

The Impact of Teaching Simulation Using Student Chatbots with Different Attitudes on Preservice Teachers' Efficacy

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(Submitted May 14, 2021; Revised October 31, 2021; Accepted November 29, 2021)

ABSTRACT: The aim of this study is to evaluate the effects of a teaching simulation activity that uses a chatbot on preservice teachers' efficacy. Forty-six preservice teachers were asked to teach the chatbot the topic of school violence and how to handle it. They were assigned to one of three groups: Teaching a chatbot whose attitude was impolite, polite, or ordinary. The participants completed a teacher efficacy test at the pretest and posttest. The results show that the participants who taught the ordinary chatbot significantly increased their teacher efficacy levels. However, an Analysis of Covariance shows that the posttest scores of student engagement were not significantly different due to the group setting. The data of participants' conversations with the chatbots and the participant interview data revealed that the ordinary group had more opportunities to increase their mastery experiences than the other groups did. It can be suggested that designing virtual students with ordinary and regular attitudes and behaviors seems appropriate to provide preservice teachers with teaching opportunities to increase their teaching efficacy levels.

Keywords: Teaching simulation, Virtual agent, Chatbot, Teacher efficacy

1. Introduction

It is imperative to increase levels of teacher efficacy because it is directly linked to teacher development, such as instructional efforts, content knowledge (Menon & Sadler, 2016), and their students' academic performance and aspiration (Muijs & Reynolds, 2002; Zee & Koomen, 2016). Teaching experience is considered a powerful influence on teachers' efficacy in and perception of their competence, determining the extent to which teachers will persevere in their classroom (Klassen & Chiu, 2010). Unfortunately, preservice teachers are rarely exposed to teaching opportunities; in most cases, they have a limited amount of student-teaching practicum. Therefore, more opportunities for teaching should be offered during teacher education programs.

Previous research has highlighted the importance of teaching experience for preservice teachers by focusing on microteaching (Arsal, 2015), teaching simulation (Polack et al., 2017), and student-teaching (Fives et al., 2007). However, managing these teaching activities is demanding, and face-to-face implementation is time-intensive. Mostly due to these practical issues, little attention was paid to research on how to improve preservice teachers' efficacy through teaching activities. To increase teaching efficacy and simultaneously resolve practical difficulties, it would be worth exploring the use of teaching simulation. Still, how to simulate teaching experiences to overcome the current challenges of teaching activities is under-investigated.

The aim of this study is to explore the potentials of chatbots to provide preservice teachers with teaching practice opportunities in a learning environment. We aim to clarify the possibilities and challenges of a teaching simulation program that pays particular attention to a conversational approach that uses a virtual agent system (also called chatbot), which is expected to give preservice teachers quasi-experiences of teaching. Specifically, we focus on the effects of the chatbot's different attitudes on preservice teachers' efficacy.

2. Literature review

This study is grounded in Bandura's (1977) social cognitive theory of behavior with a focus on self-efficacy. Bandura (1977) introduced the concept of self-efficacy beliefs, which is an assessment of one's capabilities to attain the desired performance goal. Self-efficacy is a significant component in the human agency as it influences people's aspirations and behaviors, including choice of tasks, effort, and persistence (Bandura, 1986). Since the self-efficacy theory was applied in the education realm, a considerable number of studies have been conducted to investigate how self-efficacy is related to teaching performance and student achievement (Bautista & Boone, 2015; Zee & Koomen, 2016), which has evolved into the concept of teacher efficacy. In many studies,

Tschannen-Moran and Woolfolk Hoy's (2001) definition of teacher efficacy was introduced as "a teacher's judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (p. 783). In this definition, there is an assumption of teachers' beliefs in their ability to positively affect student learning and behavior (Putman, 2012).

Higher levels of teacher efficacy led to more time investment in teaching and greater levels of aspiration (Tschannen-Moran & Woolfolk Hoy, 2001), teacher development (Menon & Sadler, 2016), student performance (Kim & Seo, 2018; Muijs & Reynolds, 2002), and student motivation (Appleton & Kindt, 2002; Lazarides et al., 2018). Teacher efficacy appears to be a belief that affects both teaching and student learning in a significantly positive way. The low level of teacher efficacy causes negative issues, such as a lack of teaching preparation (Mulholland & Wallace, 2001), job dissatisfaction (Klassen & Chiu, 2010; Perera et al., 2018), and emotional exhaustion (Skaalvik & Skaalvik, 2016). These negative aspects predict greater teacher turnover intent (Ryan et al., 2017). A high rate of teacher attrition has been one of the severe issues that cause teacher shortage problems.

2.1. Teacher efficacy promotion

Bandura (1986) categorized the sources of self-efficacy development into mastery experiences, vicarious experiences, social persuasion, and physiological/emotional factors. In the teacher education field, it can be understood as follows. First, mastery experiences are achieved by conducting teaching. Second, preservice teachers have vicarious experiences through modeling others' teaching. Preservice teachers observe in-service teachers' classrooms, other media, or their own teaching through recorded videos. Third, social persuasion means that novice teachers utilize others' feedback. Last, physiological and emotional factors are related to teachers' stress reactions and negative tendencies. Among them, mastery experiences have been identified as the most effective method (Tschannen-Moran & Woolfolk Hoy, 2007). It was reported that beginning elementary teachers showed their improved teacher efficacy through the achievement of mastery experiences of teaching (Mulholland & Wallace, 2001). It can be argued that teaching in a classroom could be essential for teachers because those experiences provide authentic evidence of their accomplishment from successful teaching (Pfitzner-Eden, 2016). Because mastery experiences originate from teaching accomplishments, preservice teachers would not have enough opportunities for improving teaching efficacy if there was a lack of teaching opportunities in their programs, such as not enough practicum and student-teaching courses. Novice and preservice teachers have relatively lower levels of self-efficacy than experienced career teachers do, which could be due to the lack of teaching experience, not because of their innate ability (Gordon & Debus, 2002).

2.2. Mastery experiences

Given the importance of mastery experiences, one of the opportunities to effectively increase efficacy is student-teaching. Cantrell et al. (2003) found that the amount of time spent in student-teaching as mastery experiences were positively correlated with their teacher efficacy. Pfitzner-Eden (2016) examined the teacher efficacy of two cohorts of preservice teachers. After the practicum, two factors of teacher efficacy (i.e., classroom management and instructional strategy) were increased in the group of preservice teachers at the beginning stage. The results of the advanced preservice teachers also showed the increased teacher efficacy of classroom management. Fives et al. (2007) explored preservice teachers' engagement in practicum and their perception of teacher burnout. The results of preservice teachers' student-teaching experience indicate that their teacher efficacy was significantly increased, and burnout symptoms were decreased over time. The researchers argue that student teaching provides mastery experiences, and at the same time, ameliorates preservice teachers' feelings of burnout. Thus, preservice teachers' mastery experiences in student-teaching seem essential to improve their teacher efficacy.

2.3. Students' attitudes and behaviors

Despite the benefits of student-teaching in general, effective student-teaching environments and contexts have been under-explored. Specifically, it seems that students' attitudes and behaviors have an impact on preservice teachers' efficacy (Dicke et al., 2014; Kokkinos et al., 2005). One of the critical causes of a high level of teacher stress is student misbehavior and disengagement, which is the biggest concern of novice teachers who lack teaching experience and coping strategies (Dicke et al., 2014). Students' disruptive behaviors and hostile attitudes evoke teachers' unfavorable and negative emotions significantly (Kokkinos et al., 2005), which negatively affect preservice teachers' intrinsic motivation to teach, goals towards their profession, and teaching efficacy (Sutton & Wheatley, 2003).

It is imperative to provide preservice teachers with opportunities to learn how to handle the different attitudes of students. In Kokkinos et al. (2005), over five hundred primary school teachers and preservice teachers completed the survey that asked their appraisals of students' undesirable behaviors. The results implicate that more teacher training should be designed to increase the awareness of a broader range of students' undesirable behaviors, provide how to cope with student difficulties, and enhance teacher efficacy in handling challenging and disruptive behavior. Kim and Cho (2014) examined the status of preservice teachers in their teacher education program and their expectation of "reality shock," which refers to a huge discrepancy between the ideal expectations of teaching and the reality of the school environment and student attitudes. The results show that the expectation of reality shock varies depending on the status in their program, which has three stages: (1) before declaring their teaching major: the highest level of expectation of future reality shock, (2) after having decided on their major: the significantly decreased expectation of reality shock, and (3) after their practicum: the high level of expectation of future reality shock. This could mean that as preservice teachers are exposed to a classroom in their student-teaching, they clearly understand that the teaching context is not only about delivering content knowledge but about coping with difficult students.

For successful mastery experiences, preservice teachers should be able to have enough opportunities to teach students with different attitudes and behaviors, including problematic and disruptive ones. One or two courses of student-teaching practicum might not fully provide mastery experiences opportunities of teaching different types of students. Few studies examined how student attitudes and behaviors are related to preservice teachers' efficacy. In addition, how to support preservice teachers' mastery experiences was under-investigated.

Along with the lack of research on the identification of contextual factors (i.e., students' attitudes and behaviors), there are practical issues when we attempt to provide sufficient student-teaching opportunities. Due to the lack of opportunities of teaching different attitudes' students, preservice teachers might not be fully prepared for their teaching, such as the absence of a direct link between instructional goals and assessment, failure to write observable instructional goals, and the lack of foundational concepts as validity and reliability when assessing students (Campbell & Evans, 2000). Besides, there is a disconnect between the campus-based portion of teacher education programs and student-teaching. This might be because practicum courses are not considered as a valued activity, and supervising practicum courses has been treated as an overload (Zeichner, 2002). To resolve these practical limitations, it requires an effort of educators to propose alternative ways for successful mastery experiences.

2.4. Chatbots

Our approach is to provide preservice teachers with sufficient teaching practice opportunities using learning technology. In the field of education, conversational virtual agents, called AI (artificial intelligence) agents or chatbots, have been investigated. Chatbots are computer programs that communicate in human language with their users. The system can conduct interaction activities through communication with the user by simulating human-like dialog patterns and behavior. In 1966, Joseph Weizenbaum developed one of the first chatbots, ELIZA, which simulates a therapist's role in clinical treatment situations. Since this breakthrough, chatbots have evolved and been utilized in a variety of areas, such as marketing, customer support, e-commerce, banking, and healthcare.

Chatbots have been adopted in education. One type is Intelligent Tutoring Systems, which have shown effectiveness in improving learning achievements specifically in science, technology, engineering, and mathematics fields (VanLehn, 2011). Winkler and Soellner (2018) reviewed that chatbots have been effectively used for medical education and therapy, language learning, feedback systems, and motivation and self-efficacy supporters. Furthermore, their findings show that chatbots have the potential to improve learners' affective, cognitive, and metacognitive learning gains (Winkler & Soellner, 2018). There are cases that chatbots are used for educational purposes (e.g., Oh et al., 2019; Song & Kim, 2020). Abbasi and Kazi (2014) investigated the use of a chatbot as a question retrieval tool to support students in solving programming questions. Seventy-two undergraduate students were randomly assigned to one of two groups: Google Group (who searched for information using Google search engine to solve questions) and Agent Group (who asked questions to the conversational agent to retrieve information for problem-solving). The results show that the learning outcomes of Agent Group were significantly higher than those of Google Group. Chatbots can be used to scaffold students' positive habit development. Kreyenin et al. (2019) measured whether chatbots may assist undergraduate students to develop a positive habit such as reflective journaling. The researchers used four versions of a chatbot that enables effective journaling via text messages. The results showed that chatbots can be effective tools in scaffolding positive habit development for undergraduate students (Kreyenin et al., 2019). However, chatbots have not been thoroughly investigated in the teacher education field.

We argue that chatbots would lead to an in-depth research investigation of the effectiveness of teaching simulation and the attitudes/behaviors of agents (i.e., virtual students). Still, the use of chatbots to offer student-teaching simulation opportunities is in its infancy. There is little knowledge of what roles AI technology might play in preservice teacher education.

2.5. This study

We aim to investigate the effects of teaching simulation through a chatbot on preservice teachers' efficacy levels. Two research questions guided the study:

- RQ1. To what extent, does the preservice teachers' efficacy change by teaching a student chatbot?
- RQ2. Are there differences in preservice teachers' efficacy associated with teaching the different attitudes of chatbots (i.e., impolite, polite, and ordinary)?
- RQ3. What are the preservice teachers' responses and experiences in teaching chatbots with different attitudes?

3. Methods

3.1. Participants and context

A sample of 46 students (14 males and 32 females) from Teachers College at a mid-sized public university in South Korea provided data for this study. The research information was explained to the participants. They are undergraduate students (senior) majoring in elementary education, who had a one-time experience of student-teaching a year prior to the intervention of this study. They were randomly assigned to one of three groups: Teaching the agent whose attitude was (1) impolite (Impolite Group, $N = 16$), (2) polite (Polite Group, $N = 16$), and (3) ordinary (Ordinary Group, $N = 15$).

3.1.1. Teaching subject

Over the last decade, school violence has been recognized as a serious problem at the research site. Increasing school violence problems lead to the increased pressure on teachers to prevent them in the classroom, and teachers should play a significant role in tackling school violence (Troop-Gordon, 2015; Yoon et al., 2016). Specifically, preservice teachers should be well prepared to teach anti-bullying issues to their future students. For these reasons, anti-bullying was chosen as a topic for the teaching simulation in this study. Before the teaching task, participants were asked to prepare their anti-bullying teaching sessions for the teaching simulation activity.

3.1.2. System design and development

A teaching simulation program was designed to support conversations between participants and a chatbot. The system was built on an existing chatbot framework that was designed to support users' interaction with the agent (Song et al., 2017; Oh et al., 2019; Song & Kim, 2020). When a participant accesses the agent system through their Web browser, the agent greets the participant, and the teaching session begins. The participant's role is the teacher, and the agent takes the student's role.

For the implementation, the participants were asked to teach the concept of school violence. The teaching method is individual text-based chatting, which is similar to social media message apps. Participants are text-based chatting with a chatbot to teach. The agent initiates conversation with greetings and questions, and a participant teaches the agent. The system analyzes a pattern of what the participant typed (e.g., a positive answer to the agent's question, a negative answer to the agent's question, a follow-up question) and responds to the participant accordingly. In the conversation, attention was specifically given to the role of the agent. Using machine learning techniques, each chatbot agent was trained to have a specific attitude. Depending on their group, the participants taught the agent whose attitude was impolite, polite, or ordinary. The impolite agent plays in distracting participants' conversation and showing disrespect and discourtesy to them, whereas the polite agent in revealing his understanding and showing gratitude to the group of preservice teachers. The ordinary agent responds to the participants ordinarily, not showing any specific negative or positive emotion and attitude. The

agent was designed as gender-neutral and the participants could not recognize the agent's gender. The agent's age was not specifically addressed in the program, but it was designed as 5th – 6th graders.

The agents' responses were designed (i.e., machine learning training) from the results of multiple interviews with local teachers and students at the design and development stage before several pilot tests. The development team collected all the possible students' reactions and responses depending on their attitudes and added them into the system database. The development team collected possible sentences that in-service teachers used in their anti-bullying interventions at school and listed them as the participants' anticipated teaching. Each agent's attitude was designed based on formal/informal interviews and conversations with the teachers and students. At the development stage, the development team asked students to come up with possible responses and reactions to each teaching sentence from the list. Then, each sentence had multiple students' responses, which were categorized into impolite, polite, or ordinary responses, and inserted into the database by the development team. This categorization of attitude was conducted by the research team first and was cross-checked by the participating teachers. When a participant starts teaching the chatbot, using classification techniques of machine learning, the system categorizes the participant's sentence into one of the anticipated teaching sentences that were collected through the interviews with the local teachers. Depending on the type of teaching sentence, the agent was designed to respond to the participant appropriately using the database of possible students' reactions and responses.

3.2. Data collection and analysis

3.2.1. Pretest and posttest

The participants completed a teacher efficacy test at the pretest and posttest. Teachers' Sense of Efficacy Scale developed by Tschannen-Moran and Woolfolk Hoy (2001) was used to assess the efficacy of participants due to its recognized acceptance in the research field and its validation with preservice teachers. The instrument consists of 24 items, assesses along a 9-point continuum with anchors at 1 (Nothing) to 9 (A Great Deal). Considering the survey type that the participants of this study were familiar with, each question item was modified from a question sentence to an assertive sentence, and the measure was tweaked to a five-step Likert scale: Strongly Disagree (1) to Strongly Agree (5). The teacher efficacy instrument includes three 8-item sub-dimensions: Student Engagement, Instructional Strategies, and Classroom Management. A reliability test was conducted for the test items from the pretest. The reliability of the full 24-item scale was .85. Reliabilities for the teacher efficacy subscales (i.e., student engagement, instructional strategies, and classroom management) were .70, .74, and .74, respectively. The student engagement dimension indicates a relatively low but acceptable level (conventionally greater than .6; Wiersma & Jurs, 2005) of internal consistency, and the other dimensions show acceptable levels of internal consistency.

3.2.2. Interview and written discourse data

Since the two research questions include "how" questions, interview and written discourse data were analyzed to complement quantitative results. The quantitative results would give us the amount of student attitude change, and qualitative analysis might answer how this change happened. After the intervention, four volunteered participants from each group were interviewed. The interview questions asked participants' experience of the teaching simulation focusing on the agent's behavior and attitude, their emotions during the text-based conversation, and feeling about teacher efficacy. In addition, participants' conversation data was collected through the agent system. The system collected each participant's session identification number, timestamp, and conversation text. The student interview and written discourse data were qualitatively analyzed.

We followed a thematic analysis method (Braun & Clarke, 2006). The qualitative data were coded to determine major themes and categories that would emerge from the data through a process of reading and rereading the data. The transcript was independently coded by the first author and the second author. The calculated inter-rater reliability ranged from 90% to 95%, averaging 92.7%. These disagreements were further discussed and resolved by the coders. The meaningful statements regarding teaching experience were initially highlighted from the interview and written discourse data. Then, the coding process was conducted by marking the segments of data with descriptive words or category names, such as "the impolite agent," "the difficulty levels of teaching," "interaction," and "teaching practice." Then, the codes were grouped into sub-categories (e.g., teaching conversation, persuasion effort, off-topic conversations). The related subcategories were integrated by comparing and contrasting the properties of each sub-category, and continuously refining and collapsing the sub-categories as stronger themes emerged. Similar ideas were summarized into statements to present the common themes and

insights from the participants' teaching simulation experience. The common issues were addressed using the analyzed themes.

4. Results

4.1. RQ1

The normality of the data was checked through the Shapiro–Wilk test. All test scores did not deviate significantly from the normal distribution (see Table 1). Means and standard deviations for teacher efficacy are presented in Table 2. A paired sample *t*-test was conducted in each group to examine the difference between the pretest and posttest scores of the teacher efficacy test. As shown in Table 2, using a nominal alpha value of .05, a significant mean difference between pretest and posttest was found for the total score of Ordinary Group ($t = -4.47, p = .001, \text{Cohen's } d = .50$).

Table 1. Tests of normality on efficacy test

	Impolite Group Shapiro–Wilk (<i>p</i> -value) (<i>df</i> = 16)	Polite Group Shapiro–Wilk (<i>p</i> -value) (<i>df</i> = 15)	Ordinary Group Shapiro–Wilk (<i>p</i> -value) (<i>df</i> = 15)	Total Shapiro–Wilk (<i>p</i> -value) (<i>df</i> = 46)
Pre	.97 (.76)	.95 (.50)	.96 (.76)	.98 (.72)
Post	.95 (.47)	.98 (.93)	.95 (.45)	.99 (.80)

Table 2. Mean scores and standard deviations on efficacy test for the participants and *t*-test results

Total	Impolite Group Mean (<i>SD</i>) (<i>N</i> = 16)	Polite Group Mean (<i>SD</i>) (<i>N</i> = 15)	Ordinary Group Mean (<i>SD</i>) (<i>N</i> = 15)
Pre	3.39 (.31)	3.64 (.27)	3.52 (.40)
Post	3.50 (.34)	3.58 (.54)	3.73 (.44)
<i>t</i> -value (<i>p</i> -value)	-2.09 (.054)	.44 (.665)	-4.47 (.001)*

Note. * $p < .05$.

4.2. RQ2

An Analysis of Covariance (ANCOVA) was performed on the teacher efficacy posttest results, in which the pretest was the covariant. The posttest result was the dependent variable, and the three-group setting was the control variable to examine the relationship between the posttest results of the three groups. Levene's tests of equality of error variances test were conducted for total scores ($F = 2.01, p = .146$), which show that the variability is not significantly different from each other. The ANCOVA result shows that the variance of the total efficacy score between the three groups was not statistically significant ($F = 2.20, p = .124$).

4.3. RQ3

4.3.1. Interview results

After the coding process for the interview data, 127 codes were grouped into 34 subcategories. From the subcategories, 15 themes emerged. As shown in Table 3, the themes found from Impolite Group are (1) Efficacy adjustment: After teaching the impolite agent, participants recognized that they had overestimated their efficacy level at the pretest; (2) Overcoming the limitation of student-teaching: Participants had never experienced impolite students in their practicum, but this implementation offered this opportunity; (3) The difficulty of teaching: Participants felt that they should be able to have a wide range of background knowledge to handle impolite students; and (4) Teaching opportunity: Participants considered this implementation as a beneficial teaching practice opportunity.

The Polite Group themes are (1) The lack of interaction: Participants did not have to actively interact with the agent because the agent seemingly understood what the participants taught; (2) Non-realistic student agent: Participants do not believe that they will meet this type of polite student in their future classroom; and (3) Teaching opportunities: The agent system helped participants overcome the limited amount of teaching practice in their teacher education program.

The Ordinary Group themes are (1) Reality-based practice: Participants were impressed by the fact that the chatbot’s questions and attitudes were very similar to the students that they taught in their student-teaching; (2) Question-answer activity: Participants appreciate the agent’s questions, which gave them time to think about the instructional content; (3) Mastery experiences: Participants felt that they had mastery experiences when teaching the ordinary agent; and (4) Importance of interpersonal skills: Participants consider that they needed interpersonal skills along with the content knowledge when teaching the ordinary agent.

The non-group-specific themes are (1) The need for personalization: Participants were not able to identify which attitude was better for them (between impolite, polite, and ordinary attitudes) because it depends on each participant and the context; (2) Benefits of chatting: Participants appreciate the text-based chat as a teaching method because they had enough time to think before typing, which could not be done when speaking; (3) The need for a voice-based system: Participants wanted oral communication opportunities to teach the agent because it is a more authentic way to teach; and (4) Less realistic attitudes of the agent: Participants pointed out that it is not realistic for a student shows only one type (i.e., impolite or polite) of attitude.

Table 3. Preservice teacher interview analysis with themes and examples

Group	Theme	Exemplary statements*
Rude	Efficacy adjustment	In the pretest, I thought that I was able to get through the most difficult students and control their disruptive behavior, but actually, I’m not, after the chatting, I realized that I’m not able to do that. I believe that my efficacy dropped at the posttest. I know that self-efficacy should be firmly based on evidence, so this kind of teaching opportunity can be used as evidence, it’s a piece of negative evidence for me though.
	Overcoming the limitation of student-teaching	From my experience of student-teaching in the practicum course last year, I haven’t seen this kind of aggressive student who asks these kinds of questions in the classroom. This is because, I think, usually [for student-teaching] the teachers and administrators at the school control the classroom environment for us, preservice teachers, before we visit the school. The teachers prepared their students quite a lot, kept them quiet, asked them to be nice to us, something like that. We don’t have many opportunities to teach this agent-like rude student. But, we all know that there are those disrespectful students in the classroom. So, it’s going to be a big help for us to teach this kind of ill-mannered student for our teaching experience.
	The difficulty of teaching	She [the agent] mentioned our constitutional law or something. I’ve noticed that it’s going to be big trouble if teachers do not have a wide range of background knowledge about the topic. To control their [students’] disruptive behaviors, the teacher must have knowledge of a wide variety of topics as well as the subject matter. Otherwise, the student would disregard or disrespect the teacher more and more. This is the hardest part, we cannot be the expert on every topic. Also, I almost lost my temper when the agent showed disruptive behaviors, but at the same time, I felt some sort of responsibility as a real teacher. It wasn’t easy at all, the agent pissed me off, but I’m supposed to teach her and control the situation.
	The difficulty of teaching	She [the agent] mentioned our constitutional law or something. I’ve noticed that it’s going to be big trouble if teachers do not have a wide range of background knowledge about the topic. To control their [students’] disruptive behaviors, the teacher must have knowledge of a wide variety of topics as well as the subject matter. Otherwise, the student would disregard or disrespect the teacher more and more. This is the hardest part, we cannot be the expert on every topic. Also, I almost lost my temper when the agent showed disruptive behaviors, but at the same time, I felt some sort of responsibility as a real teacher. It wasn’t easy at all, the agent pissed me off, but I’m supposed to teach her and control the situation.
	Practice opportunity	I think it’s [the teaching experience] helpful, I mean, it’s a good chance to practice for me to interact with a difficult and disruptive student regarding how to handle this kind of bad student.
Polite	Lack of interaction	The student [the agent] said he understood whatever I taught, so I was trying to ask some other questions to him, but he didn’t answer my

	Non-realistic student agent	questions, there was no meaningful interaction, unfortunately. I highly doubt that there is a real student like this agent in the classroom. I'd say, it's not realistic. I think it'd be great to collect data and information from in-service teachers regarding what kinds of questions their students usually ask in the classroom. You guys can add those real questions into the chatbot system.
	Teaching opportunities	In this teacher education program [at the university] we only have two types of teaching experience: student-teaching and microteaching. I don't think it's enough to experience different types of students. It'll be awesome if we have more chances to teach, something like this kind of chatting.
Ordinary	Reality-based practice	I was very surprised that the [agent's] questions and attitudes are very similar to the students that I taught during the student-teaching for the practicum course last year.
	Question-answer activity	The student's [the agent's] questions made me keep thinking, which is very helpful. Her questions are something that I've never thought about.
	Mastery experiences	I thought that I wasn't able to handle difficult students when I answered the pretest items, but I realized that it's not that hard after teaching the agent. It's really manageable and controllable. So, I think my efficacy increased a little bit at the posttest.
	Importance of interpersonal skills	After this activity, I learned that the content knowledge, anti-bullying in this activity, is not all. I mean, teachers should have skills to manage and control their students, especially interpersonal skills seem very important.
Non-group-specific	Need for personalization	Now I get it. There are different types of chatbots, right? [Interviewer: Yes, three types. Rude, polite, and normal regarding the attitude]. I think it depends on the student [preservice teacher], I mean, regarding which type of chatbot is more effective for our experience. Someone may benefit from rude students or others from polite students.
	Benefits of chatting	I like chatting for teaching, because, before I typed something, I was able to think and reflect on the student's [agent's] questions with careful consideration.
	Need for a voice-based system	Rather than chatting, I think oral communication would be even better. In the classroom, you do speak, not type. Obviously, speaking is a more natural way to teach. So, it would be good to have a voice-based system or something like that.
	Need for diverse situations	I don't think a student has one type of personality or attitude. A student can be normal, but abruptly, can be very difficult and disruptive at some point. So, it would be better to have experiences to teach different types of students. Also, it would be great to teach many students at the same time through this chatbot system, it will be like a real classroom.

Note. *Translated from the Korean language.

4.3.2. Log analysis

In total, 5,676 lines of written discourse were collected from the implementation. The participants' written discourse was 2,508 lines and the agent 3,168 lines. We solely focused on the participants' written discourse for the qualitative analysis. To understand the context of each participant's discourse clearly, the corresponding agent's discourse was reviewed. We acknowledge that the agent's predetermined questions or reactions might influence the participants' discourse. However, since our intention was to examine the differences in preservice teachers' teaching and responses between each group (i.e., impolite, polite, and ordinary agents), we focused on the participants' teaching activities considering the agent's attitudes. After the coding process, 191 codes were grouped into 48 subcategories. From the subcategories, 10 themes emerged.

As shown in Table 4, the themes found from Impolite Group are (1) Teaching: Although the impolite agent's question was outspoken and rude, participants tried to answer the agent's questions to teach the content; (2) Off-topic conversation: When the agent distracted the participants, the conversation was frequently off-topic; (3) Persuasion efforts: Participants tried to change the agent's thoughts and attitudes through the persuasion efforts;

and (4) Emotional reaction: Participants showed that they were upset during the conversation when the agent's attitude was rude.

Table 4. Preservice teacher conversation themes and example dialogs with the chatbot

Group	Theme	Exemplary Conversation*
Rude	Teaching	<p>Agent: I don't get it. What the heck? It's just a small prank between friends. You're overreacting, like a nerd.</p> <p>Participant: But, your friend could have different opinions about it. That's the trouble.</p>
	Off-topic conversation	<p>Agent: Let's say that there is someone who doesn't like me. I don't wanna hang out with him. That doesn't mean bullying! That is ridiculous!</p> <p>Participant: There is a huge difference between not hanging out with him and ignoring or harassing him, which is the definition of bullying.</p> <p>Agent: Every nerd is talking about school bullying, huh?</p> <p>Participant: Would you please watch your language?</p>
Polite	Persuasion effort	<p>Agent: I bet you don't have any friends? LOL</p> <p>Participant: No no no, I have tons of friends.</p> <p>Agent: Oops, I think you said something like this shit?</p> <p>Participant: Excuse me? I've never said that!</p> <p>Agent: Have you thought about the fact that we should respect everyone's preference? Seriously, are you a teacher? I don't buy it. Can you be the best friend of every nerd, huh?</p> <p>Participant: Please think about it in a different way. Let's go back to the definition of school bullying.</p>
	Emotional reaction	<p>Agent: You don't even know what the classroom is. If you do that [reject a bully's request], your entire school life is over. It's done.</p> <p>Participant: No, nothing like that! You should not give them your money, that's money bullying. You must report it to your teacher first.</p> <p>Agent: LOL You're trying to say all bookish answers, which do not make any sense, holy crap.</p> <p>Participant: Why doesn't it make any sense? It's very embarrassing!</p>
Ordinary	Teaching	<p>Agent: Some of my classmates, I don't like them, don't want to hang out with them. That doesn't mean it's school bullying, right?</p> <p>Participant: Not necessarily, but why don't you think about the differences between friends, and think about different personalities and preferences. No need to hang out, but you should not ignore or avoid them.</p>
	Short answer	<p>Agent: Can I ask a question? Do we need to call 117 [the emergency phone number for school problems in South Korea]? I'm worried that it will make things worse.</p> <p>Participant: It will solve the problem. Whenever you have trouble regarding bullying, please go ahead, it's a very good way to solve the problem. They will help you out for sure.</p>
	Intention to help	<p>Agent: I have a concern. Would you please listen to me? One of my friends borrows my cell phone quite often. I have a limited data plan, but she uses my phone a lot. Is this a type of school bullying?</p> <p>Participant: Yes, it is.</p> <p>Agent: I'm so scared, I might get beat up. Can you please help me?</p> <p>Participant: Sure, I can help you out, don't worry about it.</p>
Ordinary	Teaching efforts	<p>Agent: If I told my parents, they'd be very sad about it.</p> <p>Participant: All right, then why don't you tell me about it? We can solve the problem together.</p> <p>Agent: Why are there lots of school bullying problems these days?</p> <p>Participant: Some small conflicts can evolve into bullying. Also, there are some violent students, but don't worry about it, any bullying problems can be solved if we understand how to handle them correctly, I will teach you.</p>

	<p>Agent: To get along with some friends, I think I need to bear with it even if they bully me, right?</p> <p>Participant: No, you don't need to. If they bully you, they are not friends anymore, you should remember this.</p>
Follow-up questions	<p>Agent: My mom would burst into tears if I told her I was bullied.</p> <p>Participant: Even if your mom does, it's the right thing to do. It's much better rather than suffering from bullying without telling anyone. Otherwise, you can report it to your teacher or call 117 [the emergency phone number for school problems in South Korea].</p> <p>Agent: What is the definition of school bullying? Is it different from regular bullying?</p> <p>Participant: You're right. So, let's think about it, the term, school, is placed in front of bullying. What do you think?</p>
Feeling of relief	<p>Agent: I didn't know that there are many types of bullying.</p> <p>Participant: Good, any other questions about bullying? Do you understand when and where you need to report a bullying problem?</p> <p>Agent: Now I get it.</p> <p>Participant: I'm so glad that you learned something!</p>

Note. *Translated from the Korean language.

The Polite Group themes are (1) Teaching: Participants answered the agent's questions thoroughly to teach the content; (2) Short answers: When the agent's comment was polite, the participants' responses were short and brief; and (3) Intention to help: When the agent asked some help, participants were willing to help the agent.

The Ordinary Group themes are (1) Teaching efforts: [Same as the polite group's theme – teaching]; (2) Follow-up questions: Participants asked a follow-up question to the agent after answering the agent's question; and (3) Feeling of relief: When the agent showed their understanding, participants expressed their relief that their teaching worked.

As shown in Table 5, a comparison was conducted among three groups' conversations focusing on the similar questions that the agent asked. It was found that similar questions with different attitudes of the agent were followed by different responses of each group of participants. Specifically, in many cases, Impolite Group had to tackle the agent's distractions whereas Ordinary Group tried to change the agent's misconception as a teaching activity. It was also found that Polite Group usually responded to the agent with short comments.

Table 5. Comparison examples of preservice teacher conversation with chatbots

Rude Group*	Polite Group*	Ordinary Group*
<p>Agent: Isn't it self-defense if I hit him back when he beats me?</p> <p>Participant A: That depends on the case, but why do you really want to hit him back?</p> <p>Agent: OMG. You don't even know what the self-defense law is? Hahahaha.</p> <p>Participant A: What are you talking about?</p>	<p>Agent: Isn't it self-defense if I hit him back when she beats me?</p> <p>Participant D: Don't respond with violence. Just report it to your teacher or call the police.</p> <p>Agent: Very helpful! I will keep that in mind for future situations!</p> <p>Participant D: Sounds good!</p>	<p>Agent: Isn't it self-defense if I hit him back when he beats me?</p> <p>Participant G: Responding to violence with violence, it's never a good idea.</p> <p>Agent: But I also think self-defense is not a bad idea.</p> <p>Participant G: Yes, but it's different, what we think as a self-defense case and the self-defense defined in the law.</p>
<p>Agent: Isn't it self-defense if I hit him back when he beats me?</p> <p>Participant B: Then, you guys are going to be the same type of bad person.</p> <p>Agent: OMG. You don't even know what the self-defense law is? Hahahaha.</p> <p>Participant B: I absolutely know the law very well.</p>	<p>Agent: Isn't it self-defense if I hit him back when she beats me?</p> <p>Participant E: How about finding a better way to handle the problem, such as reporting it to the teacher rather than becoming the same person, who is an assailant?</p> <p>Agent: Very helpful! I will keep that in mind for future situations!</p> <p>Participant E: Very good. Any</p>	<p>Agent: Isn't it self-defense if I hit him back when he beats me?</p> <p>Participant H: In that case, you may want to think about, you're going to be the same type of perpetrator in that situation.</p> <p>Agent: But I also think self-defense is not a bad idea.</p> <p>Participant H: Please go get some help from out there.</p>

Agent: Isn't it self-defense if I hit him back when he beats me?
Participant C: If you do that, you're going to be an assailant in the school bullying problem, you're not the victim anymore.
Agent: OMG. You don't even know what the self-defense law is? Hahahaha.
Participant C: You may want to consider that it's very hard to be legally judged as self-defense in our country.

other questions?
Agent: Isn't it self-defense if I hit him back when she beats me?
Participant F: It can be regarded as a self-defense case, but it can also cause more violent accidents. So, let's find out a better and safer way to solve that kind of problem.
Agent: Very helpful! I will keep that in mind for future situations!
Participant F: Yes, you're great.

Agent: Isn't it self-defense if I hit him back when he beats me?
Participant I: But, you're going to be the assailant if you respond with violence.
Agent: But I also think self-defense is not a bad idea.
Participant I: Still, violence is never a good solution.

Note. *Translated from the Korean language.

5. Discussion

We explored the effects of a teaching simulation activity that utilizes chatbots with different attitudes on the changes in preservice teachers' efficacy. The results show that the participants' teacher efficacy of the ordinary group was increased after the intervention. The participants who taught the ordinary agent seem to have opportunities for mastery experiences. Given the possibility of contribution to teacher efficacy revealed in this study, it is expected that an enhanced virtual agent system supports preservice teachers' teaching simulations and practice opportunities. However, according to the results of ANCOVA, there was no statistically significant difference between groups.

Although we cannot claim that preservice teachers benefit more from teaching a chatbot with ordinary attitudes than from teaching impolite or polite agents, it seems that the ordinary group had more opportunities to increase their mastery experiences than the other groups did according to the qualitative results. The interview and written discourse analysis of the ordinary group indicates that they were engaged in more teaching and mastery activities (i.e., the related codes are reality-based practices, question-answer activities, mastery experiences, interpersonal skills, teaching efforts, and follow-up questions) with more efforts than those of other groups. On the other hand, the results of those who taught the polite agent showed short-answer conversations and a lack of interactions. The participants who taught the impolite agent had to deal with off-topic conversations and persuade the agent to change its mind, which might not be effective enough to shift their teacher efficacy. Thus, we argue that designing an agent with ordinary and regular attitudes and behaviors seems appropriate to provide preservice teachers with teaching opportunities to increase their teaching efficacy levels.

While there is much work to be done to understand the relations among teacher efficacy and the role of virtual agents, this study presents a novel step towards the use of AI technology to provide optimized teaching simulation environments for preservice teachers. It is almost impossible in real-life settings to have an environment with students with manipulative attitudes for preservice teachers' teaching practice. This study suggests a possible solution to the practical limitation through the way to utilize AI technology for teaching practice in learning. Further, it is expected that this intelligent system could evolve into a teaching practice environment that offers individualized teaching simulation opportunities. For example, a specific preservice teacher who might need more teaching practice with disruptive students would be able to have more opportunities in their preferable setting.

Student-teaching has been considered as one of the most influential ways of professional development for preservice teachers to boost their teacher efficacy because it provides prolonged mastery experiences for them (Knoblauch & Hoy, 2008). Student-teaching is "a relatively safe and supportive environment for student-teachers when compared to their first year of teaching" (Fives et al., 2007, p. 930). Still, it has only been achieved in classrooms. It could be stressful and overwhelming for some preservice teachers to teach in the real classroom. This is the reason that Fives et al. (2007) called for additional supports from administrators and supervisors for supporting student-teaching. It should also be noted that teacher efficacy largely depends on the teaching context and is highly likely to change as the context changes (Bandura, 1997). Therefore, preservice teachers should be able to attempt their teaching in different environments and contexts as much as possible. However, it is impracticable to have sufficient teaching opportunities in a teacher education program. This is the contribution area of this study from a practical and technological viewpoint.

5.1. Limitations and future directions

There are notable limitations we encountered as we aimed towards the exploration in this study. First, although the results of this study show a significant impact of the teaching simulation, it is far from understanding the relationships between teacher efficacy, mastery experiences, and teaching simulation. There is a report that teacher efficacy levels were not associated with teacher-student relationships (Jong et al., 2014). In addition, in this study, the participants were undergraduate students, who might be sensitive to student-teacher relationships (Gencer & Cakiroglu, 2007). Preservice teachers tend to perceive themselves as effective at implementing a variety of instructional strategies and activities (Rimm-Kaufman & Sawyer, 2004). Therefore, more accurate quantitative and qualitative evidence for their relationships should be investigated further. Second, the use of chatbots requires further investigation. More studies are required in determining when and how AI agents can be utilized for teaching simulation most effectively. Along with the agent's attitudes, numerous factors could affect their efficacy, such as preservice teachers' gender, race, age, socioeconomic status, and indigenous characteristics (Kokkinos et al., 2005). These aspects are required to be included in future research. Third, another limitation of this study is the short period of implementation. We recommend examining long-term effects in future studies. Longitudinal studies replicating these findings are an important area for future research. Fourth, although it was reported that there are no significant differences between the third year and fourth year preservice teachers' efficacy (Gencer & Cakiroglu, 2007), future research needs to investigate the effect of technology-based teaching simulation with different populations of preservice teachers. Fifth, the design of this study did not include a control group due to practical issues. Even if there were effects for teacher efficacy after preservice teachers interact with an AI agent, the results would not necessarily reveal whether the effects were different from those who interact with real students. Future research is needed to investigate whether agents' effects supplement certain aspects of teacher efficacy that are possibly missing in classroom interaction. Sixth, due to the limitation of the training data, the chatbot's responses might not be natural or authentic. More sophisticated natural language processes and machine learning algorithms are needed for future implementation. Last, it should be noted that teacher efficacy is not the accurate level of capabilities, but a motivational and perceptual construct; thus, preservice teachers' practical teaching skills may be different from the measured teacher efficacy (Tschannen-Moran & Woolfolk Hoy, 2007). This also requires further investigation.

6. Conclusion

Teacher efficacy has emerged as an essential construct in the education research field over the past three decades. While a certain number of preservice teachers would attempt to transfer from pedagogies to teaching practice, they would inevitably face demanding environments with undesirable student behaviors. Despite the limitations, the results of this study are encouraging, and we suggest that the use of AI technology will shed light on increasing preservice teachers' teacher efficacy by motivating them to promote enactive mastery experiences. The level of difficulty in student-teaching, specifically, teaching disruptive students, is mostly unclear in classroom situations. If we use a more intelligent agent, the level of difficulty can be manipulative to identify optimal levels for meeting individual preservice teacher's needs. In this sense, this study presents important novel results that might suggest a method to utilize AI agent technology for preservice teacher training. Finally, we emphasize that preservice teachers should have mastery experiences through direct interaction with diverse students. This is because stronger teacher efficacy levels are associated with higher levels of student achievement and fewer turnover rates in their profession.

References

- Abbasi, S., & Kazi, H. (2014). Measuring effectiveness of learning chatbot systems on student's learning outcome and memory retention. *Asian Journal of Applied Science and Engineering*, 3(2), 251-260. <https://www.journals.abc.us.org/index.php/ajase/article/view/251-260>
- Appleton, K., & Kindt, I. (2002). Beginning elementary teachers' development as teachers of science. *Journal of Science Teacher Education*, 13(1), 43-61. <https://doi.org/10.1023/A:1015181809961>
- Arsal, Z. (2015). The Effects of microteaching on the critical thinking dispositions of pre-service teachers. *Australian Journal of Teacher Education*, 40(3), 140-153. <https://files.eric.ed.gov/fulltext/EJ1057900.pdf>
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191. <https://doi.org/10.1037/0033-295X.84.2.191>
- Bandura, A. (1986). *Social foundations of thought and action: A Social cognitive theory*. Prentice Hall.

- Bandura, A. (1997). *Self-efficacy: The Exercise of control*. Freeman.
- Bautista, N. U., & Boone, W. J. (2015). Exploring the impact of TeachMET™ lab virtual classroom teaching simulation on early childhood education majors' self-efficacy beliefs. *Journal of Science Teacher Education*, 26(3), 237-262. <https://doi.org/10.1007/s10972-014-9418-8>
- Beran, T. (2005). A New perspective on managing school bullying: Pre-service teachers' attitudes. *Journal of Social Sciences*, 8(3), 43-49. <https://doi.org/10.1.1.540.5922>
- Campbell, C., & Evans, J. A. (2000). Investigation of preservice teachers' classroom assessment practices during student teaching. *The Journal of Educational Research*, 93(6), 350-355. <https://doi.org/10.1080/00220670009598729>
- Cantrell, P., Young, S., & Moore, A. (2003). Factors affecting science teaching efficacy of preservice elementary teachers. *Journal of Science Teacher Education*, 14(3), 177-192. <https://doi.org/10.1023/A:1025974417256>
- Dicke, T., Parker, P. D., Marsh, H. W., Kunter, M., Schmeck, A., & Leutner, D. (2014). Self-efficacy in classroom management, classroom disturbances, and emotional exhaustion: A moderated mediation analysis of teacher candidates. *Journal of Educational Psychology*, 106(2), 569-583. <https://doi.org/10.1037/a0035504>
- Fives, H., Hamman, D., & Olivarez, A. (2007). Does burnout begin with student-teaching? Analyzing efficacy, burnout, and support during the student-teaching semester. *Teaching and Teacher Education*, 23(6), 916-934. <https://doi.org/10.1016/j.tate.2006.03.013>
- Gencer, A. S., & Cakiroglu, J. (2007). Turkish preservice science teachers' efficacy beliefs regarding science teaching and their beliefs about classroom management. *Teaching and Teacher Education*, 23(5), 664-675. <https://doi.org/10.1016/j.tate.2005.09.013>
- Gordon, C., & Debus, R. (2002). Developing deep learning approaches and personal teaching efficacy within a preservice teacher education context. *British Journal of Educational Psychology*, 72(4), 483-511. <https://doi.org/10.1348/00070990260377488>
- Jong, R., Mainhard, T., Tartwijk, J., Veldman, I., Verloop, N., & Wubbels, T. (2014). How pre-service teachers' personality traits, self-efficacy, and discipline strategies contribute to the teacher-student relationship. *British Journal of Educational Psychology*, 84(2), 294-310. <https://doi.org/10.1111/bjep.12025>
- Kim, H., & Cho, Y. (2014). Pre-service teachers' motivation, sense of teaching efficacy, and expectation of reality shock. *Asia-Pacific Journal of Teacher Education*, 42(1), 67-81. <https://doi.org/10.1080/1359866X.2013.855999>
- Kim, K. R., & Seo, E. H. (2018). The Relationship between teacher efficacy and students' academic achievement: A Meta-analysis. *Social Behavior and Personality*, 46(4), 529-540. <https://doi.org/10.2224/sbp.6554>
- Klassen, R. M., & Chiu, M. M. (2010). Effects on teachers' self-efficacy and job satisfaction: Teacher gender, years of experience, and job stress. *Journal of Educational Psychology*, 102(3), 741-756. <https://doi.org/10.1037/a0019237>
- Knoblauch, D., & Hoy, A. W. (2008). "Maybe I can teach those kids." The influence of contextual factors on student teachers' efficacy beliefs. *Teaching and Teacher Education*, 24(1), 166-179. <https://doi.org/10.1016/j.tate.2007.05.005>
- Kokkinos, C. M., Panayiotou, G., & Davazoglou, A. M. (2005). Correlates of teacher appraisals of student behaviors. *Psychology in the Schools*, 42(1), 79-89. <https://doi.org/10.1002/pits.20031>
- Kreynin, I., Manek, M., & Variawa, C. (2019). Creating a virtual chatbot to scaffold skills development in first-year engineering education. *Proceedings of the Canadian Engineering Education Association (CEEA)*. <https://doi.org/10.24908/pceea.vi0.13784>
- Lazarides, R., Buchholz, J., & Rubach, C. (2018). Teacher enthusiasm and self-efficacy, student-perceived mastery goal orientation, and student motivation in mathematics classrooms. *Teaching and Teacher Education*, 69, 1-10. <https://doi.org/10.1016/j.tate.2017.08.017>
- Lincoln, Y. S., & Guba, E. G. (1986). But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. In D. D. Williams (Ed.), *Naturalistic evaluation* (pp. 73-84). Jossey-Bass.
- Menon, D., & Sadler, T. D. (2016). Preservice elementary teachers' science self-efficacy beliefs and science content knowledge. *Journal of Science Teacher Education*, 27(6), 649-673. <https://doi.org/10.1007/s10972-016-9479-y>
- Muijs, D., & Reynolds, D. (2002). Teachers' beliefs and behaviours: What really matters? *Journal of Classroom Interaction*, 37(2), 3-15. <https://www.jstor.org/stable/23870407?seq=1>
- Mulholland, J., & Wallace, J. (2001). Teacher induction and elementary science teaching: enhancing self-efficacy. *Teaching and Teacher Education*, 17(2), 243-261. [https://doi.org/10.1016/S0742-051X\(00\)00054-8](https://doi.org/10.1016/S0742-051X(00)00054-8)
- Oh, E., Song, D., & Hong, H. (2019). Interactive computing technology in anti-bullying education: The Effects of conversation-bot's role on K-12 students' attitude change towards bullying problems. *Journal of Educational Computing Research*, 58(1) 200-219.

- Perera, H. N., Granziera, H., & McIlveen, P. (2018). Profiles of teacher personality and relations with teacher self-efficacy, work engagement, and job satisfaction. *Personality and Individual Differences, 120*, 171-178. <https://doi.org/10.1016/j.paid.2017.08.034>
- Pfitzner-Eden, F. (2016). I feel less confident so I quit? Do true changes in teacher self-efficacy predict changes in preservice teachers' intention to quit their teaching degree? *Teaching and Teacher Education, 55*, 240-254. <https://doi.org/10.1016/j.tate.2016.01.018>
- Polack, J. A., Clark, M., & May, J. E. (2017). Teaching simulation during a summer science research program: poster session. *Journal of Computing Sciences in Colleges, 32*(3), 75-76. <https://doi.org/10.5555/3015220.3015242>
- Putman, S. M. (2012). Investigating teacher efficacy: Comparing preservice and inservice teachers with different levels of experience. *Action in Teacher Education, 34*(1), 26-40. <https://doi.org/10.1080/01626620.2012.642285>
- Rimm-Kaufman, S. E., & Sawyer, B. E. (2004). Primary-grade teachers' self-efficacy beliefs, attitudes toward teaching, and discipline and teaching practice priorities in relation to the "responsive classroom" approach. *The Elementary School Journal, 104*(4), 321-341. <https://doi.org/10.1086/499756>
- Rushton, S. P. (2000). Student teacher efficacy in inner-city schools. *The Urban Review, 32*(4), 365-383. <https://doi.org/10.1023/A:1026459809392>
- Ryan, S. V., Nathaniel, P., Pendergast, L. L., Saeki, E., Segool, N., & Schwing, S. (2017). Leaving the teaching profession: The Role of teacher stress and educational accountability policies on turnover intent. *Teaching and Teacher Education, 66*, 1-11. <https://doi.org/10.1023/A:1026459809392>
- Skaalvik, E. M., & Skaalvik, S. (2016). Teacher stress and teacher self-efficacy as predictors of engagement, emotional exhaustion, and motivation to leave the teaching profession. *Creative Education, 7*(13), 1785-1799. <https://doi.org/10.4236/ce.2016.713182>
- Song, D., & Kim, D. (2020). Effects of self-regulation scaffolding on online participation and learning outcomes. *Journal of Research on Technology in Education, 53*(3), 249-263.
- Song, D., Oh, E., & Rice, M. (2017, July). Interacting with a conversational agent system for educational purposes in online courses. *Proceedings of the 10th International Conference on Human System Interaction* (pp. 78-82). IEEE. <https://doi.org/10.1109/HSI.2017.8005002>
- Sutton, R. E., & Wheatley, K. F. (2003). Teachers' emotions and teaching: A Review of the literature and directions for future research. *Educational Psychology Review, 15*(4), 327-358. <https://doi.org/10.1023/A:1026131715856>
- Thomas, K. E., & Mucherah, W. M. (2016). The Contextual difference: Developing preservice teacher efficacy through immersive learning experiences. *Education and Urban Society, 48*(4), 364-383. <https://doi.org/10.1177/0013124514533795>
- Troop-Gordon, W. (2015). The Role of the classroom teacher in the lives of children victimized by peers. *Child Development Perspectives, 9*(1), 55-60. <https://doi.org/10.1111/cdep.12106>
- Tschannen-Moran, M., & Woolfolk Hoy, A. (2007). The Differential antecedents of self-efficacy beliefs of novice and experienced teachers. *Teaching and Teacher Education, 23*(6), 944-956. <https://doi.org/10.1016/j.tate.2006.05.003>
- Tschannen-Moran, M., & Woolfolk Hoy, A. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education, 17*, 783-805. [https://doi.org/10.1016/S0742-051X\(01\)00036-1](https://doi.org/10.1016/S0742-051X(01)00036-1)
- Yoon, J., Sulkowski, M. L., & Bauman, S. A. (2016). Teachers' responses to bullying incidents: Effects of teacher characteristics and contexts. *Journal of School Violence, 15*(1), 91-113. <https://doi.org/10.1080/15388220.2014.963592>
- VanLehn, K. (2011). The Relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. *Educational Psychologist, 46*(4), 197-221. <https://doi.org/10.1080/00461520.2011.611369>
- Wiersma, W., & Jurs, S. G. (2005). *Research methods in education: An Introduction*. Allyn & Bacon.
- Winkler, R., & Soellner, M. (2018). Unleashing the potential of chatbots in education: A State-of-the-art analysis. *Academy of Management Proceedings, 2018*(1), 15903. <https://doi.org/10.5465/AMBPP.2018.15903abstract>
- Wheatley, K. F. (2005). The Case for reconceptualizing teacher efficacy research. *Teaching and Teacher Education, 21*(7), 747-766. <https://doi.org/10.1016/j.tate.2005.05.009>
- Zee, M., & Koomen, H. M. (2016). Teacher self-efficacy and its effects on classroom processes, student academic adjustment, and teacher well-being: A Synthesis of 40 years of research. *Review of Educational Research, 86*(4), 981-1015. <https://doi.org/10.3102/0034654315626801>
- Zeichner, K. (2002). Beyond traditional structures of student teaching. *Teacher Education Quarterly, 29*(2), 59-64. <https://www.jstor.org/stable/23478291>