

DEVELOPMENT OF PRE-SERVICE TEACHER REFLECTION THROUGH THE
USE OF ARTIFICIAL INTELLIGENCE FEEDBACK

by

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USE OF ARTIFICIAL INTELLIGENCE FEEDBACK

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Abstract

This study explores the use of artificial intelligence (AI) and targeted reflection to enhance the teaching practices of pre-service teachers. Utilizing the ClassifAI software, pre-service teachers received objective feedback on key instructional components, such as opportunities to respond, teacher talk versus student talk, and the level and amount of questioning. The research aimed to assess the effectiveness of AI-driven feedback and targeted reflection questions in providing pre-service teachers with valuable, objective insights to reflect on their instructional methods. The results indicate that the integration of AI and structured reflection significantly improved participants' awareness of their teaching practices, with a marked increase in the use of higher-order questions and a greater variety of opportunities for student response. Additionally, participants reported using AI as a tool to track their growth, set teaching goals, and refine their instructional strategies. Despite challenges in the accuracy of AI analysis and the limitations of audio-based data collection, the study demonstrates the potential of AI to support reflective practice and professional development in teacher preparation programs.

Background

Teacher reflection is a crucial step in the lesson-planning process (Elford et al., 2022). Through self-reflection, teachers are able to learn and adjust their planning and instruction to support their students. In this study, the ClassifAI software and targeted reflection questions are used to provide pre-service teachers with objective feedback in opportunities to respond, including comparing teacher talk vs student talk, level of questioning, and amount of questioning.

Feedback and reflection are essential components of effective teaching and learning. Teachers and students alike benefit from receiving feedback. Reflection should focus on both the planning and implementation of lessons to enhance instructional effectiveness. One critical area often overlooked in teacher preparation programs is the opportunity for pre-service teachers to receive objective feedback and engage in intentional reflection on their lesson planning and instruction. Pre-service teachers at Texas Christian University (TCU) dedicate extensive time and effort to planning a single lesson. Yet, after teaching it, they often move on without revisiting or analyzing their approach. As a result, many find themselves merely going through the motions of planning and teaching rather than actively reflecting on their instructional decisions and their impact on student learning, limiting their ability to learn from and improve upon their instructional practices. Integrating structured feedback and reflection into teacher training programs can help bridge this gap, fostering continuous growth and improvement.

Problem Statement

Teachers are constantly planning and instructing, but frequently neglect to reflect on their planning and instruction, which misses an opportunity for the teacher to learn and adjust instruction. During observations, principals and vice principals may be subject to bias or only

provide limited feedback, not representative of the whole synopsis of the lesson. This limits the teacher to a few recommendations for improvement, which may just be indicative of the appraiser's preference.

Purpose

The purpose of this study is to provide pre-service teachers with valuable means to learn from their instruction through the use of AI, objective feedback, and targeted reflection, specifically related to three evidence-based practices for improving student engagement: (a) opportunities to respond, (b) teacher talk vs. student talk, and (c) higher-order questions

Research Question

This study seeks to examine the effectiveness of AI and targeted reflection in providing pre-service teachers with valuable and objective feedback. The overarching research question guiding this study is: *How effective is AI-driven instructional feedback and targeted reflection at providing pre-service teachers with valuable and objective reflection?* To explore this question, the research focuses on three key subquestions: (a) How does the use of higher-order questions (e.g., “how” and “why” questions) by pre-service teachers change over the course of their teaching experience? (b) How does the incorporation of opportunities for student responses evolve throughout the participants' teaching experience? (c) In what ways do structured reflection prompts, informed by AI-generated feedback, shape pre-service teachers' awareness of their instructional strengths and areas for growth? By addressing these subcategories, this study aims to provide insights into how AI-driven feedback and structured reflection contribute to the professional development of pre-service teachers.

Literature Review

Feedback is a cornerstone of effective teaching and professional development, particularly for pre-service educators. As future professionals, these individuals rely on structured, meaningful feedback to refine their instructional practices and foster continuous growth. The book *GET Feedback: Giving, Exhibiting, and Teaching Feedback in Special Education Teacher Preparation* emphasizes the essential characteristics of effective feedback, also highlighting the role of adult learning theory in shaping feedback practices that support professional development (Elford et al., 2022). Similarly, Knight and Faggella-Luby (2024), in the book *Data Rules*, explore the integration of data-driven feedback through structured frameworks such as the Impact Cycle, which helps teachers identify areas for improvement, learn new strategies, and implement data-informed refinements following the 10 Data Rules. Both works examine the transformative potential of technology in enhancing feedback mechanisms, whether through technology-based reflection or real-time coaching. This literature review examines the intersection of feedback, data-driven reflection, and technology, analyzing their collective impact on teacher development and student engagement.

GET Feedback: Giving, Exhibiting, and Teaching Feedback in Special Education Teacher Preparation

Feedback holds an essential role in administering the growth of an individual, specifically pre-service teachers. Feedback “is any information the recipient receives that informs their understanding or restructures their thinking or beliefs related to their performance, knowledge, or skills” (Elford et al., 2022, p. 4). Elford and colleagues (2022) note that effective feedback is characterized by four key domains: specificity, immediacy, purposefulness, and constructiveness (Elford et al., 2022). These elements contribute to the efficacy of feedback, ensuring that it is meaningful and impactful. Understanding the significance of feedback also necessitates an

appreciation of the role of reflection. The process of reflecting on feedback enhances learning and professional growth, particularly for educators. However, feedback for adults differs significantly from that given to young students. The concept of andragogy, or the science of adult learning, provides a framework for tailoring feedback to adult learners. Pre-service educators are future professionals and young adults and are at an important transition point to receive this targeted feedback. Elford et al. (2022) outline six core principles of adult learning theory:

[Table 1 about here]

First, adults want to understand the purpose behind their learning. For example, explaining that ClassifAI can transcribe student speech, identify different speakers, and generate summaries can help teachers see its value in assessing participation and understanding. Second, adults see themselves as capable of making decisions and prefer to take ownership of their learning. In the context of this project, professional development should offer choice and flexibility, such as allowing educators to explore features of AI and target reflection at their own pace or choose specific classroom audio recordings to analyze. Third, adult learners bring a wealth of prior experience into new learning. Teachers already have mental models of classroom dynamics and student engagement. The AI program and target reflection prompts build on this by providing new tools to analyze familiar situations—such as identifying patterns in questioning. Fourth, adults are most ready to learn when the material relates directly to their real-life tasks or challenges. The material the AI analyzes is directly related to relevant challenges an educator may be experiencing. Fifth, adults prefer learning that is focused on solving real-world problems. Learning should be contextualized around classroom scenarios; for instance, the AI and targeted questions used in this study are targeted for a likely scenario in any classroom. Sixth and lastly, while external incentives can help, adults are primarily motivated by internal goals—such as

improving student outcomes, becoming more efficient, or gaining confidence with technology. Demonstrating how AI feedback and targeted reflection support student growth and enhance teaching strategies helps reinforce its payoff for educators. By integrating adult learning theory into feedback practices, educators can ensure that feedback is more effective and conducive to professional development. This theoretical foundation informs the development of the targeted reflection questions used in this study, emphasizing the necessity for teachers to perceive clear benefits in engaging with the reflection process.

Technology has increasingly become a powerful tool for delivering feedback, providing innovative methods that align with the key domains of effective feedback. The authors highlight various technological approaches, including bug-in-ear coaching, video-based feedback, simulations, and video reflection technology, all of which enhance the feedback process (Elford et al., 2022). Building on this body of research, this thesis will explore the integration of AI as a feedback mechanism, examining its potential to facilitate targeted reflection and support educators in their professional growth. However, what is it that educators should be reflecting on?

Data Rules

In *Data Rules* (2024), Drs. Jim Knight and Michael Faggella-Luby emphasize the critical role of data-driven feedback in improving instructional practices. The authors advocate for teachers to systematically collect and utilize data to refine both planning and teaching. The authors discuss the *Impact Cycle* as a means to use data to improve teaching. The Impact Cycle is a three-stage framework designed to foster instructional improvement: Identify, Learn, and Improve (Knight & Faggella-Luby, 2024). This cyclical process enables educators to assess their current practices, acquire new strategies, and implement refinements based on data-driven

insights. Additionally, the book argues 10 Data Rules for using data to improve teaching. These are rules to guide educators towards appropriate uses of data and effective outcomes from data use.

[Table 2 about here]

The book addresses the complexities of student engagement, a crucial yet challenging aspect of effective teaching. Engagement is inherently variable and difficult to assess using traditional methods. ClassifAI, the AI program used in this study, codes for questioning as a modality for student engagement. The authors categorize engagement into three domains: Behavioral, Cognitive, and Emotional (Knight & Faggella-Luby, 2024). The authors explain the importance of fostering engagement, particularly in the pursuit of equitable education. “If we want equitable schools, where all students have an equal chance to succeed, we need to create schools where students are engaged” (Knight & Faggella-Luby, 2024, p. 92). Building engagement to improve student learning outcomes can come directly from collecting data related to opportunities to respond, level/amount of questioning, and teacher time talking vs student time talking during an audio recording. These data points are what the primary research focuses on, which are all data points collected by ClassifAI. This reinforces the necessity of equipping teachers with effective strategies to enhance student participation and learning outcomes. AI, as used in this study, builds on the framework presented in the Data Rules book and how this technology can be used for teachers' benefit.

Technology is highlighted as a powerful tool in facilitating feedback across various modalities. One particularly impactful method is video analysis, which plays a significant role in the Identify stage of the Impact Cycle. As the authors state, “When people review a video of themselves doing their work, they move from talking about change to doing something about

change” (Knight & Faggella-Luby, 2024, p. 63). Video recordings provide teachers with an objective lens through which they can analyze their instructional methods. Unlike subjective feedback, which may be influenced by personal opinions, video-based objective feedback is rooted in observable, measurable data, allowing for a more precise and actionable reflection process. Obtaining permission to record video can be challenging, but imagine if there were an audio-based solution instead. This objective feedback serves as a mirror for educators, offering a clear reflection of their performance. The significance of this study lies in its focus on providing teachers with efficient and effective means of reflection to refine their instruction, particularly in relation to increasing opportunities for students to respond and promoting higher-order questions. By leveraging feedback and reflection, educators can create more dynamic, responsive, and equitable learning environments.

Method

Participants

The sample included seven undergraduate third-year pre-service teachers in the first semester of their teacher education program. The students were enrolled in EDSP 30343 Special Education Methods and Assessment concurrently with EDSP 30341 Special Education Field Experience. The course focus is on the procedures and processes for assessing and teaching basic academic skills, including oral language, reading, written language, and mathematics to students with disabilities. Additionally, the course discusses the individual education program planning and monitoring, as well as how to design and deliver explicit instruction to students who are underperforming in typical classroom settings (Faggella-Luby, 2024, See Figure 1).

[Figure 1 about here]

Participants were notified that their participation or lack thereof in this study would not affect their grade outcome. If concerned about their participation, they were asked to talk to me or the teaching assistant (TA) of the course. Throughout the study, anonymity was practiced, and confidentiality was maintained.

Materials

ClassifAI is “A Human-Centered AI-Driven Instructional Feedback System”. The ClassifAI software was developed by Texas Christian University Computer Science students and faculty members Dr. Liran Ma, Dr. Faggella-Luby, and Dr. Alexander over the course of two years (Ma et al., 2024; See Figure 2).

[Figure 2 about here]

ClassifAI includes a range of powerful features designed to process and analyze audio content. It uses speech recognition to convert spoken words into text and speaker diarization to distinguish between different voices in an audio recording. The platform can also summarize long recordings into clear, concise overviews. It categorizes and analyzes questions by type to uncover key insights. Finally, users can easily export the processed data in a variety of formats for further use. The questions are categorized using Costa’s Levels of Questioning, which categorizes questions or tasks based on the challenge or rigor of skill that is being asked of the student (Costa, 1985). The levels of the program and classifications in the transcript are, “Level 1 - Gathering, Level 2 - Processing, and Level 3 - Applying. For simplicity, we will denote each level as Low, Medium, and High Level, respectively. Additionally, we will denote inconclusive classifications as NA” (Costa, 1985). To use the program, individuals may upload an audio file. The program will provide a transcript of the audio submission, along with a word cloud of repeated words, a

talking distribution pie chart, a question Costa level distribution graph, and a collapsed timeline of questions.

The reflection questions provided to the students to reflect and respond to after receiving data from the ClassifAI program were crucial to narrowing reflection based on the AI program. The reflection questions can be found below. There were three cycles of reflection: Cycle One, at the beginning of the course; Cycle Two, in the middle; and Cycle Three, at the end of the course.

[Table 3, 4, and 5 about here]

Design

The study is designed to measure the effectiveness of using AI and questioning to aid teacher reflections. Students who participated in the study were teaching at the Starpoint school one day a week as part of the EDSP 30241 course requirement. Before the study began, the primary researcher met with the students of the course. This study was part of a class assignment. The primary researcher was introduced and explained the research questions and purpose of the study (See Figure 3). Additionally, the researcher provided an overview of the features of ClassifAI and a demo for students to see how the program works. The primary researcher explained to participants what they would be asked to do if they wanted their data to be included in the study, as well as provided students with an introduction to providing their students opportunities to respond throughout instruction and higher-order questioning.

[Figure 3 about here]

Randomly selected participants were asked to record a small portion of the lesson. It was suggested that the most interactive or engaging part be recorded, as decided upon by the participants themselves. The researcher advised participants to record at least twenty minutes of

their lesson to have an adequate sample for the AI program to analyze. The participants were then asked to upload their audio recordings to the ClassifAI software and analyze the results the AI provided. After students imported the audio recording into the ClassifAI software, the students were asked to respond to reflection questions. The students were given these questions to reflect a total of three times throughout the semester - during the first few weeks of teaching, in the middle, and at the end of the semester.

Data Collection

The participants' reflection question data were collected through TCU Box, an encrypted file-sharing program. The participants' identities were removed and given an alphanumeric code for coding and analysis to maintain confidentiality..

Coding and Analysis

Following the submission of the participants' reflections, the responses were coded using a method called focused coding. The focused coding followed a specific set of steps, including: (a) preparing the data, (b) reviewing first cycle codes, (c) creating tentative categories, testing and adjusting categories, and developing an outline (Saldana, 2012). Through focused coding, common themes were found in the data from the participants' responses.

Researcher Positionality

The primary researcher, Lauren Schenk, is a pre-service teacher in the TCU College of Education, who just last year was enrolled in the EDSP 30242 Special Education course. There is a potential for personal bias as I was once in the participants' role. The researcher is now student teaching at an elementary school in Fort Worth ISD.

Results

The findings of this study emerged through a comprehensive analysis of participants' responses across three structured reflection cycles. The results are organized into six key themes: Higher-Order Thinking Questions; Response and Adjustments; Varieties of Opportunities to Respond; Understanding the Significance of Opportunities to Respond; Reflecting on the Impact of Opportunities to Respond; and the Benefits of Reflective Practice. These categories encapsulate the central insights gained from the data and illustrate the nuanced ways in which AI feedback and targeted reflection informed participants' instructional decisions and professional growth.

Higher-Order Thinking Questioning

A higher-order thinking question is a question that involves demonstrating an elevated understanding of concepts and noticing connections between concepts. These include big idea questions. The targeted reflection questions ask the participants to note how many total questions they asked during their lesson and how many how/why questions the participants asked during their lesson. For this study with pre-service teachers, high-order questions are counted if the question begins with the word "how" or "why." To determine the effect of the feedback and reflection on including high-order thinking, the average was taken from each of the participants' responses. For reflection cycle one, the average total number of questions asked was 63.7, and the average number of higher-order questions was 9.6. For reflection cycle two, the average total number of questions asked was 82.6, and the average number of higher-order questions asked was 14.8.

[Figure 4 about here]

From reflection cycle one to reflection cycle two, the average amount of higher-order questions (how/why) and the average total number of questions asked increased.

Response and Adjustments

The targeted reflection questions asked students to choose one question the participant asked during their lesson that they did not get an intended response. The reflection asked, *What was the question? How did you reteach or rephrase the questions to the student? What was the outcome of your adjustment? Did your student eventually get to the correct answer?* The data showed that if a teacher asked a question during the lesson that did not receive a correct or intended response from the student, rephrasing the question improved accuracy as demonstrated in this participant's response, "However, I noticed that after one student responds to a question, I move on. I want to rephrase my questions to require a response from each student" (Participant x8.2). For this participant, not only did rephrasing the question aid the student in reaching the correct answer, but it also included all students in the learning by providing opportunities to respond. Participants additionally noted that recalling previous knowledge improved accuracy if a teacher asked a question during the lesson that did not receive a correct or intended response from the student. An example of this result is described by the participant: "When my students struggled to describe the definition of conflict after the lesson, I asked them if they remembered the way I described it" (Participant x5.1). In this scenario, the participant was attempting to trigger the student's background knowledge to help build on understanding.

Variety of Opportunities to Respond

Participants planned and included a variety of opportunities to respond in their lesson plans and instruction. An opportunity to respond is any chance a student has to respond to the content. The opportunity to respond can come in many different modalities. Pre-service participant teachers at Starpoint incorporated both verbal and non-verbal opportunities to respond. Including, but is not limited to, writing, illustrating, question response, raising hands,

using whiteboards, choral response, demonstration, and head nodding. For each reflection cycle, participants were to reflect on three opportunities to respond. All seven participants included “verbal response”, “verbal feedback”, or “verbal questioning” as an opportunity to respond modality. All seven participants included writing as a modality of opportunity to respond. Five participants included drawing as an opportunity to respond. Three participants used checklists for students to respond.

[Figure 5 about here]

To illustrate the opportunity to respond to data, the researcher inputted the data into a word cloud processor. This is a measure of analysis for the use of opportunities to respond to instruction. The larger text illustrates modalities that were used more than smaller text sizes, which demonstrates modalities that were used less often in the data, documenting the variety of use of opportunity to respond modalities. The visual indicates that the three largest words were verbal and writing, and other significant words include checklist and drawing. This indicates that these words/modalities of opportunities to respond were used more often than others by the participants during instruction.

Understanding the Significance of Opportunities to Respond

The targeted questions in reflection cycle one encouraged participants to discuss the significance of providing opportunities for students to respond. In their responses, participants highlighted several key benefits, including fostering critical thinking, enhancing engagement, reinforcing learning, facilitating timely feedback, improving communication skills, building student confidence, and enabling teachers to make informed decisions based on student responses. One participant elaborated on the importance of providing modalities when they said, “When students actively engage by responding, they process the content more deeply, which

enhances their understanding and retention" (Participant X5.1). This participant recognizes that active participation is important, in contrast to passive learning. One participant emphasized the instructional value of actively engaging students through frequent opportunities to respond, noting its impact on learning and classroom engagement:

Providing students opportunities to respond is important for developing students learning because it serves as a way to keep them engaged with the material/content that is being learned. I am realizing that in my lesson, there is definitely room for me to provide more OTR [Opportunities to Respond] (Participant X9.1).

Participant X9.1 not only recognizes the pedagogical importance of this strategy but also identifies an area for personal growth, indicating that reflective practice is prompting actionable insights for instructional improvement.

Reflecting on the Impact of Opportunities to Respond

The second reflection cycle encouraged participants to examine how increasing opportunities for students to respond could influence both teaching and learning. Many participants highlighted that providing more opportunities to respond enables teachers to gather immediate feedback, make real-time instructional adjustments, and refine future lesson planning. Additionally, this practice can help pre-service teachers recognize the value of allowing sufficient wait time for students to process and articulate their responses. One participant reflected on this experience, stating:

While focusing on implementing more opportunities to respond, I have noticed a higher engagement from my students. The increase in OTRs also provides me with more formative assessment data that I can use during the lesson (to make in-the-moment

teaching decisions) and after the lesson (to reflect on and plan for the next lesson) (Participant X8.2).

This participant has noticed an increase in engagement as a result of implementing more opportunities to respond. Due to the increase in opportunities to respond, the student has also been able to develop data to inform instruction in the moment and for future planning.

Benefits of Reflective Practice

The third reflection cycle provided pre-service teachers with an opportunity to broadly reflect on their growth and the process of using AI to provide feedback and aid reflection. Participants found that using ClassifAI technology helped objectively identify areas for improvement. One participant noted, “A big takeaway was becoming aware of areas where I can improve, like adding more open-ended questions or providing extra support for students who might struggle” (Participant X4.3). Another offered, “It has helped me to see my blindspots, and refocus on certain areas that seemed too difficult in the beginning... and see what I am too little or too much of” (Participant Y4.3). Many participants also expressed interest in using this technology in the future to objectively track their growth as educators, set personal goals, and identify areas for improvement. This participant explained, “Reflecting on this process has made me more intentional about designing lessons that balance guidance with opportunities for student independence” (Participant X5.3). Knowing what areas of instruction the participants could improve, the pre-service teacher participants were subsequently able to design their lesson plans more intentionally, focusing on areas of need to best support and guide the student to success.

Discussion

The primary objective of this study is to provide teachers with a valuable means for reflection and improvement of their instruction. The goal was to assess the effectiveness of AI

and targeted reflection questions in enhancing the reflective practices of pre-service teachers. A randomly selected group of volunteer third-year pre-service teachers utilized the ClassifAI software to analyze recordings of their own lessons from Starpoint School. Through this process, they received AI-generated feedback and responded to structured reflection questions, allowing them to evaluate their lesson planning and implementation. The findings from this study highlight several important trends regarding pre-service teachers' use of higher-order questions, opportunities to respond (OTR), and the impact of reflective practices on teaching and learning.

Higher-Order Thinking Questioning

The results show a noticeable increase in both the average number of higher-order thinking (HOT) questions and the total number of questions asked by pre-service teachers from reflection cycle one to reflection cycle two. On average, from reflection cycle one to reflection cycle two, there is about a five-question increase in higher-order questions asked on average. The data additionally shows an average of 20 questions increase in total questions asked throughout the audio recording. This trend suggests that with experience and reflection, pre-service teachers are becoming more proficient in incorporating HOT questions into their teaching. The focus on "how" and "why" questions, which are central to fostering deeper student understanding and critical thinking, aligns with previous research that underscores the importance of these types of questions in promoting cognitive development, "Teachers often rely on basic recall questions, which can hinder critical thinking, but carefully planning questions using cognitive taxonomies can promote a higher order of thinking" (Nappi, 2017). The increase in the use of such questions may reflect greater confidence and awareness among pre-service teachers as they gain more exposure to questioning strategies that elicit deeper student engagement and reasoning.

Responses and Adjustments

The data also revealed that when pre-service teachers asked questions that did not elicit the intended response, rephrasing the question or reviewing previous knowledge significantly improved the accuracy of student responses. This finding highlights the importance of teacher flexibility and responsiveness to student needs. When teachers encounter incorrect or unclear responses, their ability to adjust their questioning is a critical component of effective instruction. Rephrasing questions allows teachers to scaffold student thinking and promote understanding, a practice that can lead to better student outcomes. Furthermore, the use of prior knowledge to support corrections emphasizes the importance of connecting new content to students' existing knowledge base, which is known to aid learning retention. For students to be successfully engaged, educators must support ideal engagement to provide for an equitable learning environment.

Variety of Opportunities to Respond

Participants in the study demonstrated a commitment to providing diverse opportunities for students to respond. The use of both verbal and non-verbal modalities, such as writing, illustrating, and using whiteboards, enhances student engagement and provides multiple avenues for participation. This finding is significant as it relates to previous research, “Increasing teacher-directed opportunities to respond resulted in higher levels of student participation, greater accuracy in responses, improved academic performance, and positive student behavior” (MacSuga-Gage & Simonsen, 2015). The word cloud analysis of the data reveals the range of OTR methods employed, encouraging the variety of approaches that pre-service teachers used to elicit responses. This variety not only helps accommodate different learning styles but also ensures that all students have the chance to engage with the content in ways that best suit their needs.

Understanding the Significance of Opportunities to Respond

The reflection responses indicated that pre-service teachers recognized the value of providing OTR, not just for engagement but for promoting deeper learning. As one participant noted, OTRs help students process content more deeply, improving understanding and retention of knowledge. By actively engaging with the material, students are more likely to internalize concepts and develop critical thinking skills. The participants' acknowledgment of the need to provide more OTRs also points to their growing understanding of how important it is to keep students actively involved in the learning process.

Reflecting on the Impact of Opportunities to Respond

The second reflection cycle further highlighted the positive impact of increased OTRs on both teaching and learning. Participants reported that providing more OTRs not only enhanced student engagement but also enabled teachers to gather real-time formative assessment data. This data allowed them to make on-the-spot instructional adjustments, demonstrating the importance of responsive teaching. Moreover, the reflective process emphasized the significance of wait time, as it allows students to process information and formulate thoughtful responses. The increased engagement and data collection that participants experienced highlight the benefit of OTRs as a tool for both immediate instructional decision-making and future lesson planning.

Benefits of Reflective Practice

Finally, the third reflection cycle demonstrated the value of using reflective practices and technology (such as ClassifAI) to support teacher growth. Participants reported that the feedback from the AI helped them identify areas of improvement, such as the need for more open-ended questions or additional support for struggling students. The ability to objectively track growth and reflect on one's teaching practices is valuable for pre-service teachers, as it encourages

self-awareness and promotes ongoing professional development. Participants also expressed a desire to continue using this technology in the future to track their progress and set personal goals for growth, indicating that they found the reflective process to be both valuable and motivating.

Limitations of Artificial Intelligence

As evident to anyone who has used any variation of AI programming, AI technology is far from perfect. The same is the case with the ClassifAI program. As reported by the pre-service teacher participants and through observations, the AI has trouble uploading the audio, detecting voice from the audio in the transcript, classifying speakers in the transcript (teacher vs. student), and categorizing levels of questions. Overall, the ClassifAI had variable accuracy for participants. The AI lacks personability, which an appraiser may hold for observation and feedback.

Limitations

Limitations were apparent throughout this study and played a role in the outcome and success. First, the audio recording only documents verbal opportunities to respond; thus, the non-verbal opportunities to respond, like writing, could not be observed using the ClassifAI software. Findings are limited to verbal opportunities to respond, and non-verbal may be just as valuable for learning. Second, the length of the audio recordings varied across sessions, potentially affecting the consistency of data collected. This was due to participant variety. Third, the nature of the lesson (i.e, writing) influenced the amount and type of student response. This means that, for example, in a writing lesson, the opportunity to respond would be non-verbal (writing), thus, no audio would be recorded. For some students, the frequency of questioning may not have increased significantly—or at all—depending on the nature of the lesson. In later

lessons, opportunities for non-verbal responses were incorporated, though these could not be captured by the audio recording. The amount of questioning during lessons did not uniformly increase across all students. Fourth, engagement levels were not directly measured and were instead based on subjective teacher observations, leaving room for potential bias in assessing authentic engagement. Lastly, the study did not include a comparative analysis to determine how student performance or questioning trends might have changed across different conditions.

Recommendations

Develop structured methods for incorporating objective reflection into lesson planning for you before, during, and after lessons. Teachers should regularly analyze the effectiveness of their instruction based on objective data and feedback, considering both student engagement and learning outcomes.

Conclusion

Overall, the results of this study suggest that pre-service teachers are making notable strides in improving their questioning techniques, providing diverse opportunities for student responses, and using reflective practices to enhance their teaching. By focusing on higher-order questions and opportunities to respond, pre-service teachers can foster more engaging and effective learning environments. These findings have implications for teacher preparation programs, which can further emphasize the importance of reflection, flexible teaching strategies, and the use of technology to support ongoing teacher development.

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Appendix

Table 1

Core Principles of Adult Learning Theory

1. Learners need to know (the “what, why, and how)
 2. Self-concept of the learner (autonomous and self-directing)
 3. Prior experience of the learner (resources and mental models)
 4. Readiness to learn (life-related, developmental task)
 5. Orientation to learning (problem-centered, contextual)
 6. Motivation to learn (intrinsic value, personal payoff)” (Elford et al., 2022, p. 10-11)
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Adapted from p.10-11 Elford et al. (2022)

Table 2

10 Data Rules

1. Data Should Foster Hope
2. Data Should Be Tied to Professional Learning
3. Data Should Be Chosen by the Teacher
4. Data Should Be Objective
5. Data Should Be Reliable and Mutually Understood
6. Data Should Be Valid
7. Data Should Be Gathered Frequently
8. Data Should Be Gathered by the Teacher
9. Data Should Be Easy to Gather and Review
10. Data Should Be Validated by Research

Adapted from p.21-35 Knight & Faggella-Luby (2024)

Table 3

Targeted Reflection Questions (Cycle One)

How many questions did the ClassifAI determine you had?

How many questions did you count that you have based on the transcript?

Does ClassifAI match your actual lesson delivery?
 Calculate: % Agreement = (total number of agreements / total number of questions) x 100 =

Choose one question you asked during your lesson, that you did not get a response you intended.

- What was the question?
- How did you reteach or rephrase the questions to the student?
- What was the outcome of your adjustment made?
- Did your student eventually get to the correct answer?

How many “how” and “why” questions did you ask throughout your lesson?

- Calculate % how/why questions = (total number how/why questions/ total number of questions) =

An opportunity to respond can come in many different modalities (verbal response, non-verbal - thumbs up, whiteboard, writing, etc.) What opportunities to respond did you provide for your Starpoint student in your lesson? Name and explain at least three.

-
-
-

Why is providing students opportunities to respond important for developing the student's learning?

Table 4

Targeted Reflection Questions (Cycle Two)

How many questions did the ClassifAI determine you had?

How many questions did you count that you have based on the transcript?

Does ClassifAI match your actual lesson delivery?
 Calculate: % Agreement = (total number of agreements / total number of questions) x 100 =

Choose one question you asked during your lesson, that you did not get a response you intended.

- What was the question?
- How did you reteach or rephrase the questions to the student?
- What was the outcome of your adjustment made?
- Did your student eventually get to the correct answer?

How many “how” and “why” questions did you ask throughout your lesson?

- Calculate % how/why questions = (total number how/why questions/ total number of questions) =

An opportunity to respond can come in many different modalities (verbal response, non-verbal - thumbs up, whiteboard, writing, etc.) What opportunities to respond did you provide for your Starpoint student in your lesson? Name and explain at least three.

-
-
-

How is providing students more opportunities to respond impacting your teaching and student learning?

Table 5

Targeted Reflection Questions (Cycle Three)

How did the total number of opportunities to respond change across your three lessons? How did that impact student learning? Student engagement?

How did the total number of how/why questions change across your three lessons? Did the percentage change?

Why is providing students with opportunities to respond important for developing their learning?

How does the number of opportunities to respond that a teacher provides impact student learning and engagement?

How was the process of running the transcript through ClassifAi and analyzing your transcript of instruction beneficial for your learning and teaching practice? What went well? What was challenging?

How might this technology benefit you in assessing your lesson delivery and instruction?

What reflections do you have on this process for improving the design of your lesson plans?

Figure 1

TCU Pre-Service Teacher teaching with Starpoint Student as a requirement of EDSP 30341

Special Education Field Experience course



Figure 2

ClassifAI Logo

Figure 3

Presentation to Pre-Service Teacher Participants

The slide is titled "Organizing Our Reflections" and is presented in a software application window. The content is organized into two main sections: a bulleted list on the left and a screenshot of the ClassifAI website on the right.

- Meet Lauren
- Purpose
- Features of ClassifAI & Demo
- Honors project
 - Part of Class
 - Voluntary
- Explain Reflections
- Procedures
 - Choose and interactive part of your lesson
 - Audio record at least 20 minutes
 - Upload to ClassifAI based on class schedule

The screenshot of the ClassifAI website shows a dark-themed interface. At the top, there is a navigation bar with the ClassifAI logo and "Account Sign Out" links. A sidebar menu on the left includes "Analyze", "My Reports", "Export Data", "Files", "Account", and "Legacy Analyze". The main content area features a toggle for "Use YouTube Link", a request to "Please upload an audio or video recording to be transcribed and analyzed", and lists of accepted audio and video file formats. A "Choose File" button is present, along with a "Privacy Disclaimer" and an "Analyze Recording" button. The URL <https://classifai.tcu.edu/home/> is displayed below the interface. The ClassifAI logo is also shown in a separate box at the bottom right of the screenshot.

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Figure 4

Change in Total Questions and Higher Order Thinking Questions

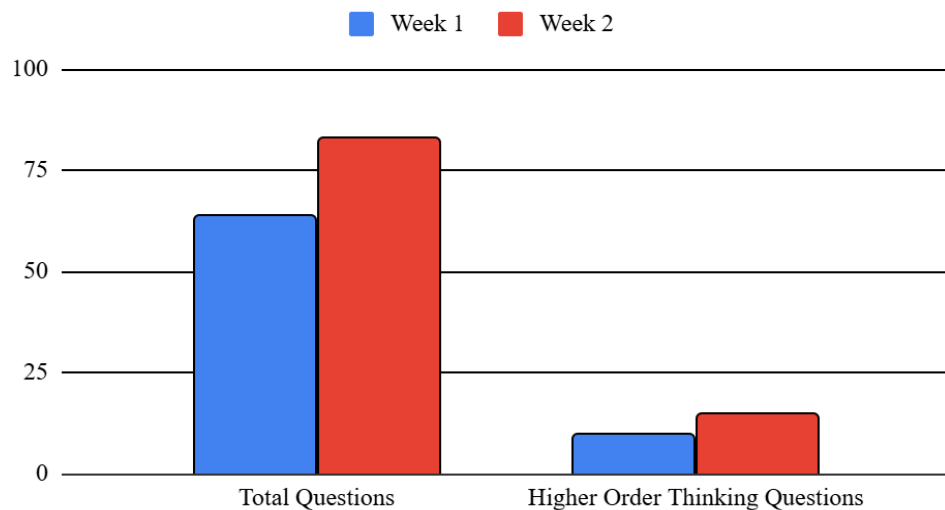


Figure 5

