SE β | Wald's $X^2$ | df | p | $e^{\beta}$(odd ratio) |
|---|---|---|---|---|---|---|
| Constant | -5.816*** | 1.258 | 21.381 | 1 | .000 | .003 |
| Hours of using video and computer for leisure activities during weekend | -.010 | .113 | .008 | 1 | .927 | .990 |
| Frequency of using computer for own learning | .063 | .129 | .241 | 1 | .623 | 1.065 |
| Math self-efficacy | .189 | .163 | 1.342 | 1 | .247 | 1.208 |
| Math Performance (Base Year Math IRT scores) | .009 | .015 | .398 | 1 | .528 | 1.009 |
| Level of taking advanced math courses | .532** | .224 | 5.646 | 1 | .017 | 1.703 |
| SES | .151 | .277 | .297 | 1 | .586 | 1.163 |
| Test | | | $X^2$ | *df* | *P* | |
| Goodness of Fit | | | | | | |
| Hosmer & Lemeshow | | | 3.439 | 8 | .904 | |

*Note*. *** p<.001; ** p<.05; *p<.1

**Research Question 3. To what extent do differences between male and female students exist in using technology for leisure activities and own learning?**

Using chi-square test, I compared the level of using technology (video games and computers) for leisure activities and own learning between male and female students in two-year and four-year colleges. As shown in **Table 7**, chi-square analyses revealed significant differences in using the technology-based activities between female and male students in two and four-year postsecondary institutions. Male students spent substantially more time playing video games and computers for leisure and for their own learning compared to female students. Such gender gap in playing video games and computer is consistent with the results of the previous studies (Cherney, 2008; Lucas & Sherry, 2004; Subrahmanyam et al., 2001; Terlecki & Newcombe, 2005). This result explains, at least partly, why female students might be less likely to choose STEM majors. The frequent use of computer and video games would help students work on STEM related tasks and understand the nature of STEM occupations. However, the result suggests that compared to male students, female students seem to have fewer opportunities to be exposed to such technologies. In fact, the annual Annenberg Public Policy Center survey on family media use indicated that 76% of households with at least one boy and only 58% of households with at least one girl own video games (Woodard & Gridina, 2000).

**Table 7: Chi-square Analyses in Using the Technology-based Activities of Female and Male Students by Type of Postsecondary Institutions**.

| | Type of Postsecondary Institutions | | | |
|---|---|---|---|---|
| | 4-Year Colleges | | 2-Year Colleges | |
| | Female | Male | Female | Male |
| Hours of playing video games and computer for leisure activities on weekends | | | | |
| 0 hour | 1,429 | 304 | 479 | 98 |
| 1 hour | 525 | 365 | 193 | 95 |
| 2 hours | 229 | 376 | 80 | 95 |
| 3 hours | 80 | 216 | 40 | 83 |
| 4 hours | 38 | 144 | 27 | 50 |
| 5 hours | 28 | 125 | 15 | 46 |
| 6 hours | 36 | 238 | 28 | 98 |
| Total | 2,365 | 1,768 | 862 | 565 |
| $X^2$(df) | 1,065.424 (6)*** | | 314.570(6)*** | |
| | Female | Male | Female | Male |
| How often use computers for own learning | | | | |
| Never | 192 | 138 | 118 | 71 |
| Rarely | 637 | 358 | 241 | 125 |
| Less than once a week | 540 | 303 | 160 | 92 |
| Once or Twice a week | 697 | 502 | 223 | 140 |
| Everyday or Almost Everyday | 310 | 469 | 133 | 137 |
| Total | 2,376 | 1,770 | 875 | 565 |
| $X^2$(df) | 132.112(4)*** | | 20.032(4)*** | |

*Note*. *** $p$<.0001

## DISCUSSION

Although this study has a limitation in that the dataset (ELS 2002) did not describe the detailed contents of computer and video games activities, the results of the study suggest several implications for practice. First, using technology inside and outside of the classroom can help motivate students to prepare for their career in STEM fields. As reviewed, the selected technology-based activities, that is, playing video games and using computers, are relevant to STEM tasks and play a vital role in enhancing students' visual-spatial skills required in STEM fields. Accordingly, students who tend to use technology are significantly more likely to select STEM college majors and pursue STEM careers because such technology-based activities help students to become familiar with practical STEM skills and understand the nature of STEM occupations. Second, integrating technology into traditional math classrooms can provide educational environments where students learn STEM contexts as well as math knowledge and skills. This is supported by the findings that math performance and taking advanced math courses, in conjunction with technology based activities, significantly affect students' STEM major choices. Third, the significantly lower tendency of female students to use technology is consistent with the findings of the previous studies (Cherney, 2008; Lucas & Sherry, 2004; Subrahmanyam et al., 2001; Terlecki & Newcombe, 2005). While the mechanism underlying the gender difference in the use of technology remains unclear, it is clear that female students are generally less likely to be exposed to technology. Therefore, educators and parents should encourage female students to access technology for their leisure activities and own learning. Regardless of STEM occupations, technology skills and knowledge is required to succeed in the 21st century global economy (Katehi, Pearson, & Feder, 2009). Thus, promoting technology-based activities in educational environments will be necessary for students to prepare for the 21st century job market.

## APPENDIX A

**STEM Categorization and Major Fields of Study in ELS 2002/06**

| STEM Categorization | ELS 2002 |
|---|---|
| Mathematics | Mathematics and Statistics |
| Agricultural/natural Sciences | Agriculture/natural resources/related<br>Science technologies/technicians |
| Physical sciences | Physical sciences |
| Biological sciences | Biological/biomedical sciences |
| Engineering/engineering technologies | Engineering technologies/technicians<br>Mechanical/repair technologies |
| Computer/information Sciences | Computer/information sciences/support technicians |

Note: STEM categorization is adopted from "Statistics in Brief (Chen & Weko, 2009)" published by the U.S. Department of Education

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