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DEVELOPMENT ARTICLE

Towards technology integration: the impact of motivational and volitional email messages

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Abstract The purpose of this study was to determine the effects of motivational and volitional email messages (MVEM) on preservice teachers' motivation, volition, performance, and their attitudes toward technology integration. Each of four sections in an educational technology course for preservice teachers was randomly assigned to one of two groups: one group which received MVEM constructed based on audience analysis; and the other which received placebo email messages consisting of class activities reminders without audience analysis. Results indicated that the group provided with MVEM showed higher volition and more positive attitudes toward technology integration than the group provided with placebo messages even though there was no difference in motivation or performance. These results suggest that MVEM can serve as an effective tool for facilitating preservice teachers' positive attitudes toward technology integration. Implications for the design and development of interventions or systems for technology integration are discussed and further research is recommended.

Keywords Attitude change · Technology integration · Teacher education · Motivational strategies · Volitional strategies

Technology integration refers to teachers' promotion of the use of technology by students to solve problems (Ertmer 2005; Jonassen et al. 2003). Technology integration requires thoughtful design on the part of teachers. For example, technology integration can involve students' use of PDAs to record and analyze water quality data in a stream to determine

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ways to promote improved conditions for native trout. Designing such an activity requires more effort on the part of teachers than simply recording grades in Microsoft Excel.

Though millions of dollars have been spent acquiring tools and providing training to enable the integration of technology into K-12 education, technology integration has been minimal (Barron et al. 2003; Bauer and Kenton 2005; Belland 2009; Ertmer 2005; Hernandez-Ramos 2005; Hew and Brush 2007). It has been posited that two sets of barriers affect technology integration: factors *internal* to individual teachers such as beliefs about the value of technology and factors *external* to individual teachers such as access to technology and incentives (Ertmer 1999, 2005; Hew and Brush). Once the barriers can be removed, so the reasoning goes, technology integration will happen (Ertmer 1999; Hew and Brush).

The fundamental premise behind the theory of barriers to technology integration is that of planned behavior. However, the theory of planned behavior may not completely explain why technology integration has been minimal. According to the theory of planned behavior, individuals' salient beliefs about a type of action inform their attitudes about the action (Belland 2009; Fishbein and Ajzen 1975). Their attitudes then inform their intention to perform and subsequently their actual performance of the action (Fishbein and Ajzen). However, the theory of planned behavior may not be the best way to explain and predict technology integration because even when teachers profess beliefs in the value of technology integration and have sufficient access to and skill in using technology they may still not integrate technology (Belland 2009; Chen 2008; Windschitl 2002).

Role of motivation and volition

It may be tempting to attribute the lack of technology integration to lack of beliefs in the value of and skills in using technology. However, deficits in technology integration are also likely due to motivational and volitional problems (Pintrich et al. 1993; Venkatesh et al. 2002). Motivation towards a task refers to one's willingness to exert and sustain effort at the task (Stipek 2002). Volition towards a task refers to one's ability to take actions on his intention for the task and ignore competing desires to sustain efforts at the task (Eccles and Wigfield 2002). In other words, individuals with high motivation towards a task may have the goal to complete the task, but it is their volition towards the task that will help them do what they need to do to reach the goal (Corno 1993; Locke and Latham 2004). Volition towards an activity can also act independently of motivation by interacting with attitudes to produce non-conscious behavior, or behavior that was not planned and implemented consciously (Locke and Latham). This is important especially in that much technology integration is the result of non-conscious behavior (Belland 2009).

Role of motivation and volition in technology integration

Proper attitudes towards instructional technology among teachers are necessary to produce non-conscious technology integration. However, attitudes are highly resistant to change (Dole and Sinatra 1998). However, this does not mean that technology integration is impossible. New information (e.g., regarding the benefits of using computers in the classroom) can lead to attitude change among individuals with the proper motivation and volition (Dole and Sinatra). Furthermore, deliberate action not in accordance with attitudes does occur, but only among individuals with the proper motivation and volition toward a given task (Fazio and Dunton 1997). For example, individuals with negative attitudes

towards blood donation may donate blood if motivated to do so by a family member who survived an accident due to blood transfusions. Many authors have found that a critical factor impacting whether or not individuals actually perform an action is the level of intrinsic motivation they have for the task—or the extent to which performing the task itself provides satisfaction (Chatzisarantis et al. 2006; Pintrich et al. 1993; Venkatesh et al. 2002). Intrinsic motivation for using forms of technology has been found to predict individuals' intentions to use the technology (Venkatesh et al. 2002).

Having high intrinsic motivation to integrate technology may encourage teachers to decide to integrate technology, but to do so teachers also need volition (Eccles and Wigfield 2002). As can be seen in Fig. 1, according to our model, access to resources and sufficient technology skill combines with positive attitudes to lead to intrinsic motivation. Intrinsic motivation to integrate technology then must combine with volition to lead to technology integration.

The design of motivational and volitional support

Providing motivational and volitional support for teachers may be one way to increase teachers' inclination to integrate technology (Glazer et al. 2005; Kitsantas and Baylor 2001; Wang and Ertmer 2004). Motivation and volition can be changed through instructional messages (Jarvenoja and Jarvela 2005; Visser et al. 2002). Instructional messages have been found to improve the motivational states of university students (Visser et al. 2002). Instructional messages and contexts were found to account for one-third of the volitional states of high school students engaged in computer-supported learning activities (Jarvenoja and Jarvela). In many states technology integration courses are required in preservice education but teachers are rarely required to complete technology integration courses for recertification purposes. Therefore, a logical place to start to build teachers' intrinsic motivation and volition for integrating technology is preservice teacher education (Doering et al. 2003; Thompson et al. 2003).

Providing motivational and volitional support to preservice teachers in face-to-face class settings may not be practical due to time constraints. Furthermore, many preservice teacher education courses are now delivered online (Collopy and Arnold 2009). As indicated by the National Center for Educational Statistics (2009), 66% of postsecondary institutions offer at least some courses online. The use of email may be a practical way to provide motivational support to college students (Visser et al. 2002). In fact, preservice teachers might view email messages as a type of personal attention (Woods 2002). It has become a familiar technology as email has been implemented in numerous contexts that require interactions between instructors and learners or among learners (e.g., Boxie 2004; Burgstahler and Cronheim 2001; Cascio and Gasker 2001; Dunlap et al. 2000; van der Meij and Boersma 2002).

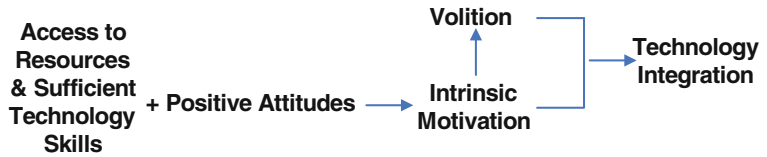

Fig. 1 Model for the prediction of technology integration

While motivational email messages have not been used extensively to promote technology integration, they have been used to help individuals perform other difficult tasks. People have difficulty maintaining weight loss and stopping smoking even when they have the required skills, beliefs, and access to required resources. However, motivational and volitional supports have produced outcomes such as greater smoking cessation (Lenert et al. 2004) and maintenance of weight loss (Svetkey et al. 2008) than control conditions.

To be effective, the design of motivational and volitional supports must be grounded in theory (Hannafin et al. 1997). A prominent model for the design of motivational and volitional messages is Keller's integrative theory of motivation, volition, and performance (MVP) intended to provide designers with a framework to "create effective learning environments that meet the needs of the intended audiences" (Keller 2008, p. 80). This theory integrates two theories of volition—Gollwitzer's concept of implementation intentions (Gollwitzer 1990; Gollwitzer et al. 1990) and Kuhl's concept of action control (Kuhl 1987)—into Keller's established ARCS model of motivational design (Keller 1987b). Furthermore, the MVP theory provides guidance on how to conduct an audience analysis of students' motivational and volitional needs. In the following paragraphs, the application of each component of the MVP theory to the design of messages is explained.

Motivational and volitional audience analysis

Visser and Keller (1990) introduced an audience analysis process by which motivational challenges can be assessed. Although their study was conducted in a face-to-face classroom without the explicit use of the term *volition*, their individual audience analysis process could be applied for the construction of motivational and volitional email messages (MVEM). In fact, MVEM that were constructed on the basis of motivational and volitional audience analyses and individually distributed based on specific individual problems have been found to lead to greater motivation than generic MVEM (Kim and Keller 2008).

ARCS

The ARCS model consists of a set of categories (*A*ttention, *R*elevance, *C*onfidence, and *S*atisfaction) of motivational concepts and strategies that were derived from a synthesis of the research on human motivation (Keller 2008). The model provides guidance for motivational needs assessment and incorporation of motivational supports into instructional messages. First, *attention* supports stimulate a sense of inquiry by calling attention to pertinent information. *Relevance* supports relate the content of instructional messages to preservice teachers' own lives. *Confidence* supports indicate to preservice teachers that the learning task is not too complex or difficult, and will seem less difficult and complex as they learn more about it. *Satisfaction* supports give examples of positive consequences of successfully completing the learning task. For example, suppose that in Week 1 of a technology integration class, Jennifer does not see the relevance of technology integration nor is confident in her ability to integrate technology. MVEM containing relevance and confidence supports would be created. Suppose that in Week 3 Jennifer sees the relevance of technology integration but is still not confident and does not see the potentially positive things that technology integration could bring her students. Then the Week 3 MVEM would contain confidence and satisfaction supports.

Implementation intentions

Gollwitzer's (1990) concept of implementation intentions allows support for the process of transforming desire to action. MVEM can include strategies that help preservice teachers take action on their goals. By explaining the needs to set a goal, to plan for the goal, and to make a commitment to the goal, MVEM can facilitate preservice teachers' active commitment to accomplish their goals in the course and for their teaching career. For example, suppose that in Week 2 of a technology integration course, Jennifer does not have the goal of integrating technology. MVEM focusing on goals would thus be created. If in Week 3 she has the proper goals but not the intention to integrate technology, MVEM would prompt Jennifer to form the appropriate intentions.

Action control

Kuhl's (1987) action control theory was developed to help people overcome maladaptive behaviors. The six strategies of Kuhl's (1987) action control theory can be implemented to construct MVEM that could help preservice teachers sustain, pursue, and accelerate their current intention and commitment in the course and teaching careers: (1) *selective attention strategy* was used to encourage preservice teachers to pay attention only to the information related to actions for their goals; (2) *encoding control strategy* was used to facilitate accepting their current task as a requirement to achieve their goals; (3) *emotion control strategy* was used to prevent any negative feelings from interfering with actions for their goals; (4) *motivation control strategy* was covered in the "ARCS" section; (5) *environment control strategy* was to protect them from distractions or social commitments by advising them to let people know their goals and plans; and (6) *parsimonious information processing strategy* was used to help them make decisions on how to distribute time and effort effectively and efficiently. Let us suppose that in Week 2 Jennifer has difficulty paying attention to only relevant stimuli. MVEM would thus be focused on selective attention. If in Week 3 she can focus her attention but has trouble controlling her emotions, then MVEM would focus on emotion control.

Although recent research indicates that there can be a positive effect of motivational and volitional support strategies on students' learning motivation and achievement (Kim and Keller 2008), there has not been systematic investigation of effective yet efficient ways of doing this to positively affect preservice teachers' attitudes toward technology integration. For example, although Kim and Keller (2008) found that MVEM had positive effects on undergraduates' motivation for and achievement in an archeology course, they did not investigate the participants' attitudes toward archeology; that is, the subject matter itself. Accordingly, this study used MVEM based on Keller's (2008) MVP theory in order to facilitate preservice teachers' positive attitudes toward technology integration. Furthermore, this study tested the effectiveness of MVEM on attitude change, which has not previously been studied. There is still only limited knowledge of how to integrate motivational and volitional messages effectively (Keller et al. 2005). In addition, MVEM have not been empirically studied in the context of technology integration. Therefore, it was of interest to investigate whether or not MVEM could be effective in forming preservice teachers' positive attitudes toward technology integration.

Hypotheses

The hypotheses are that preservice teachers receiving MVEM will exhibit (a) higher motivation scores; (b) greater volition scores; (c) attitudes more conducive to technology integration; and (d) better performance on computer skills and essay tests on knowledge of how to integrate technology, at the conclusion of this research than those receiving placebo email messages. Prior research indicates that MVEM positively impact motivation and achievement (Kim and Keller 2008). Ultimately, we are interested in investigating how to impact non-conscious behavior, as much technology integration behavior may be non-conscious (Belland 2009). Locke and Latham (2004) noted that volition combined with attitudes may predict non-conscious behavior. Furthermore, notwithstanding the difficulty of attitude change, attitudes can change among individuals with the proper motivation and volition (Dole and Sinatra 1998).

Method

Setting

Participants

The participants were 56 preservice teachers. The majority were female, with only six male participants. Most were freshmen and sophomores and the course was required for all of them. They voluntarily participated in this study and did not receive extra credit for their participation. The total number of preservice teachers enrolled in the four sections was 89 (17–21 per section) and initially 65 preservice teachers agreed to participate in the study but nine were excluded from the data analysis due to missing data.

Course

Participants were enrolled in four sections of an "Introduction to Educational Technology" course required for all teacher education majors (e.g., Mathematics Education, Elementary Education) at a southeastern public university. The course was designed to help preservice teachers gain (a) technical skill in using computer applications and systems and (b) the ability to integrate technology into teaching.

Instructors

The four sections were taught by two instructors (each instructor taught two sections) using the same course materials and procedures from the same syllabus that the instructors finalized together before the semester started. Both had taught the course for 2 years. Each section met at a different time. The instructors were informed of the content of the emails; however, they did not know which section was included in the experimental group or in the control group.

Independent variables

The independent variable was the type of email messages sent to the participants. There were two levels—MVEM and placebo messages, as detailed in the next sections.

MVEM

Motivational and volitional email messages are defined as email messages designed to increase the motivation and volition of the recipients (see Table 1 for sample MVEM). Individualized MVEM were constructed for each participant in the experimental group on the basis of audience analyses. The MVP theory (Keller 2008)—a fusion of the ARCS motivational design model, Kuhl's (1987) theory of action control, and Gollwitzer's (1990) theory of implementation intentions—guided the design of MVEM. Support embedded in MVEMs was tailored to participants' specific motivational and/or volitional challenges related to their:

- Motivation (Keller 2008):
  - attention
  - perception of the relevance of course content
  - confidence in performing tasks
  - satisfaction from performing successfully tasks
- Implementation intentions (Gollwitzer 1990):
  - formation of goals and intentions
  - translation of goals and intentions to action
  - self-reflection on the process of translating goals and intentions to action
- Action control (Kuhl 1987):
  - selective attention
  - encoding control
  - emotion control
  - environment control
  - parsimonious information processing

The audience analyses were conducted using data collected with surveys examining participants' motivation and volition (see "Dependent measures" section). Each week, in this manner, motivational and volitional profiles for each participant were generated indicating each participant's specific motivational and volitional challenges. As MVEM targeted individuals' specific motivational and volitional problems, only necessary motivational or volitional strategies were selected and sent to them. For instance, when an individual audience analysis on participant A indicated that she gained satisfaction from the creation of technology-enhanced lessons, MVEM did not contain messages corresponding to the satisfaction component of the ARCS model. But if participant A exhibited difficulty committing to a goal, then participant A's individualized MVEM would target the preactional phase of implementation intentions (Gollwitzer 1990).

Placebo email messages

The other level of the independent variable was placebo email messages that contained general information regarding the course without motivational and volitional strategies. Placebo email messages were reminders of the class activities and tests. One example message is as follows: "Joe, we're emailing to remind you that you will learn about HyperStudio on March 29th and innovative technologies on April 5th. Essay Test #4 regarding Chapter 7 and 8 will be on April 12th. Good luck on your study!"

Table 1 Examples of MVEM grounded in the model and concepts of motivation and volition

Keller's (2008) theory of MVP		Example messages corresponding to each model and concept
ARCS model (Keller 1987b)	Attention	Jenna, we have done with analyzing your responses to the questionnaire. You seem not to think technology integration has any advantage for you because you feel uncomfortable with incorporating technology into lesson planning, which takes lots of time and effort. But, don't worry. Discomfort happens to everybody. Those burdens will be gone soon as shown in this graph (Present a graph showing a rapid decrease of time to spend for lesson planning incorporating technologies)
	Relevance	In the questionnaire, you said that you did not see so much connection of this technology integration class with your personal thought about teaching, which was not common. However, how about online discussion as one way of technology integration? If you believe that discussion in class is a critical activity for students' learning, you may want to consider online discussion as good as classroom discussion or even better, or that you could use as extended classroom discussion? It is true that online discussion works well for students' learning since they have sufficient time to think about classmates' thoughts and reflect on their own
	Confidence	You may think it is too difficult to integrate technology into teaching. But, what do you think about this: Just having students use Inspiration to sequentially list things to do for their projects and logically set timelines. Is this as complex as you thought technology integration was? As you learn more about tools and technology integration in this class, you'll say, "I WANT TO! I CAN! I WILL!"
	Satisfaction	Do you want to get satisfied with this technology integration class? We suspect you do because your responses to the questionnaire indicated that you had a high level of motivation for the course. You might want to see what is good about technology for students' learning. Once in a class I used a short video clip on the Apple Education website, which showed a group of kids figuring out how to calculate the number of chairs in the auditorium of their school. After the video clip, the kids in the class started getting enthusiastic about addition and multiplication. You will be satisfied with learning about technology integration because you will be able to expect positive things that your teaching with technology will bring to your students

Table 1 continued

Keller's (2008) theory of MVP		Example messages corresponding to each model and concept
	Pre-actional phase • *Commitment to goal* • *Formation of intention commitment* • *Intentions for action: Planning for action*	You've learned a variety of computer programs such as MS Word, Excel, PowerPoint, Inspiration, etc. As you no doubt know, no matter how strong your desires to succeed are, or how well you have translated intentions into plans, you must constantly strive to implement your desires for actions to succeed at the levels of which you are capable. This is the hard part, but believe it or not, it gets easier as you practice Sometimes people discount the importance of intentions. They say things like, "the pathway to Hades is paved with good intentions." In spite of this, having the appropriate kinds of intentions is critical to success. Notice I said "appropriate" intentions. You develop appropriate and productive intentions in regard to lesson planning with technology Let's pick PowerPoint and imagine that you are about to teach with it in your class. What subject matter would you choose as the best fit for you to teach your students? Your preference for that subject matter could change as you have more instructional planning and teaching experiences; however, at the moment, imagine that you're supposed to teach that subject matter with PowerPoint. How would you use it? You should not want to use it for just explaining what you're supposed to teach. How, then, would you use it for your students? Think about one instructional example of yours for a moment…
Implementation Intentions (Gollwitzer 1990; Gollwitzer et al. 1990)	Actional phase • *Initiation of action* • *Goal-oriented action*	Now, it's time to make a real plan for how to teach with technology! Remember, your commitment is key. Without a teaching plan, you would not be sure how well you will teach the subject matter that you chose with PowerPoint. I can give you some tips on how you can work on your teaching plan effectively and efficiently. I hope you take actions, and we can talk about your satisfying experiences next time. Here are tips (Show MVEM in Action Control cells below)
	Post-actional phase • *Realization termination of action* • *Assessment, evaluation (self-reflection)*	With your own teaching plan, you might be sure how well you will teach the subject matter that you chose with PowerPoint. You can imagine your students' reaction to your teaching. Or, you can actually use the plan in your teaching practicum. You can also check with your peers. In order to effectively and efficiently take actions on your goal for teaching planning with technology, you need to check how well you've been doing. Constantly ask yourself and your peers and renew your plans and actions based on your and their reflections. Throughout these processes, you will be more confident in teaching with technology. You will experience its benefits that we already talked about. I'm sure that you're saying "I want to, I can, and I will!"

Table 1 continued

Keller's (2008) theory of MVP		Example messages corresponding to each model and concept
Action control (Kuhl 1987)	Selective attention	There is so much information about the use of PowerPoint for teaching. You would see hundreds websites if you search it in Google. However, you can't look at all the information. Remind yourself of your goal—what you really want to teach. Then, you can pay attention only to relevant information
	Encoding control	Once again, remember that you need to have a teaching plan before you teach!
	Emotion control	You might think, "why should I work on this?" "Why should I use technology for teaching?" etc. However, don't allow negative feelings to interfere with your work. You're leaning technology for teaching because students need that. You will soon find out why so many teachers want to learn to better use technology for their students
	Motivation control	(Already covered in MVEM as shown in the ARCS Model cells above)
	Environment control	Discussing teaching plans with a small group can also be helpful. In addition to the advantage of sharing information, you tend to work as scheduled because you don't want to break promises with your group members
	Parsimonious information processing	Nobody can make a good teaching plan in minutes. Even much-experienced teachers prepare their teaching with effort. Binge-planning would not make you feel confident about your teaching plan

In order to minimize the possibility of social interactions with regard to this study (e.g., talking about MVEM) between participants who were in different groups, the group assignment was done by sections, not by participants. One section taught by each instructor was randomly assigned to the treatment, and one to the control condition; thus, two sections received MVEM and the other two sections received placebo email messages.

Dependent measures

Pre- and post-survey

Participants' motivation to integrate technology was measured using pre- and post-tests of Keller and Subhiyah's (1993) Course Interest Survey (CIS). The CIS instrument was developed in correspondence with a theoretical foundation represented by the ARCS Model (Keller 1987a, b) and designed to measure learners' reactions to classroom instruction. CIS contains 16 Likert-type items (all items were used in both the pre- and post-tests in this study), such as "I do not see how the content of this course relates to anything I already know," "To accomplish my goals, it is important that I do well in this course," "I expect to feel satisfied with what I will get from this course," with 4 items related to each of the following: attention, relevance, confidence or satisfaction (Keller 2005). Previous work showed the Cronbach α reliability coefficient to be .95 (Keller 2005). In this study, the Cronbach α was .81.

Participants' volition was measured using pre- and post-tests of Mccann and Turner's Academic Volitional Strategy Inventory (AVSI). The AVSI instrument was developed by Mccann and Turner (2004) to measure the levels of learners' volitional strategies. The instrument includes 20 Likert-type items (all items were used in both the pre- and post-tests in this study), such as "I think about the goals I have set for myself and how and what I do now may affect my future," "I tell myself, 'get to it and concentrate, this is an important assignment, exam, paper,'" and "I think about my strengths and the resources I can draw on to help me with difficult assignments," asking respondents to assess their tendency to exert volitional control under different circumstances. Previous work showed the scale to have a Cronbach α reliability coefficient of .90 (McCann and Turner 2004). In this study, the Cronbach α was .81.

Participants' attitudes toward technology integration were measured using pre- and post-tests of Hall, George, and Rutherford's (1986) Stages of Concern Questionnaire (SoCQ). The SoCQ instrument requires respondents to report their degree of agreement with a variety of different statements regarding their concern about an innovation. The questionnaire has 35 items (all items were used in both the pre- and post-tests in this study) corresponding to one of the seven-stages of teacher concerns as described in Table 2. This instrument has been used in a variety of studies that assessed teachers' attitudes toward technology integration in order to investigate ways of providing supports for them (e.g., Bradshaw 1997; Hope 1998; Mills and Tincher 2003; Ward et al. 2002). Responses to the items are in the form of an eight-point Likert scale. Previous work showed the scale to have a Cronbach's α reliability coefficient of .76 (Hall et al. 1986). In this study, the Cronbach's α was .90.

Abbreviated survey

The abbreviated survey consisted of six questions measuring motivation (i.e., attention, relevance, confidence, and satisfaction) and six questions measuring volition (i.e.,

Table 2 Stages of concern (Hall et al. 1986)

Stage	Description	Example Question
0: Awareness	Having little knowledge or interest in technology integration	"I am completely occupied with other things than technology integration"
1: Informational	Willing to learn about technology integration	"I would like to know what resources are available if I decide to integrate technology into my future classroom"
2: Personal	Concerned about the impact of technology integration on themselves	"I would like to have more information on time and energy commitments required by educational use of technology for my teaching"
3: Management	Concerned about logistics, time, and management	"I am concerned about my inability to manage all that educational use of technology for teaching requires"
4: Consequence	Concerned about the effects of technology integration on students	"I am concerned about my future students' attitudes toward the technology that I'll use in my instruction"
5: Collaboration	Concerned about collaborative efforts to improve technology integration	"I would like to coordinate my efforts with others to maximize the effects of educational use of technology for my future students"
6: Refocusing	Exploring alternative ideas of technology integration	"I would like to modify my use of educational technology based on the experiences of my students"

formation of intention, planning for action, initiation of action, action control, and reflection). Example motivation questions included, "Do you find learning about technology integration to be relevant to your future?" and "Do you feel comfortable with incorporating technology into lesson planning?" An example volition question was, "During the last week of working for this course: Did you have a goal related to teaching with technology?" The abbreviated survey was designed to gather needed information for audience analysis during Weeks 2 and 3 while meeting the demands of the instructors, who did not want a long survey used in all weeks.

Performance measure

Performance was operationalized as the mean of participants' scores on a computer skill test and an essay test. The two kinds of tests were designed to address the major learning goals of the class—acquisition of technical skills and the knowledge of how to integrate technology. The rationale for the combination of these two tests as the performance measure is that one test alone would not measure participants' performance in this course where their acquisition of technology skills along with knowledge of how to integrate them to instruction is expected. The computer skill test assessed participants' skills in using computer tools (i.e., Microsoft Excel and Microsoft PowerPoint), while the essay test assessed participants' knowledge of how and why technology is integrated into the classroom. The Skills Assessment Manager (SAM) software (Cengage Learning 2010) was used to test participants' computer skills. SAM presents tasks for learners to complete within software programs such as PowerPoint and assesses learners' ability to complete the tasks effectively and quickly. In the essay test, participants responded to the prompt, "Based on the information from the textbook as well as your experience in this class and reflection, (1) Explain why computer technology is important for education

(1st paragraph); (2) Elaborate how computers are changing the way people teach and learn (2nd paragraph); and (3) Describe how we can apply the Internet to education (3rd paragraph)." It was assessed on the basis of evidence of reflection (40%), logic (20%), and mechanics (40%). The instructors were trained as a team to use the same technique and rubric to grade the essay test. The instructors graded students in their own class section. As such, calculating inter-rater reliability was not possible. But since each instructor taught one experimental and one control section, consistency in grading was maintained.

Procedures

See Fig. 2 for an illustration of the study procedures. As indicated in the Figure, full surveys were used in Weeks 1 and 4 for the purposes of measuring differences between the experimental and control groups but also to inform the creation of MVEM. Abbreviated surveys were used in Weeks 2 and 3 to inform the creation of MVEM. At the beginning of the first week of the study, each group spent approximately 20 min responding to the pre-survey, which measured participants' attitudes toward technology integration, motivation, and volition to integrate technology. Since the survey was conducted right before the instructor started the class of the day, participants' responses reflected their attitudes, motivation, and volition up to and not including that day's class.

During the week, the researchers analyzed the individual responses of participants in the first group and constructed MVEM for each of the participants based on individual audience analyses. Before the instructor started the class at the beginning of the second week, each group spent approximately 5 min responding to the abbreviated survey

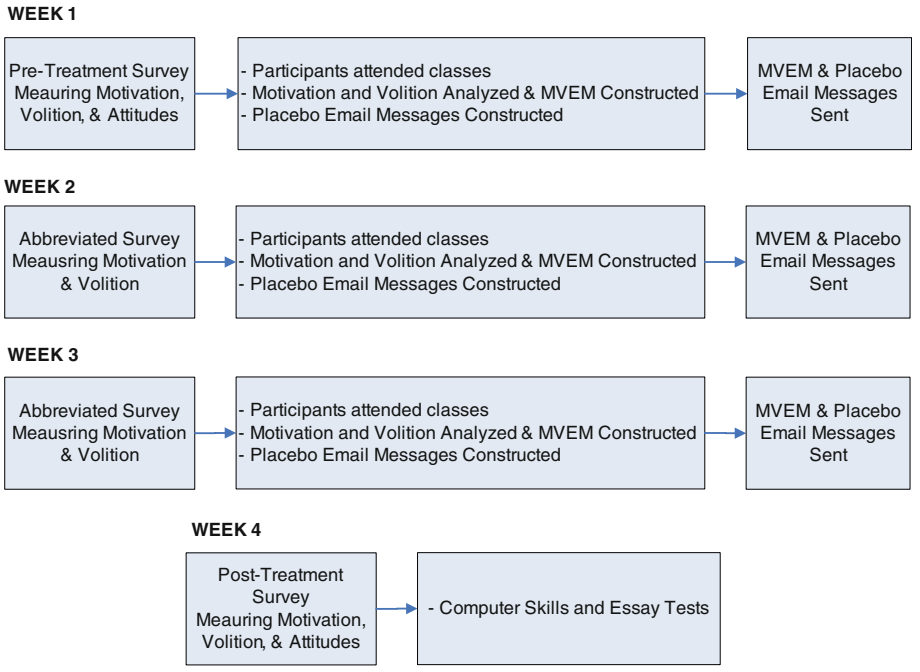

Fig. 2 Study procedures

regarding motivation and volition. After conducting an audience analysis, MVEM and placebo email messages were constructed and distributed to the first group and the second group, respectively, at the end of the week. The same procedure was followed in Week 3. In the fourth and last week of the study, each group responded to the post-survey in class for approximately 20 min, which consisted of the CIS measuring motivation, the AVSI measuring volition, and the SoCQ measuring attitudes toward technology integration.

Data analysis

The pre- and post-survey data were analyzed according to the four dependent measures: motivation as measured by the CIS, volition as measured by the AVSI, performance as indicated by the composite test score, and attitudes toward technology integration as assessed by the SoCQ. One way ANOVAs of the pre-survey scores were used to determine whether there were initial differences in any dependent measures between the two groups. Post-survey scores and test scores obtained after all messages were sent were used to investigate if there were differences between the two groups in each dependent measure through the use of a one-way ANOVA.

Results

With α set at .05, and with a sample size of 56, the power for detecting moderate effects was .83. A review of data for all four dependent measures indicated that there was no serious violation of the assumptions of normality. In the following subsections, comparisons of the groups on the pre-test results are presented. Then, descriptive data are presented for motivation, volition, attitudes, and performance. Finally, the results of hypothesis testing are described. Effect sizes were computed using the Cohen's d formula.

Analysis of pre-treatment differences

See Table 3 for the means and standard deviations of the pre-test scores by treatment condition. There was no initial difference between the control and experimental groups on motivation, F (1, 54) = .129, p = .721. There was no initial difference between the two groups on volition, F (1, 54) = 1.694, p = .199. Finally, there was no initial difference between the two groups in attitudes, F (1, 54) = 1.084, p = .303.

Descriptive data

The means and standard deviations for all dependent measures are presented in Table 4. On motivation, participants in the experimental condition scored 4.28, while participants in the control condition scored 4.17 (ES = .34). On volition, participants in the experimental condition scored 3.55, while participants in the control condition scored 3.22 (ES = .54). On attitudes, participants in the experimental condition scored 4.55, while participants in the control condition scored 3.92 (ES = .46). On performance, participants in the experimental condition scored 4.02 while participants in the control condition scored 4.26 (ES = −.73).

Table 3 Means and standard deviations on pre-survey

Groups	Dependent measures		
	Motivation CIS score[a]	Volition AVSI score[b]	Attitudes SoCQ score[c]
MVEM ($n = 31$)	4.09 (.44)[d]	3.38 (.47)	3.74 (1.29)
Placebo email messages ($n = 25$)	4.05 (.49)	3.21 (.54)	4.12 (1.42)

[a] Possible range for CIS score (1–5)

[b] Possible range for AVSI score (1–5)

[c] Possible range for SoCQ score (0–7)

[d] Numbers in parentheses are standard deviations

Table 4 Means and standard deviations on post-survey and performance test

Groups	Dependent measures			
	Motivation CIS score[a]	Volition AVSI score[b]	Attitudes SoCQ score[c]	Performance Test score[d]
MVEM ($n = 31$)	4.28 (.51)[e]	3.55 (.51)	4.55 (.93)	4.02 (.60)
Placebo email messages ($n = 25$)	4.17 (.32)	3.22 (.61)	3.92 (1.38)	4.26 (.33)

[a] Possible range for CIS score (1–5)

[b] Possible range for AVSI score (1–5)

[c] Possible range for SoCQ score (0–7)

[d] Possible range for Test score (0–5)

[e] Numbers in parentheses are standard deviations

Hypothesis testing

See Table 5 for a review of the hypotheses and an indication of which were supported.

MVEM did not have a significant effect on motivation, F (1, 54) = .814, $p = .371$, ES = .34. Levene's test revealed sufficient homogeneity of the post-test scores,

Table 5 Review of hypotheses

Hypothesis	Supported	Not supported
Preservice teachers receiving MVEM will exhibit higher motivation scores at the conclusion of this research than those receiving placebo email messages		X
Preservice teachers receiving MVEM exhibit greater volition scores at the conclusion of this research than those receiving placebo email messages	X[a]	
Preservice teachers receiving MVEM will exhibit attitudes more conducive to technology integration at the conclusion of this research than those receiving placebo email messages	X[a]	
Preservice teachers receiving MVEM will exhibit better performance on computer skills and essay tests on knowledge of how to integrate technology at the conclusion of this research than those receiving placebo email messages		X

[a] $p < .05$

F (1, 54) = 1.770, p = .189. However, MVEM had a significant effect on volition, F (1, 54) = 4.757, p = .034, ES = .54. Participants provided with MVEM (M = 3.55) scored significantly higher than those given placebo email messages (M = 3.22). The effect size (ES = .54) was considered to be medium according to Cohen's (1977, reprinted 1987) index. Levene's test revealed sufficient homogeneity of the post-test scores, F (1, 54) = .006, p = .937.

There was a significant effect of MVEM on attitudes toward technology integration, F (1, 54) = 4.126, p = .047, ES = .46. Participants provided with MVEM (M = 4.55) scored significantly higher than those given placebo email messages (M = 3.92). The effect size (ES = .46) was considered to be medium according to Cohen's (1977, reprinted 1987) index. Levene's test revealed sufficient homogeneity of the post-test scores, F (1, 54) = 1.596, p = .212. There was no significant effect of MVEM on performance, F (1, 54) = 3.174, p = .080, ES = −.73. Levene's test revealed there was no violation of homogeneity of the post-test scores, F (1, 54) = 3.739, p = .058.

Discussion

The purpose of this study was to examine how the type of email messages (MVEM vs. placebo messages) affected preservice teachers' motivation, volition, performance, and attitudes toward technology integration. First we summarize the important results, and then we discuss what this means for teacher education.

Summary of results

There were no significant differences between control and experimental groups on the dependent measures at the study beginning. However, preservice teachers who received MVEM exhibited significantly greater volition and attitudes towards technology integration than those who received placebo email messages. There were no significant differences between control and experimental students on motivation or on performance.

Interpretation

Our findings are notable for the following reason. First, we estimate that it would take an average college student 30 min to read the messages we sent to the preservice teachers in this study. If our estimation is correct, the total time preservice teachers actually were in contact with the instructional messages was very small, yet the messages produced statistically significant medium-sized effects on volition and attitudes. Our intervention was not intended to directly affect preservice teachers' knowledge and skills. Revisiting Fig. 1, preservice teachers in the experimental condition scored higher than preservice teachers in the control condition on two of four predictors of technology integration. As noted by Locke and Latham (2004), volition and attitudes may be more important predictors of behavior than motivation because volition combined with attitudes can regulate non-conscious behavior. Because many decisions that teachers make regarding technology integration and lesson planning are non-conscious, greater volition to integrate technology may mean greater technology integration in reality (Belland 2009; Locke and Latham 2004).

That we found a significant medium-sized effect on attitudes is also important in that teachers who have positive attitudes towards technology integration are more likely to

make non-conscious decisions to implement technology-enhanced lessons (Locke and Latham 2004). Some researchers have found attitudes to be the most important predictor of computer use in education (e.g., Sang et al. 2010; Vannatta and Fordham 2004). The treatment group's SoCQ score, 4.55, shows that their attitudes toward technology integration can be described with the characteristics of Stage 4 (consequence); that is, they are concerned with how technology integration affects their future students. Since these preservice teachers are concerned about the impact of technology integration on students, their attitudes are considered close to the ideal definition of technology integration, which means moving beyond superficial uses such as using Excel to keep track of grades and PowerPoint to give lectures. The control group's SoCQ score, 3.92, shows that they were in Stage 3 (management), meaning that they were concerned about how to use technology itself without thinking about how that technology integration is related to student learning.

Our finding of no significant effect of MVEM on motivation seems to be inconsistent with a prior study where MVEM individualized based on motivational and volitional audience analyses produced greater motivation than generic MVEM (Kim and Keller 2008). However, this result could be due to the fact that both groups already had a high level of motivation (MVEM = 4.09; Placebo = 4.05; see Table 3). The construction of MVEM based on audience analyses allowed preservice teachers to receive specific motivational supports that corresponded only to their motivational problems. Thus, because they generally did not have serious motivational problems, they did not need as many motivational strategies as was expected and MVEM consisted of a few motivational strategies. This could explain why there was no significant difference in motivation between the MVEM group and the placebo groups. Further research is needed to examine the impact of MVEM on preservice teachers' motivation in the context of technology integration.

Overall, the present study provides evidence to suggest that using MVEM can facilitate preservice teachers' positive attitudes toward technology integration and their volition to integrate technology. Promoting preservice teachers' motivation and volition through the provision of motivational and volitional strategies may increase their positive attitudes regarding technology integration.

Implications

This research has important implications for the promotion of technology integration and the understanding of how to affect motivation, volition, and attitudes. The prevalent view that a set of internal and external barriers prevent teachers from integrating technology (Ertmer 2005; Hew and Brush 2007) does not fully consider the role of motivation and volition in the technology integration process. However, research suggests that technology integration is not entirely a planned process (Belland 2009). Furthermore, teacher decisions to integrate technology may rely largely on non-conscious decisions that are mediated by volition and attitudes (Locke and Latham 2004). Our finding of a significant impact of MVEM on attitudes and volition to integrate technology represent a first step in a new approach to the promotion of technology integration.

An outside observer might note that MVEM seem promising but simply are not feasible due to the time it would take to create customized MVEM for each student. However, it would not necessarily require a great time commitment on the part of instructors. Audience analysis is something that all good instructors do anyway. Instructors do not need to use the same surveys that we used in this study to assess their students' motivational and volitional challenges. Rather, they can simply ask students to write down answers to two questions

two–three times per semester such as "When you think about your future classroom, how do you see yourself using technology for teaching?" and "What kind of challenges do you think you might have integrating technology?" They can then select premade MVEM that fit the students' specific motivational and volitional states. Third, sending email to students is not difficult or expensive.

An automated system could be developed that recognizes volitional and motivational patterns of students. So if Student A scores in the 90th percentile on motivation but in the 15th percentile on volition, then he/she could be classified as high-motivation/low-volition. A system could automatically send MVEM that is tailored to that student's specific motivational and volitional profile. In addition, though in this study MVEM were used in a face-to-face class, MVEM may also work well in online classes. Moreover, the findings might be improved if instructors rather than researchers send the messages. One challenge students in asynchronous courses often note is that of feeling disconnected (McInnerney and Roberts 2004; Park and Choi 2009). As they begin to feel disconnected, their motivation related to the course material drops (McInnerney and Roberts). However, if they receive MVEM from their instructors, this might lessen the possibility of feeling disconnected and may increase student motivation (Park and Choi 2009).

Limitations and suggestions for future research

Limitations include the use of abbreviated surveys in Weeks 2 and 3, limited data collection methods, random assignment of class sections rather than individual students, a small but insignificant difference between the treatment groups on the volition pre-test, and the duration of the study. We had to use abbreviated surveys in Weeks 2 and 3 for the instructors to allow us access to the class. Using the full pre-post-survey may have allowed us to produce a more accurate motivational and volitional audience analysis, which in turn could have helped us produce better customizing MVEM. This could have led to different results such as a significant effect on preservice teachers' motivation to integrate technology. Future research should attempt to use more complete and reliable surveys during all weeks. We randomly assigned class sections rather than individual participants so as to avoid possible communication among participants who received different messages. This may have posed a threat to validity; however, there was no difference between class sections on the pre-test. There was a small but insignificant difference between the control and experimental groups on the volition pretest. Due to the non-random selection of participants, we are unable to determine if this was due to a systematic difference or chance. The uncertainty as to the origin of the preexisiting difference in volition, although it is statistically insignificant, impacts the interpretation of differences on the post-volition measure.

Using the Stages of Concern model (Hall et al. 1986) in a more integrative manner might be necessary to document more clearly preservice teachers' attitudes toward technology integration. Also, when supports for preservice teachers' technology integration are planned, individual scores of SoCQ should be thoroughly examined rather than averaging the entire group's score to categorize them to one Stage of Concern.

Moreover, the use of qualitative data collection methods such as open-ended survey items, interviews and focus-group discussions would enrich the findings of future studies. Such an approach would allow preservice teachers to share reflections on the process, as well as allow researchers to gather other in-depth insights into the impacts of the treatment.

The performance score was a composite score from two distinct measures. The essay score involved rating preservice teachers' reflection on the content of the course. Reflection

is difficult to assess, so the results related to the performance scores should be interpreted with caution (Hatton and Smith 1995).

Future research should examine the impact of MVEM in a semester long implementation, since during an entire semester, students would spend much more time reading MVEM: 2.5 h, versus the 30 min in this study. Future research is needed to determine the most efficient ways to promote motivation, volition, and attitudes towards technology integration.

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