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Addressing preservice teachers' conceptions of motivation[1]

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Abstract

Preservice teachers' prior knowledge about teaching and learning may differ substantially from the theories and ideas presented in their education courses. In the present study, a refutational (conceptual change) text on motivation was used in an effort to address preservice teachers' conceptions of motivation. Results indicated that preservice teachers who read the refutational text performed significantly better on a posttest and demonstrated more of a change in their knowledge. Further results indicated that in the absence of this text, self-regulated learning strategies enabled preservice teachers to undergo a change in their knowledge from the pretest to the posttest.

1. Introduction and rationale

Preservice teachers bring a wealth of knowledge about teaching and learning to their education courses. The personal history-based beliefs that preservice teachers have serve as prior knowledge about what constitutes "good teaching", and serve as a basis for evaluating new theories and ideas (Holt-Reynolds, 1992). Preservice teachers' personal history-based beliefs serve as an invaluable framework into which new knowledge about teaching and learning can be integrated.

While these beliefs are often useful frameworks, research has begun to document that these beliefs may also be incompatible with the information presented in education courses. This incompatibility has been demonstrated in the areas of teaching and learning, classroom management, and motivation, for example. Research using student teachers has demonstrated that student teachers often think of teaching as telling and of learning as memorization (e.g., Wubbels, Korthagen & Broekman, 1991; Calderhead & Robson, 1991). Other research has demonstrated that student teachers tend to think of classroom management as controlling their students (Jones & Vesilind, 1995). A recent study demonstrated that undergraduate education majors tend to think of effective motivators as being extrinsic in nature, such as through prizes, stickers, candy or free time, rather than more intrinsic in nature such as through choice, autonomy, and challenge (Salisbury-Glennon, Stevens & Duffy, in progress).

There are a few reasons why preservice teachers' beliefs may be incompatible with the theories and

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ideas presented in their teacher education courses. One reason is that these beliefs are often grounded in the experiences that these preservice teachers had as students (Lortie, 1975). However, this knowledge may not necessarily be well adapted to teaching, since this knowledge was compiled primarily from the perspective of the student not the teacher.

A second reason why preservice teachers' own beliefs may be incompatible with the theories and ideas presented in teacher education courses is that they are based on general lay theories about teaching and learning, or in some cases, common conceptions about teaching and learning. Research on conceptions in other domains, such as science and science education, demonstrates that students who are new to a topic often hold beliefs and conceptual frameworks that are similar to earlier accepted theories in the field of study, rather than the currently accepted theories in the field.

Hence, preservice teachers' beliefs may be incompatible with the theories and ideas presented in teacher education courses either because these beliefs are based on their experiences as students or because they are based on lay theories or common conceptions that are more similar to earlier accepted theories in the field. What makes the field of education unique is that in education, both of the above reasons converge upon a common point; the historical shift in the theories of learning underlying instruction.

Preservice teachers' experiences as students are often grounded in theories of learning and instruction that had been previously dominant in the field of education, such as the behavioral theories of learning, for example. Similarly, preservice teachers may have general lay theories, or conceptions that are similar to earlier accepted theories in the field of education rather than the currently accepted theories. For both of these reasons, their current conceptions may appear both plausible and fruitful.

Hence, in the field of education, the learner may have beliefs that are incompatible with what is presented in teacher education courses, either due to personal history-based beliefs, or to lay theories that are similar to earlier accepted theories in the field. If these beliefs and conceptions are not addressed, preservice teachers may perpetuate these beliefs in their own classrooms. However, in typical education courses and texts, information is simply transmitted and does not take into consideration the personal history-based beliefs and conceptions that preservice teachers have.

1.1. Addressing the conceptions of preservice teachers

One possible method of instruction that can be used when students' entering beliefs serve as barriers to conceptual understanding is conceptual change pedagogy (e.g., Pintrich, Marx & Boyle, 1993; Posner, Strike, Hewson & Gertzog, 1982). Many conceptual change techniques are grounded in conceptual change theories which are based in part on Piagetian constructivism asserting assimilation, accommodation, and equilibration as the mechanisms for conceptual change.

One common theory of conceptual change is that posited by Strike & Posner (1982). In their initial theory, they sought to answer the question, "how do learners make the transition from one conception, C1, to a successor conception, C2?" Their answer suggested the following four conditions for successful conceptual change to take place: (1) there must be dissatisfaction with current conceptions, (2) a new conception must be intelligible, (3) a new conception must appear initially plausible, and (4) a new conception should suggest the possibility of a fruitful research program.

More recently, this initial theory of conceptual change has been met with some criticism. Hence, in their revisionist theory of conceptual change, Strike and Posner (1992) suggest that a wider range of factors, such as motives and goals, needs to be taken into account, current conceptions must be seen in interaction with other components, and that both a developmental and an interactionist view of conceptual ecologies is required for a complete theory of conceptual change.

Conceptual change and conceptual change pedagogy has been used frequently in the science domains, such as physics for example. Meyer (1993) suggests that one technique for aiding conceptual change is to use a historical progression. This historical perspective can help students to grasp new concepts because they can see how different viewpoints evolved over time, including their own. This

technique is especially helpful when learners who are new to a topic hold beliefs and conceptual frameworks that are similar to earlier thinking in a domain. Gardner (1991) suggests that the key to education for understanding is to devise learning environments in which students draw on their earlier conceptions and integrate these prior conceptions with the knowledge that is currently being presented to them.

One example of a learning environment which fostered conceptual change is demonstrated in a series of research studies (e.g., Stofflett & Stoddart, 1994; Stofflett, 1994). In one of these studies, for example (Stofflett & Stoddart, 1994), the authors point out that many teacher candidates and even practicing teachers continue to hold naive scientific theories. This is often due to the fact that the traditional didactic instruction that is used in many teacher education courses fails to challenge or improve student preconceptions. Hence, in their study, a conceptual change instruction treatment was implemented based on Posner et al.'s four conditions necessary for conceptual change. In the conceptual change treatment, a five-step process was used to diagnose and address misconceptions.

Results of their study indicated that the participants in the conceptual change instruction condition demonstrated a significantly higher change in their conceptual knowledge of the science content (the water cycle) than the traditional group. Further results based on an analysis of lesson plans demonstrated that the participants in the conceptual change condition were also more likely to use innovative methods as opposed to more traditional methods of instruction in their lesson plans.

Additional research in the sciences and science education has shown that another aid to addressing misconceptions and fostering conceptual change is the use of a conceptual change text, also called a refutational text. This type of text attempts to acknowledge the learners' existing conceptions and contrasts them with the more scientifically accepted conception, often through a historical progression. In a series of studies in physics (e.g., Hynd & Alvermann, 1986a; Alvermann & Hague, 1989), subjects received either a refutational (conceptual change) text or a nonrefutational (regular) text. The results of these and similar studies demonstrated that subjects who read the refutational text were more likely to undergo a significant conceptual change in their misconceptions.

The present study draws on the literature on preservice teachers' history-based beliefs (Holt-Reynolds, 1992) which suggests that these beliefs may be incompatible with the theories and ideas presented in teacher education courses. The present study also draws on the literature on conceptions, conceptual change and conceptual change techniques, which suggests techniques to help students to integrate their conceptions with new information. Hence, in the present study, research on conceptual change techniques using text was applied in an effort to address the preservice teachers' conceptions of motivation. Refutational texts written on previously and currently dominant views of motivation were used to address the conceptions of preservice teachers.

Further, in his concluding comments about misconceptions, Gardner (1991) asserts that in some cases, success is due to a teacher [or other external factor] who helps the student to advance beyond his/her earlier ways of thinking to meet school concepts, and in some cases, the success is due to the student him/herself who is able to achieve these insights on his/her own. In addition to investigating the effects of the text on addressing preservice teachers' conceptions regarding motivation, the present study also investigated factors that led preservice teachers to achieve insights on their own, in the absence of the refutational (conceptual change) text. Hence, the present study also investigated the strategies that the preservice teachers used who experienced a relatively large change in their conceptions in the absence of the refutational text.

2. Method

2.1. Participants

The participants in this study were 163 undergraduate education majors enrolled in an introductory educational psychology course at a large eastern US research university. The course was a required course for all teacher education majors.

2.2. Measures

The pretest, posttest and delayed posttest were the same instrument which was administered at three different times throughout the study.[2] This instrument was designed by the principal investigator with permission using a format used in the conceptual change literature in physics (e.g., Alvermann & Hynd, 1989). The instrument consisted of 20 items on motivation theories. Each item on the instrument was a short scenario. Participants were asked to respond to each item by indicating whether they thought the item was true or false. For example:

> Dr. White is pleased to see that his daughter is very motivated to read her biology assignments. In fact, she often reads biology books from the library that are not assigned. In order to encourage her to continue to learn about biology, Dr. White pays her $3 for every chapter that she reads. This is a good way to motivate her to continue reading the biology books.

Participants also completed The Quick Word Test (Borgatta & Corsini, 1964,1993) which correlates 0.83 with the Weschler Adult Intelligence Scale (Meyer & Rice, 1983). The Quick Word Test was used as a measure of students' verbal ability so that the experimenters could, if necessary, remove mitigating effects due to the participants' general verbal ability.

Participants also completed the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia & Mc Keachie, 1993) to provide a measure of self-regulated learning. The MSLQ is an 81-item self-report, Likert-type instrument that is designed to assess students' motivational orientation and use of cognitive learning strategies. The MSLQ consists of the motivation scales of: intrinsic goal orientation, extrinsic goal orientation, task value, control of beliefs, self-efficacy, and test anxiety. The MSLQ also consists of the cognitive learning strategy scales of: rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning and help seeking.

The MSLQ has reasonably good construct validity, internal consistency, reliability, and predictive validity (Pintrich et al., 1993). This instrument was used in an effort to provide insight into the motives and goals that may be used to achieve conceptual change, factors specified by Strike & Posner (1994), for example, as being necessary to describe a learner's ecology and to better understand conceptual change.

2.3. Materials

The materials used in the study consisted of a refutational (conceptual change) text and a nonrefutational (regular) text. Generally, a refutational text is written to address readers' naive conceptions by contrasting them with more scientifically accepted conceptions. In contrast, a nonrefutational or regular text is written to inform the reader without any attempt to address his/her conceptions.

The refutational (conceptual change) text used in the present study was written to address preservice teachers' conceptions about motivation. This text contrasted the reinforcement view of motivation with the intrinsic view of motivation throughout the text. In this way, the refutational text directly contrasted preservice teachers' common conceptions of motivation with more scientifically accepted views of motivation. This refutational text may be seen in Appendix A.

In contrast, the nonrefutational (regular) text simply described the intrinsic view of motivation (the more scientifically accepted view). This text did not contrast this view with the reinforcement view of motivation. In this way, the nonrefutational text did not directly address or confront conceptions of motivation commonly held by preservice teachers. This nonrefutational text may be seen in Appendix B. Both the refutational and the nonrefutational texts were of similar lengths (584 and 564 words, respectively) and levels of readability (Flesch Grade level 15.5 for both, and Flesch Reading Ease, 33.1 and 32.9, respectively).

[2] The alphas computed on the pretest, posttest and delayed posttest were 0.68, 0.74, and 0.74, respectively. The internal consistency reliabilities are well within the acceptable range for experimental research (Gronlund, 1977).

3. Procedure

3.1. Phase 1

On the first day of the study, participants were administered the motivation pretest, The Quick Word Test, and the MSLQ. All of the measures were administered by the same experimenter who read the directions aloud while the participants read them silently. The experimenter ensured that all participants completed each measure before the group proceeded to the next measure. The administration of these three measures took approximately 45 min.

3.2. Phase 2

The second day of the study occurred one week after the first day to reduce any priming effect that may have resulted from the motivation pretest. The participants were randomly assigned to one of the two treatment groups; refutational (conceptual change) text or nonrefutational (regular) text. The participants were told to read the text as they would normally read their textbook for the course and were further told that they could highlight, make notes in the margin, or do whatever they would normally do with their course textbook as they read the texts in this experiment. The participants were told that they had 5 min to read and study the text, which was enough time for all participants. After 5 min the participants were told to turn the text over and to complete the immediate posttest which was also in their packet. The experimenter monitored the room to ensure that no one looked back at the text while completing the posttest. Following the completion of the posttest, the participants returned their packets and were reminded to return for the third day of the study, one week later.

3.3. Phase 3

The third day of the study took place one week after the second day and two weeks after the first day of the experiment. On this third day, the participants were administered the delayed posttest.

3.4. Self-regulated learning interview

After the first three phases of the experiment were conducted, a closer inspection of the data obtained from the participants who were randomly assigned to the nonrefutational (regular) text condition was conducted. It was noted that some of these participants who received the nonrefutational text experienced a relatively large change in their scores between the pretest and posttest, while some of these participants experienced a relatively small change in their pretest to posttest scores. Since all of the participants in this phase of the study were randomly assigned to the nonrefutational text, it was hypothesized that perhaps individual differences in self-regulated learning strategies accounted for this difference in the degree to which scores increased from the pretest to the posttest.

A select sample of participants who were randomly assigned to the nonrefutational text were interviewed using the self-regulated learning interview schedule (SRLIS), developed by Zimmerman and Martinez-Pons (1986). These participants were classified as either "high conceptual changers" (mean change score $= 8.7$) or "low conceptual changers" (mean change score $= 1.3$). All of the "low conceptual changers" could have experienced a change of at least ten more points, as they all had posttest scores of 10 or less out of a possible total posttest score of 20. The mean change score obtained by all participants in the nonrefutational text condition was 2.19.

Due to the specificity of this sample, (participants randomly assigned to the nonrefutational text, and experiencing a relatively high or relatively low change between their pretest and posttest scores) 10 subjects were eligible for this interview phase of the experiment. While this is a relatively small number of participants, the investigators felt it worthwhile to conduct this interview into the individual difference factors affecting the differences in pretest to posttest change scores.

4. Results

4.1. The MSLQ

For each participant, scores from each subscale of the motivated strategies for learning questionnaire

(MSLQ) were added together to form an overall MSLQ composite score. Participants with MSLQ composite scores in the upper third of the distribution were classified as higher self-regulated learners. Participants with composite scores in the lower third of the distribution were classified as lower self-regulated learners.

4.2. Pre-measures

Preliminary analyses of variance were conducted to ensure that there were no initial differences between participants who were randomly assigned to the refutational or nonrefutational text conditions. The results of two separate analyses of variance indicated that there were no significant differences between the participants who were randomly assigned to the two text conditions in their initial knowledge of motivation $F(1,93) = 0.88$, $p > 0.05$, or general verbal ability $F(1,93) = 0.88$, $p > 0.05$.

Additional analyses were conducted to ensure that there were no initial differences between participants who were classified as higher or lower self-regulated learners. The results of two additional analyses of variance also indicated that those participants classified as higher or lower self-regulated learners did not differ significantly in their initial knowledge of motivation $F(1,93) = 2.58$, $p > 0.05$, or in their general verbal ability $F(1,93) = 0.76$, $p > 0.05$.

4.3. Posttest

4.3.1. Text

The results of a 2×2 analysis of variance, text type (refutational or non-refutational) $\times$ self-regulated learning (higher or lower self-regulated as measured by the MSLQ) indicated that there was a significant main effect for text type. Participants who were randomly assigned to the refutational text designed to address conceptions performed significantly better on the posttest than the participants who were randomly assigned to the regular text $F(1, 91) = 14.31$, $p < 0.001$. Participants who received this refutational text averaged more than three points higher on the posttest than participants in the regular text condition. The effect size for text was $+0.71$. These results may be seen in Table 1.

4.3.2. Self-regulated learning as measured by the MSLQ

The results of the 2×2 analysis of variance demonstrated that there was not a significant difference in the posttest scores between participants classified as higher and lower self-regulated learners on the basis of the MSLQ $F(1,91) = 3.71$, $p = 0.057$. Those classified as higher self-regulated learners on the basis of the MSLQ averaged 1.8 points higher on the posttest, for an effect size of $+0.35$.

4.4. Delayed posttest

4.4.1. Text

The results of a 2×2 analysis of variance on the delayed posttest parallel those on the posttest. There was a significant main effect for text type. Participants who received the refutational text designed to address conceptions performed significantly better on the delayed posttest than participants who received the regular text $F(1,77) = 6.53$, $p < 0.05$. Participants who received this refutational

Table 1
Mean post-test performance as a function of text-type and self-regulated learning

	Text type								
	Nonrefutational			Refutational			Row means		
Self-regulated learners	*M*	SD	*n*	*M*	SD	*n*	*M*	SD	*n*
Lower	12.30	5.39	27	15.86	3.92	22	13.90	5.07	49
Higher	14.30	3.31	23	17.09	2.97	23	15.70	3.41	46
Column means	13.30	4.43	50	16.48	3.43	45			

Table 2
Mean delayed post-test performance as a function of text-type and self-regulated learning

	Text type								
	Nonrefutational			Refutational			Row means		
Self-regulated learners	*M*	SD	*n*	*M*	SD	*n*	*M*	SD	*n*
Lower	13.59	4.86	22	15.60	3.73	20	14.55	4.42	42
Higher	14.11	3.40	19	16.60	3.19	20	15.28	3.67	39
Column means	13.85	4.18	41	16.10	3.46	40			

text averaged more than two points higher on the delayed posttest than participants in the regular text condition. The effect size for text was + 0.54. These results may be seen in Table 2.

4.4.2. Self-regulated learning as measured by the MSLQ

There was not a significant difference in the delayed posttest scores between participants classified as higher and lower self-regulated learners on the basis of the MSLQ $F(1,77) = 0.74$, $p > 0.05$. Those classified as higher self-regulated learners on the basis of the MSLQ averaged 0.7 points higher on the posttest, for an effect size of only + 0.17.

4.5. The self-regulated learning interview schedule (SRLIS)

This phase of the study used the self-regulated learning interview schedule (SRLIS) developed by Zimmerman & Martinez-Pons (1986). The frequency with which each of nine self-regulated learning strategies was used by those classified as either higher changers or lower changers was assessed. A series of F-tests was used to compare the two change groups' use of each self-regulated learning strategy. Results indicated that there was a significant difference in the frequency of use of five out of nine self-regulated learning strategies between high and low changers.

High changers demonstrated a significantly greater frequency of the use of the following five self-regulated learning strategies than low changers: organizing and transforming $F(2,8) = 20.0$, $p < 0.01$; keeping records and monitoring, $F(2,8) = 45.12$, $p < 0.01$; environmental restructuring, $F(2,8) = 12.32$, $p < 0.01$; rehearsing and memorizing $F(2,8) = 6.51$, $p < 0.05$; and self-evaluation, $F(2,8) = 5.88$, $p < 0.05$.

5. Discussion

5.1. Refutational text

Preservice teachers bring a variety of beliefs regarding teaching and learning to their undergraduate education courses. These beliefs often serve as useful frameworks for understanding new information. However, these beliefs may be incompatible with the theories and ideas preservice teachers encounter in their education courses. This incompatibility has been demonstrated in the areas of teaching and learning, and classroom management (e.g., Calderhead & Robson, 1991; Jones & Vesilind, 1995). This incompatibility has also been demonstrated in the area of motivation, as undergraduate education majors tend to think of effective motivators as being extrinsic in nature, rather than intrinsic (Salisbury-Glennon et al., in progress).

The present study applied research conducted on conceptual change techniques using text in an effort to address the conceptions held by preservice teachers regarding motivation. In this study, a refutational text was written which compared the once dominant reinforcement view of motivation with the more recently dominant intrinsic view of motivation using a historical progression.

Results indicated that preservice teachers who received the refutational text designed to address

their conceptions about motivation performed better on a posttest than preservice teachers who received the regular text. These preservice teachers who read the refutational text also demonstrated more of a change in their knowledge from the pretest to the posttest than the preservice teachers who read the regular text. Preservice teachers who read the refutational text averaged 32% higher knowledge of motivation after reading the text while preservice teachers who read the regular text showed only an 18% improvement.

Hence, the present study demonstrated that the refutational text enabled pre-service teachers to increase their short-term retention of the intrinsic view of motivation as measured by the posttest. Additionally, the refutational text fostered more of a change between the pretest and the posttest representing more of a change from their initial conceptions to the theories presented in education courses. This finding corroborates previous research findings in physics (e.g., Hynd & Alvermann, 1985,1986b; Alvermann & Hague, 1989), and demonstrates the utility of a refutational text in the social science domain of educational psychology in addressing conceptions regarding motivation held by preservice teachers.

While previous research has focused primarily on short-term comprehension of the information presented in text, few studies have investigated the relative long-term impact of refutational text as measured by a delayed posttest (e.g., Alvermann, Hynd & Qian, 1990). Perhaps most significant is that this study found that reading the refutational text written to address conceptions also enabled preservice teachers to perform better on a delayed posttest, administered one week after preservice teachers read the texts. One may argue that an immediate posttest may show little more than short-term comprehension. The fact that the refutational text also enabled preservice teachers to perform better on a posttest given one week after reading the text provides some support that this refutational text designed to address preservice teachers' conceptions about motivation did address their conceptions. The refutational text written to address conceptions held by preservice teachers appears to have enabled preservice teachers to both assimilate the information into their existing beliefs; and perhaps to accommodate their beliefs to the information for more long-term integration of the information.

5.2. Self-regulated learning

Further, in addition to investigating the effects of the refutational text on addressing preservice teachers' conceptions, the present study also investigated the factors which led preservice teachers to integrate new ideas and theories with their conceptions in the absence of the refutational text. More specifically, this phase of the study investigated the strategies that preservice teachers used who experienced a relatively large change in their conceptions of motivation between the pretest and the posttest. To control for the effects of refutational text, all preservice teachers who participated in this phase of the study read the nonrefutational text.

The results of the self-regulated learning interview schedule (SRLIS) indicated that the preservice teachers who experienced a relatively high increase in their score from the pretest to the posttest in the absence of the text, engaged in significantly greater use of the following self-regulated learning strategies: organizing and transforming, keeping records and monitoring, environmental structuring, rehearsing and memorizing, and self-evaluation.

Closer inspection of these strategies indicates that they can be interpreted using Zimmerman's (1990) social cognitive model of academic self-regulated learning. This model of self-regulated learning integrates the triadic determinants of self-regulated learning: personal, behavioral and environmental. Zimmerman (1990) asserts that this approach to self-regulated learning seeks to coordinate all three influences of self-regulated learning rather than relying on just one or two. Hence, closer inspection of the strategies used by preservice teachers who experienced a relatively high increase in their score from the pretest to the posttest without reading the refutational text indicates that these strategies may all be classified as either personal and behavioral determinants of self-regulated learning by Zimmerman's model. In this case, in the absence of the text, an environmental determinant of self-regulated

learning, the preservice teachers who experienced a significant increase in their score relied on the personal and behavioral determinants of self-regulated learning. These personal and behavioral self-regulated learning strategies may have enabled these preservice teachers to compensate for their lack of environmental determinants of self-regulated learning (the text) and further enabled them to address their conceptions in the absence of the text.

This finding lends support to Gardner's (1991) claim that either the teacher [or other external support] or the student him/herself can enable the student to move beyond earlier ways of thinking to meet the concepts presented in school. This finding suggests that preservice teachers can use self-regulated learning strategies to address their existing conceptions so that they can accommodate them to the information presented in their courses. In conclusion, the present study demonstrates that either a refutational text or self-regulated learning strategies may enable preservice teachers to address their conceptions of motivation so that they are more in line with the information that is being presented in their teacher education courses.

5.3. Educational implications

Results of the present study suggest that preservice teachers' conceptions of motivating their students to learn may not be compatible with the theories and ideas presented in their teacher education courses. This finding corroborates research on preservice teachers' conceptions in the areas of teaching and learning (e.g., Wubbels et al., 1991); classroom management (e.g., Jones & Vesilind, 1995); and teacher planning (e.g., Morine-Dershimer, 1993). Results of the present study further suggest that the refutational text seemed to be effective in addressing preservice teachers' conceptions regarding motivation and enabling them to develop a conceptual understanding of motivation that is more in line with the information that is being presented in their teacher education courses.

These results suggest that refutational texts could be used as an aid to conceptual understanding and could be used in textbooks or as a supplement to them. These texts could also be used to supplement classroom instruction so that instructors and professors are sure to address preservice teachers' conceptions. Results of the present study further suggest that if self-regulated learning is fostered in education courses and preservice teachers are taught self-regulated learning strategies, these strategies may enable them to address their own conceptions and to develop a conceptual understanding that is more compatible with the theories and ideas being presented in their teacher education courses.

Appendix A. Refutational text

A.1. Intrinsic vs. reinforcement theory of motivation

Ideas about how best to foster motivation to learn have changed dramatically in the past 30 years. The previously dominant reinforcement theory of motivation asserted that various forms of reinforcement should be used to motivate students to learn. This reinforcement theory of motivation is incompatible with the currently accepted intrinsic motivation theory which asserts that motivation occurs when individuals engage in an activity for its own sake, not because of an external reinforcement. To illustrate this, imagine the following situation. A fifth grade teacher wants his/her students to be motivated to learn about the planets. How can the teacher best ensure this? Many people, including reinforcement theorists, answer that this could be done though the use of praise, prizes, stickers, or comments such as "excellent". They maintain that it is up to the teacher to motivate the students. Intrinsic motivation theorists disagree. They argue that for students to be motivated to learn, we cannot rely solely on external or extrinsic factors. Rather, motivation must come from within, from students' own internal beliefs and emotions.

According to intrinsic motivation theory, conditions that draw upon student interest and foster choice and autonomy facilitate intrinsic motivation within students. Such conditions are present in classrooms where teachers encourage students to choose tasks based on their own interests, and take responsibility for their own learning. In contrast to intrinsic motivation theory, reinforcement theory

of motivation maintains that reinforcement should be used to motivate students to learn. Recent studies have demonstrated, however, that reinforcers are not sufficient to motivate students to learn.

There are a variety of reasons for this. First, although motivation may occur as the result of reinforcers, it is often short-lived. Second, students may grow tired of the reinforcers and they may cease to be motivating. Third, research has shown that reinforcement may actually decrease an individual's intrinsic motivation to engage in a task. Often, receiving the reinforcer becomes the primary goal for the student rather than learning the information.

When students are intrinsically motivated to learn, they are motivated by an internal desire to learn or an interest in the topic. They do not need to rely on the teacher or other external factors for their motivation. In contrast, when students engage in learning because they are reinforced or externally motivated, they are less likely to become actively involved in the task itself and do only as much as is necessary to receive the reward.

When students engage in tasks because they are intrinsically motivated to learn, they are more likely to choose challenging tasks. Usually, more learning takes place after students have engaged in a challenging task because the challenging task requires that they use deeper thinking and learning processes. In contrast, when reinforcers such as praise, stickers and grades are used to motivate students to learn, students often choose simple tasks as a quick route to the reinforcer.

Intrinsically motivated learners find learning satisfying and rewarding. Research has demonstrated that conditions supporting intrinsic motivation foster greater creativity as well. In contrast, reinforcement has been shown to cause students to develop negative attitudes about their learning and has been shown to hinder creativity.

Intrinsic motivation facilitates conceptual learning. When information is learned at a conceptual level, it is more likely to be retained, applied or transferred. In contrast, when students are extrinsically motivated to learn through the use of reinforcers, they tend to rely on memorization and superficial understanding of concepts.

Appendix B. Nonrefutational text

B.1. Intrinsic motivation to learn

One of the biggest challenges that teachers face is how to motivate their students to learn. To illustrate this, imagine the following situation. A fifth grade teacher wants to get his/her students motivated to learn about the planets. How can the teacher best ensure this? Intrinsic motivation theory sheds some light on how students can best become motivated to learn. Intrinsic motivation theory asserts that students' motivation to learn must come from within. According to intrinsic motivation theorists, teachers must construct facilitative conditions to foster intrinsic motivation within the students. This can be done by encouraging students to choose their own task based on their own interests, to take responsibility for their own learning, to make different tasks relevant to themselves, and to see the value in engaging in tasks. To be intrinsically motivated, students must be actively engaged in the learning task.

According to intrinsic motivation theory, students are motivated to learn when their motivation stems from their own beliefs and emotions. When students are intrinsically motivated, they are motivated by their own desire to learn the information, and learning the information becomes a reward in itself. The result of intrinsically motivated behavior is often an experience of interest and enjoyment, a feeling of competence and self-fulfillment, and a feeling that the outcomes of learning are the result of one's own efforts.

When students are intrinsically motivated to learn, they are actively involved in and focused on their learning and often become immersed in it. They are in control of their learning and take responsibility for it. This active learning often causes the learner to expend more time and effort on the task. Why? Because unlike when other sources of motivation are used, when students are intrinsically motivated to learn, learning the information becomes the primary goal. The intrinsically motivated student finds learning the information to be rewarding.

When students are intrinsically motivated to learn, they are more likely to engage in tasks that

are challenging. Usually more learning takes place after students have engaged in a challenging task, because challenging tasks require that students expend more time and effort and use deeper thinking and learning processes in an effort to understand the material. In addition, when students complete a challenging task, they often feel a sense of pride and accomplishment.

When students are intrinsically motivated to learn, they tend to have more of a positive attitude toward their learning. Intrinsic motivation is associated with greater emotional involvement and enjoyment in learning tasks. Intrinsically motivated learners are more likely to find learning satisfying and rewarding because their engagement in the learning task often stems from their personal interests and curiosity. Learning the information also helps them to meet their goals. In addition to having a positive attitude toward their learning, intrinsically motivated students have been found to be more creative during their learning.

When students are intrinsically motivated to learn, they are more likely to use deep-level cognitive strategies which can enable them to develop a thorough, deep-level understanding of the material. When students are intrinsically motivated, they are more likely to learn the information conceptually. When information is learned at a conceptual level, it is more likely to be retained, applied or transferred. Intrinsic motivation can aid understanding of the material.

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