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Assistive Technology Implementation with Students with High-Incidence Disabilities: Current Status and Training Needs

Anna Evmenova

George Mason University

EDRS 810, Fall 2006

Dr. Dimiter Dimitrov

Submitted in partial fulfillment of the requirements for EDRS 811

Abstract

The study examines the current assistive technology (AT) implementation by teachers working with students with high-incidence disabilities. The purpose of the study was to provide the state-of-art information regarding teachers' knowledge, preparedness and technology use with students identified with learning disabilities and emotional disturbance. The findings from 123 surveys showed that gender and age were unrelated to teachers' perceptions of trainings, AT knowledge and implementation. It was found that the frequency of used devices was associated with the grade level and subject area. Moreover, it was predicted by the students' placement in general or special education settings. Finally, results yielded that teachers' satisfaction with received technology training predicted the level of their self-rated AT knowledge. Implications for teacher preparation programs and research are discussed.

Introduction

The fascinating world of assistive technologies (AT) grows rapidly. Each day new devices and programs, that help students with disabilities overcome many of their challenges, are developed. Assistive and instructional technology tools contribute to the academic improvement for students with high-incidence disabilities, specifically learning disabilities (LD) and emotional disturbance (ED). The effects of assistive technology for students with LD/ED were examined in all content areas including reading (Hall, et al., 2000; Wise, et al., 2000), writing (Higgins & Raskind, 2004, Lewis, et al., 1999, MacArthur, 1998, 1999; Williams, 2002), math (Bley & Thornton, 2001; Bryant, et al., 2000; Irish, 2002; Kelly, 2003) as well as science and social studies (Ferretti, et al., 2001; French, et al., 2003; Quintana, et al., 2004). While a majority of these studies demonstrates the positive impact of AT on improved performance by students with high-incidence disabilities, the research on the actual status of technology use to support students with LD and ED seems to be limited and inconclusive (Edyburn, 2000).

Technology Implementation Studies

The majority of existing research on AT implementation in the classroom settings is often focused on students with severe disabilities. McGregor and Pachuski (1996) investigated the teachers' readiness to implement AT with students, primarily, with physical, sensory, and cognitive disabilities. Abner (2002), Kaperman, Sticken and Heinze (2002) identified teachers' training needs as well as how students who are visually impaired use AT. The technology role in inclusion of students with severe multiple disabilities in regular education settings was also addressed in the research (Carey & Sale, 1994; Copley & Ziviani, 2004; Derer, et. al., 1996; Hutinger, et al. 1996). All of these studies highlighted the insufficient use of AT. While technology applications in public schools have been extensively investigated with students with

more severe disabilities, little is known on the actual use of technology to support students with learning disabilities and emotional disturbance (Blackhurst, 2005; Edyburn, 2003; McArthur, et. al., 2001).

Furthermore, despite the fact that AT has the potential to support the learning needs of all students with disabilities, it is still not widely implemented due to various encountered barriers, including teachers' inadequate training (Hasselbring & Glaser, 2000). Teachers may feel lost and resistant towards AT and its implementation with their students because these technologies are constantly changing and there are always new tools for them to consider and learn how to use (Blackhurst, 2005). Education institutions, at all levels, are trying to change the way teachers think and react to these rapid developments in technology. One way of doing this is by offering professional development opportunities that provide teachers the skills they need in order to develop the necessary technical skills (Zhao & Sziko, 2001). However, while research showed how trainings addressed teachers' needs and AT use with students with severe disabilities (e.g., Copley & Ziviani, 2004; Derer, et. al., 1996; Lesar, 1998), the relationship between training and AT knowledge in regard to teachers of students with high-incidence disabilities remains unknown.

Finally, no evidence has been found in the review of the literature that addresses if teachers' gender and age differences potentially influence their perception of training and use of assistive technology. Therefore, a decision was made to conduct a preliminary survey study to determine LD/ED students' technology use as well as factors that influence it. The purpose of this study is to examine the relationship between teachers' gender and age, preparedness, knowledge, and use of assistive technology devices with students with high-incidence disabilities.

Research Questions

For the purpose of this study the following research questions were addressed:

1. Are there gender differences in the teachers' evaluation of technology trainings as well as self-ratings of AT knowledge and do they depend on age?
2. Is there association between the frequency of technology used (3 levels) and:
    a. Gender (2 levels)
    b. Age (3 levels)
    c. Subject area (5 levels)
    d. Grade level (3 levels)
3. Do students' placement and grade level predict the number of assistive technology devices/programs used by students?
4. Is there a relationship between teachers' evaluation of technology trainings and self-rated AT knowledge? Does the technology training predict AT knowledge?

Method

Participants

The participants in this study were initially selected from former and current students in George Mason University's special education master's program and graduate certificate program for state licensure in the endorsement areas of learning disabilities and emotional disturbance. Those initially selected participants were encouraged to invite their peers to participate in the study. As a result, 79 percent of the participants were GMU graduates, while 21 percent of the participants attended other universities and colleges. Demographic data (participants' age, gender, teaching position, current classroom setting and geographical location) were also collected. As indicated in Table 1, the demographics were varied.

Instrument

The 20-item cross-sectional survey instrument used in this study was designed based on previous research (Carey & Sale, 1994; Copley & Ziviani, 2004; Derer, et. al., 1996; McGregor & Pachuski, 1996). It was adapted specifically for teachers working with students with high-incidence disabilities. The survey focused on 1) technology use in various grade levels and subject areas, 2) the extent to which technology training prepared teachers to use AT, and 3) self-reported knowledge in the area AT. The initial draft of the survey was reviewed by several AT experts and was revised based on their feedback. Cronback's alpha was used to estimate the reliability of data. As a result, the coefficient of internal consistency reliability was .89.

Part 1 of the survey consisted of questions that captured demographic data including, gender, age, grade, subject teaching, and other related information. These independent variables, for the preliminary analysis, were collected using categorical scales. Then, continuous Likert-type scale questions were used to identify if teachers felt prepared to integrate technology with their students with high-incidence disabilities after the training (e.g., 1= no needs met; 4= all needs met) as well as their knowledge of AT tools (1=nonexistent; 5=expert). In addition, the continuous data from open-ended questions on the frequency of technologies used was recoded into a categorical variable with low, medium, high frequencies of use for further analysis.

Data Collection Procedures

A cross-sectional online survey was used to determine current use of AT by students with learning disabilities and emotional disturbance. The survey was distributed to approximately 150 individuals including former and current students in GMU's special education master's and graduate certificate program in learning disabilities and emotional disturbance. They were contacted by email through the special education listserv supported by H. Kellar Institute for

Human disAbilities at GMU. The email message included the link to the online survey. Individuals were asked to participate in the study if they were teaching students with high-incidence disabilities, specifically students with either LD, ED, or both. In addition, they were asked to forward the survey link to other teachers working with students with high-incidence disabilities in their schools.

The first closed-ended question on the survey requested participants to give their consent to participate in the study. The participants would not be allowed to continue with the survey unless they agreed to participate. The initial contact of the participants took place in April 2006 through the listserv. Three weeks later, another email message was sent through the listserv that was identical to the initial message. The last request for participation occurred two weeks after the second email and five weeks since the initial request. Participants were contacted several times in an attempt to achieve a high response rate. Due to the fact that teachers were asked to further distribute the survey, it is hard to estimate the exact return rate. However, 123 surveys were returned yielding a possible 82% return rate.

The follow-up telephone interviews were conducted with 10% of the participants who provided their contact information to triangulate the findings from the surveys. Data from 123 surveys were entered into *SPSS*.

Data Analysis

To address research question 1, a two-way (gender x age) ANOVA was used, where gender had 2 levels and age had 3 levels. Effect sizes were determined using partial Eta square ($p\eta^2$).

To address research question 2, a chi-square test for association between the frequency of technology use (3 levels) and the following categorical variables: gender, age, subject area, and grade level was conducted using SPSS.

Research question 3 was addressed with Multiple Regression (MR) with one dependent variable, the number of assistive technology devices/programs, and two predictors: student placement and grade level. Student placement was represented by two categories: general education classroom and special education classroom. Special education classroom category included resource and self-contained settings.

To address research question 4, simple linear regression analysis was conducted using SPSS, with the self-rated knowledge of AT being the dependent variable and the teachers' evaluation of technology integration training, the independent (predictor) variable.

Finally, descriptive statistics analysis was conducted to examine additional useful information.

Results

Regarding the 1st research question, "Are there gender differences in the teachers' evaluation of technology trainings as well as self-ratings of AT knowledge and do they depend on age?", results in Table 3 indicate that there is no statistically significant main effect for Gender, $F(1;117) = 2.01$, $p = .159$, $p\eta^2 = .02$ as well as for Age, $F(2;117) = .72$, $p = .487$, $p\eta^2 = .01$ in teachers' evaluation of technology trainings. However, there is a statistically significant interaction between Gender and Age, $F(2;117) = 3.33$, $p = .039$, $p\eta^2 = .05$. As can be seen in Figure 1, the highest number of needs met through the training was reported by females in the first age group (20-25), whereas males 20-25 years of age indicated that the training met their needs the least.

Regarding the second part of research question 1, the results show no statistically significant difference for Gender, $F(1.117) = .05$, $p = .825$, $p\eta^2 = .00$ and for Age, $F(2;117) = 1.34$, $p = .266$, $p\eta^2 = .02$ in teachers' self-rating of AT knowledge (see Table 3). However, once again, there is a statistically significant interaction between Gender and Age, $F(2;117) = 5.12$, $p = .007$, $p\eta^2 = .08$. Figure 2 demonstrates that male ages 42-60 reported the highest, expert, knowledge of AT, whereas the lowest knowledge was reported by males ages 20-25.

As indicated in Tables 4, 5, 6, and 7, regarding research question 2, "Is there association between the frequency of technology used and gender, age, subject area, and grade level?", the Pearson chi-square test shows that there is no statistically significant association between gender and the frequency of technology use, $\chi^2(2) = 4.18$, $p = .124$. Also, there is no statistically significant association between age and the frequency of technology use, $\chi^2(4) = 5.09$, $p = .279$. However, the Pearson chi-square test shows that there is statistically significant dependence between subject area and the frequency of technology, $\chi^2(8) = 27.77$, $p = .001$. Also, there are two cells that contribute to the presence of association between subject area and the frequency of technology use: (a) Science/Social Studies and Low Frequency (SD = 2.2), (b) Science/Social Studies and High Frequency (SR = -2.6). However, the results should be interpreted with caution due to one case of expected frequency smaller than 5. Furthermore, the Pearson chi-square test shows that there is a statistically significant association between grade level and the frequency of technology use $\chi^2(4) = 25.38$, $p = .000$. There are also two standardized residuals greater than 2.0 in absolute value indicating that there are two cells that contribute to the presence of association between grade level and the frequency of technology use: (a) Elementary and Low Frequency (SR = -2.5), (b) Elementary and High Frequency (SR = 2.7).

Regarding research question 3, "Do students' placement and grade level predict the number of assistive technology devices/programs used by students?", the multiple regression prediction of the number of AT devices/program from students' placement and grade level is statistically significant, $F(2;116) = 17.78$, $p = .000$ (see Table 8). Multiple correlation, R = .484 is the Pearson correlation between actual and predicted Y values. The coefficient of multiple determination, $R^2 = .235$, indicates that 23.5% of difference in the number of AT devices/program used is explained by the difference in student placement and grade level. Multiple regression equation is $\hat{Y}(\#AT) = 4.094(PL) - 3.476\ (GR) + 9.143$. There is a statistically significant unique contribution of the grade level to the prediction of the number of AT devices/programs, "over and above" the contribution of students' placement, $p = .000$. The unique contribution of student placement to the prediction of the number of AT devices/program, "over and above" the contribution of the grade level, is also statistically significant, $p = .001$. In terms of relative importance, the order of predictors as follows: (1) students' grade level; (2) students' placement. Squared part correlations provide the magnitude of the unique contribution of each predictor. Thus, as can be concluded from the data in Table 8, $\approx$8.3% of total variance in the number of AT devices/programs is explained by the unique contribution of students' placement. In addition, $\approx$17.6% is explained by the unique contribution of the grade level.

There are no outliers on X, since the min and max on the Centered Leverage Value is less than the "cutting" value of .073. There are also no influential data points since the max value of the Cook's distance is smaller than 1. There is only 1 outlier on Y since the min and max values of the studentized deleted residual (3.164). However, since it is very close to 3.0 in absolute value, it was kept in the data set.

Regarding research question 4, "Is there a relationship between teachers' evaluation of technology trainings and self-rated AT knowledge? Does the technology training predict AT knowledge?", results indicate that there is a statistically significant linear relationship between teachers' self-rated AT knowledge and how technology integration training met their needs, $F(1;121) = .4.69$, $p = .032$. However, $R^2 = .037$ shows that only 3.7% of difference in teachers' self-rating of AT knowledge is explained by the difference in technology trainings meeting their needs. The regression equation is Teacher Knowledge = .204 x Training + 2.242.

In addition, descriptive statistical analysis revealed that the overall number of students with high-incidence disabilities served across 123 teachers was 2,867, including 2,179 students with LD and 688 with ED. Among all students, only 411 students (14.3%) used AT. Moreover, only 314 students (10.9%) had it documented on their Individualized Educational Plans (IEPs). A majority of the teachers (80.5%) reported having some training in AT and technology integration.

Discussion

Based on the sample of 123 teachers of students with high-incidence disabilities, gender and age are found to be unrelated to their perceptions of technology training and self-rated AT knowledge. While some research studies show that male users demonstrate better attitudes towards technology, specifically computer-based (Whitley, 1997), the evidence also exists that the differences are removed when computing experience is controlled (Dyck & Smither, 1994; Van Braak, 2001). Nevertheless, there is a statistically significant main effect for interaction for gender and age. Female teachers, ages 20-25 felt that technology training met their needs the most, whereas male teachers, ages 20-25, felt that technology training met their needs the least. In regard to knowledge self-ratings, older male teachers (42-60) rated their self-knowledge of AT

higher than the youngest group (20-25). However, these results should be interpreted with great caution because of two reasons. First, while the small number of male teachers represents the existing population's proportions in teaching profession, it may alter the results. Second of all, teachers were self-reporting their perceptions and knowledge, so it may not fully represent the actual level of knowledge.

Furthermore, there are no gender and age differences in the use of assistive technology for students with LD and ED. The results that there is no gender difference confirm the results of several researchers working with regular education technology (Jennings & Onwuegbuzie, 2001). In turn, the findings about the insignificance of age differences are quite surprising.

There is a statistically significant difference in AT use by grade level and subject area. Further descriptive statistical analysis allows reporting that students with high-incidence disabilities used AT more in language arts and elementary grades. This finding can be explained by the notion that widely used technology, like *Microsoft Word* with a spell checker, can be considered "assistive" for students with LD and ED (Sitko, Laine, & Sitko, 2005). Such technology is accessible and available for teachers to use, while more content specific AT programs are less common and have to be carefully selected and obtained. In turn, it seems that a majority of the used AT devices and programs is designed for younger students and may not be age appropriate for higher grades. According to the results of this study, for each grade level increase the number of AT devices/program decreases by 3.5 if everything stays constant. However, there is no evidence that that number of available technologies decreases in the higher grade levels. Further research in this area is necessary to support such conclusion.

AT use can be predicted from the students' placement, demonstrating higher use in special education settings. It can be concluded that the special education placement group uses

more AT devices/programs by 4.1 if everything else stays the same. One possible explanation comes from the individual nature of AT tools. The use of technology, especially assistive technology, suggests more individualized instruction addressing each student's specific needs (Zhao & Czisko, 2001). It may also be suggested from previous research (Bowser & Reed, 1995; Schlosser, et. al., 2000; Todis & Walker, 1993) that teachers report insufficient knowledge about how to integrate technology into general education curriculum. However, such conclusion should be made with caution because data was not collected and analyzed on the level of the current technology integration.

Finally, AT training and the extent to which it met teachers' needs predicted their self-rating of AT knowledge. Teachers who received the training that addressed their needs reported higher knowledge of AT than teachers who either did not receive any training or did not find it relevant to their needs. Thus, it is possible to suggest that training designed to meet teachers' specific needs enhances teachers' knowledge and confidence in AT, thus, empowering them to use technology more with their students.

Implications for Theory and Practice

Results of this study allow suggesting that assistive technology needs for students with high-incidence disabilities may not be fully addressed. Only 14.3 percent of students with LD and ED use AT and only 13.9 percent have it documented, despite of the mandate to consider AT in the development of the IEP for each child (Peterson-Karlan & Parette, 2005). More work has to be done to introduce teachers of students with high-incidence disabilities to the benefits of AT and prepare them to utilize existing technological options with this population. While 80.5% of participants received some training in technology integration, 47.9% of all teachers reported that training met no or few their needs. In addition 47.2% of LD/ED teachers self-reported their

knowledge of AT as nonexistent or novice. Such rate is higher than the one reported by teachers of students with more severe disabilities in previous research (Derer, Polsgrove, & Rieth, 1996; McGregor & Pachuski, 1996). Therefore, the field of AT should pay more attention to educating current and prospective teachers of students with high-incidence disabilities about AT options available for their students.

More training produces more knowledge and then more technology use. In addition, training doesn't have to be different for males and females of different age. Some studies indicate that due to the fact that older teachers belong to different generations, they are struggling to provide students with appropriate technologies (Peterson-Kaplan & Parette, 2005). Despite such conclusions, the results of this study demonstrate that regardless of the age or gender, teachers require more training opportunities that would address their specific needs.

In addition, while AT appears to be relatively developed for students with challenges in reading and writing, more programs are needed to support students with LD and ED in math, science and social studies as well as tools should be age appropriate.

Limitations

The results of this study should not be taken into consideration without the following limitations. This study collected data from teachers working in one state. Such overrepresentation on only one state makes it harder to generalize findings to the whole population. In addition, teachers working in rural areas were underrepresented in this study, biasing the results.

Furthermore, a majority of the participants received AT training from GMU. Thus, the results are biased to only those teachers who received technology training as part of their master's or licensure program. Moreover, both GMU graduates and students who attended

different universities and colleges reported having technology training of different nature. It included coursework, in-service training, on-site workshops, etc. Thus, the study should be replicated to weigh the impacts of different types of trainings on teachers' perceptions and use of technology rather than the overall effect.

An additional limitation comes from teachers self-evaluating and reporting of what they assumed was "expert knowledge" and "all needs met" after the training rather than what may be considered an exceptional knowledge and use of AT. Thus, this study could be replicated by involving teachers' observations as well as designing survey questions to constitute a dependent measure "AT knowledge."

Finally, when reporting AT use, teachers reported using both low and high technological solutions. Further differentiation between those may significantly alter the findings of this study.

Future Research

Future research is needed to determine the technology preparedness, knowledge, and AT use by teachers working with students with high-incidence disabilities across the nation. It is important to make sure to include in the future studies teachers with different educational and technology training backgrounds working in different population density areas. Future research could also incorporate more detailed analysis of the training type teachers prefer to better prepare them for technology integration of several low and high technologies specifically designed for students with LD and ED. Finally, it would be interesting to see whether the AT devices and programs used for this population in special and inclusive regular education settings is different as well as whether AT implementation impacts the general technology use with all the students.

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Table 1

Survey Participants Demographic Data (N = 123)

Variable	Frequency	Percent
Gender		
Male	21	17.1%
Female	102	82.9%
Age Group		
20 – 25	14	11.4%
26 – 41	45	36.6%
42 – 60	64	52%
Position		
General education teacher	8	6.5%
Special education teacher	110	89.4%
Other	5	4.1%
Classroom Setting		
General education classroom	48	39%
Special education resource class	13	10.6%
Special education self-contained	62	50.4%
Population Density		
Urban fringe	61	49.6%
City	31	25.2%
Town	24	19.5%
Rural	7	5.7%

Table 2

Summary of Two-Way (Gender x Age) ANOVA for Teachers' Perceptions of AT Training

Source	*df*	*F*	partial η^2	*p*
Gender (G)	1	2.01	.02	.159
Age (A)	2	.72	.01	.487
G x A	2	3.33*	.05	.039
Within-group error	117	(.72)		

*$p < .05$.

Table 3

Summary of Two-Way (Gender x Age) ANOVA for Teachers' Self-Rating of AT Knowledge

Source	*df*	*F*	partial η^2	*p*
Gender (G)	1	.05	.00	.825
Age (A)	2	1.34	.02	.266
G x A	2	5.12**	.08	.007
Within-group error	117	(.77)		

**$p < .01$.

Table 4

Chi-square Test for Association between Frequency of Technology Use and Teachers' Gender

	Frequency of Technology Use			
Teachers' Gender	Low	Medium	High	Total
Male	8	8	5	21
Std. Residual	.5	1.2	-1.3	_
Female	31	23	48	102
Std. Residual	-.2	-.5	.6	–
Total	39	31	53	123

Note: Pearson Chi-Square = 4.18, $df = 2$, $p = .124$

Table 5

Chi-square Test for Association between Frequency of Technology Use and Teachers' Age Group

	Frequency of Technology Use			
Teachers' Age Group	Low	Medium	High	Total
20-25	6	5	3	14
Std. Residual	.7	.8	-1.2	_
26-41	17	10	18	45
Std. Residual	.7	-.4	-.3	–
42-60	39	31	53	64
Std. Residual	-1.0	.0	.8	
Total	39	31	53	123

Note: Pearson Chi-Square = 5.09, $df = 4$, $p = .279$

Table 6

Chi-square Test for Association between Frequency of Technology Use and Subject Area

	Frequency of Technology Use			
Subject Area	Low	Medium	High	Total
Elementary, mixed	4	4	15	23
Std. Residual	-1.2	-.7	1.6	_
Language Arts	7	9	24	40
Std. Residual	-1.6	-.3	1.6	_
Math	10	7	4	21
Std. Residual	1.3	.7	-1.7	_
Science and Social Studies	12	7	1	20
Std. Residual	2.2	.9	-2.6	_
Other	6	4	9	19
Std. Residual	.0	-.4	.3	_
Total	39	31	53	123

Note: Pearson Chi-Square = 27.77, $df = 8$, $p = .001$

Table 7

Chi-square Test for Association between Frequency of Technology Use and Grade Level

	Frequency of Technology Use			
Grade Level	Low	Medium	High	Total
Elementary	5	9	33	47
Std. Residual	-2.5	-.8	2.7	_
Middle	14	12	8	34
Std. Residual	1.1	1.2	-1.8	–
High	18	9	11	38
Std. Residual	1.8	-.2	-1.4	
Total	37	30	52	119

Note: Pearson Chi-Square = 25.38, $df = 4$, $p = .000$

Table 8

Summary of Multiple Regression Analysis for Variables Predicting the Number of AT Used (N= 123)

Variable	B	SE B	ß	*p*	Part Correlations
(Constant)	9.14	2.21		.000	
Students'	4.09	1.16	.289**	.001	.288
Placement	-3.48	.674	-.421***	.000	-.419
Grade Level					

Note: R= .484; R^2= .235 (*p*=.000)

***p* < .01. ****p* < .001

Figure 1. Interaction effect between teachers' gender and age on their perception of technology trainings

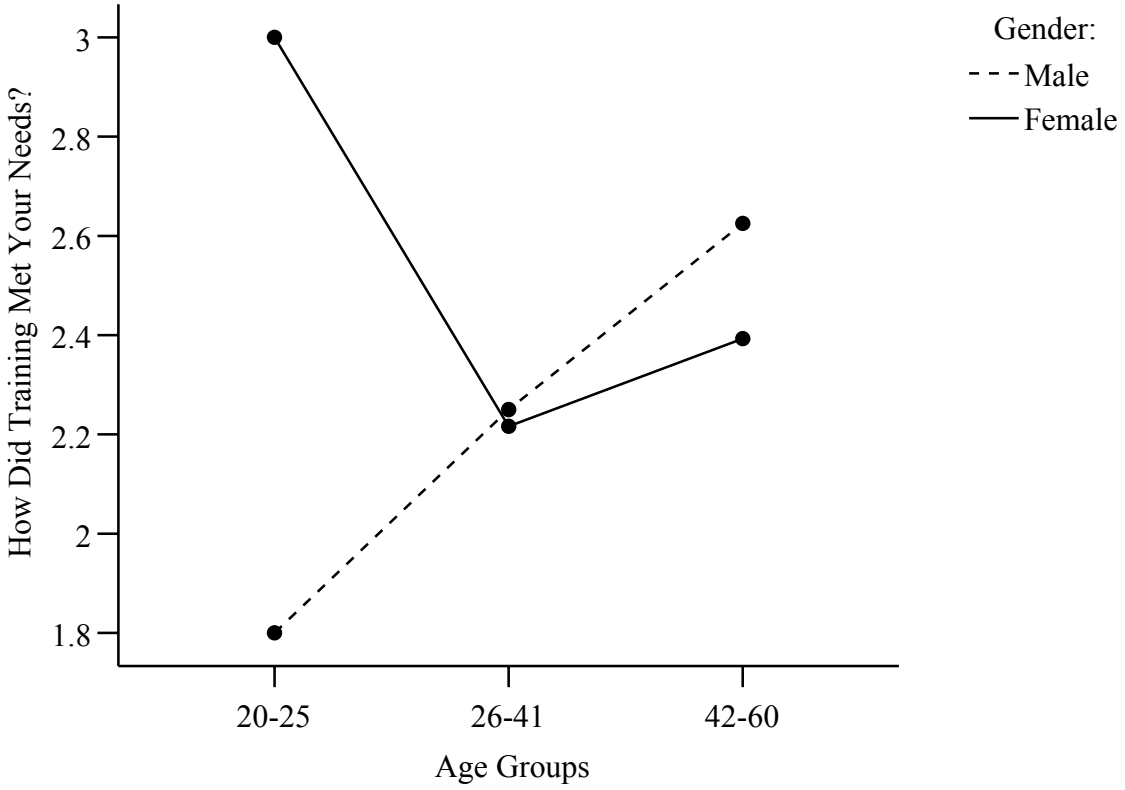

Figure 2. Interaction effect between teachers' gender and age on their self-rating of AT knowledge