

## Holistic Virtual Simulation Platform for Pre-service Teachers' Questioning and Discussion Skill Development

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**Abstract:** This study explores the use of a holistic virtual simulation platform to develop pre-service teachers' questioning and discussion skills. Asking effective questions and facilitating discussions are fundamental yet challenging skills for pre-service teachers to master. Robust experiences for pre-service teachers to practice questioning and discussion skills in a COVID-19 free environment are needed. Kolb's (1984) experiential learning theory combined with Ericsson's (2007) deliberate practice was used as a theoretical framework to design the holistic virtual simulation platform. The platform combines a synchronous experience using a virtual simulation where participants interact with avatar students, and an asynchronous experience using a learning management system for skill development. Mentor feedback based on the Danielson (2013) rubric was provided throughout both the synchronous and asynchronous events. Using a mixed-method approach, pre-service teachers' questioning and discussion skill development and their experience of using the holistic virtual simulation platform were explored.

### Introduction

A teacher's ability to effectively teach is associated with many important outcomes such as teacher job satisfaction, teaching longevity, and student achievements (Goodwin, 2012; Karbownik, 2014; Von Der Embse et al., 2016); however, evidence shows that many newly hired teachers are unprepared (Levine, 2006) and lack fundamental teaching skills when they enter the classroom as teachers (Dias-Lacy & Guirguis, 2017). Traditional pedagogies and opportunities to develop skills such as in-class activities and practicum have been shown to be ineffective for mastering specific skills (Dearani et al., 2017). Questioning and facilitating class discussions are teacher skills that can significantly engage students' thinking and reasoning (Le et al., 2018), and deepen students' conceptual understandings (Reisman et al., 2019), yet novice teachers are challenged to implement these fundamental teaching skills (Reisman et al., 2019). Research by Klette, Hammerness, and Jensen (2017) revealed that future teachers are typically given limited practice opportunities. With sustained efforts to shift teacher preparation from knowledge acquisition to applied knowledge, many teacher preparation programs are emphasizing a practice-based approach that integrates theory with teaching experiences (Walkoe & Levin, 2018). A large obstacle to practice-based teacher preparation is the lack of pedagogies and instructional activities (Percy & Troyan, 2017); however, deliberate practice provides a promising approach.

This research is built on the premise that deliberate practice opportunities are required to develop and master particular skills. This research investigates pre-service teachers' questioning and discussion skill

development and their experience of using a holistic virtual simulation platform. The platform combines a synchronous experience using a virtual simulation where participants interact with avatar students, and an asynchronous learning platform providing a skill development experience. Combining experiential learning theory (Kolb, 1984) and deliberate practice (Ericsson, 2007), this research provides an experiential deliberate practice for pre-service teachers' skill development. It leverages virtual technologies to enhance the fundamental, yet difficult to attain, teaching skills of asking effective questions and leading discussions. More recently, much of teacher preparation is moving online and the onset of COVID-19 has accelerated the transfer to fully online or virtual teacher preparation programs.

## Literature Review

Research shows that virtual preparation can be just as effective for teacher education as classroom environments (Lamb & Etopio, 2020). Advances in technology enable a virtual arena where the classroom setting can be realistically simulated (Lamb & Etopio, 2020). Most previous skill-development research using simulations occurred in conjunction with face-to-face classes (Hardin & Freeman-Green, 2015; Mikeska et al., 2019; Piro & O'Callaghan, 2019; Lee et al., 2018). Sasaki et al. (2020) explored an online approach; however, their study provided feedback on simulated practices a week after performance. Since the feedback was not more immediate, the study was not grounded with skill development theory. Although most research has focused on experts and not novices, deliberate practice is estimated to account for more than half the variance in expert performance (Ericsson & Harwell, 2019). The theoretical framework for this study combines major instructional components of Ericsson's (2007) deliberate practice with Kolb's (Kolb et al., 2001; Kolb, 1984) experiential learning theory.

## Theoretical Framework

Deliberate practice develops a learning environment when participants achieve skill development and growth outside of their natural comfort zones through planned and distributed practice sessions, timely feedback, and self-reflections over a period of time (Ericsson & Pool, 2016). Other components of distributed practice include isolating the skill for practice, creating and expanding a mental model of the skill, and setting desired goals. According to deliberate practice theory, simply practicing a skill will not necessarily lead to improved performance (Ericsson & Harwell, 2019). Along with each criteria specified, deliberate practice requires the inclusion of an expert coach or mentor to provide feedback. Deliberate practice occurs under the direction of an expert mentor who assesses participants and assigns individualized skill practice sessions that are distributed over time. Practice sessions are deliberately designed to 1) push participants past their comfort zones, 2) provide immediate and timely feedback for improvement, 3) offer opportunities to implement feedback, 4) evaluate performance based on a standard, and 5) develop expert skills.

Experiential learning theory (Kolb et al., 2001; Kolb, 1984) consists of four cyclical stages: *concrete experience*, *reflective observation*, *abstract conceptualization*, and *active experimentation*. According to Kolb (1984), the cycle can begin at any step, but effective learning only occurs when a learner can execute all four stages of the model in logical sequential order. Kolb's (1984) experiential learning theory described how knowledge results from the combinations of grasping and transforming an experience. Knowledge is thus created through the transformation of experience in a holistic approach emphasizing how experiences (cognitions, environmental factors, and emotions) influence the learning process. Grasping involves concrete experiences serving as a basis for reflection and abstract conceptualizations formed from assimilating the information after reflection. Transforming encompasses reflection on experiences for drawing new implications which can be actively tested and guide creating new experiences (Kolb et al., 2001). Summarily, the learner has a *concrete experience* and participates in *reflective observation* of the experience, which leads to the formation of *abstract conceptualization* (analysis and conclusions) used in *active experimentation* and resulting in new experiences. Effective learning only occurs when a learner has progressed through all four stages (Kolb, 1984).

## The Holistic Virtual Simulation Platform

For the synchronous component, the Holistic Virtual Simulation Platform uses *Mursion* for a mixed-reality virtual environment. The simulations can occur over a web meeting where the participant sees the avatars on their

own computer or device screen. Participants practice teaching avatar students from the pre-established scenarios: a science topic, the water cycle. To provide a level of realism, avatars, have a backstory with unique personalities. For example, one avatar character is very studious and displays an interest in drama and acting. The variations in avatar characters give the participants more experience related to real-world scenarios. The avatars are controlled by an *interactor*, a real person, in real-time during the simulation. The interactor uses each avatar's individual profile to determine in-character responses to the participant during the simulation. Immediately following the simulation, the participant receives feedback from a qualified mentor, a highly effective classroom teacher with over 5 years of experience, who has completed a professional development program in providing specific feedback based on the Danielson rubric. The debrief and feedback is a general review as well as explicit comments based on specific sections of the teaching simulation.

For the asynchronous component, the platform uses the Canvas learning management system. Participants improve their skills through online self-paced skill development modules. They engage in fundamental aspects of experiential learning sequence, particularly reflect, theorize, and apply. The Canvas platform provides a series of core practices, distributes opportunities to enact practices, and places to reflect on their questioning and discussion skills.

## Research Questions

The purpose of this study is to investigate the use of the holistic virtual simulation platform to develop pre-service teachers' questioning and discussion skills. Below are the research questions.

- a. What elements, if any, of the synchronous experience in a holistic virtual simulation platform assisted questioning and discussion skill growth?
- b. What elements, if any, of the asynchronous experience in a holistic virtual simulation platform assisted questioning and discussion skill growth?
- c. How did the holistic virtual simulation platform assist questioning and discussion skill development at each stage of experiential learning cycle?

## Methodology

In this research, pre-service teachers begin with the *concrete experience* stage to synchronously teach avatar students in the virtual simulation classroom. Although Kolb's (1984) experiential learning theory suggests learning can occur by starting at any stage, the participants are adult learners and linking the learning to a concrete experience aligns with adult learning theory which suggests learning should relate to real-life experiences (Knowles et al., 2020). While engaging in a planned and distributed practice session that is likely outside their comfort zone, pre-service teachers can witness virtual avatar student reactions to their questions in real time. These virtual reality teaching experiences provides teachers a unique deliberate practice opportunity to develop a specific skill (i.e., questioning and discussion) that is not normally available in a strictly online class.

After the virtual teaching experience, the pre-service teachers move to the *reflective observation* stage to evaluate their practice performance where they review their simulation video and mentor feedback based on the Danielson (2013) rubric. Repeating self-reflection helps them solidify their mental model. For the *abstract conceptualization* and *active experimentation*, pre-service teachers move to an online asynchronous platform, where they set desired goals and engage in creating and expanding their mental model of the skill through online self-paced skill development modules. The *active experimentation* provides isolated skill practice and timely feedback to master the skills. They repeat the Kolb's cycle for each skill. Later the skills are practiced together to integrate the two desired skills. Participants are provided three simulation experiences teaching the same lesson with the modifications based on feedback and reflection.

This research study used a mixed-method approach, with the collection of both qualitative and quantitative data. The primary sources of data include participant teaching scores on questioning and discussion skills evaluated by two qualified raters based on the Danielson (2013) rubric, participant surveys following each virtual simulation session, and participant interviews on their entire skill development experience. Twenty-five pre-service teachers participated in a virtual experiential deliberate practice opportunity using the holistic virtual learning platform.

Participants were first provided with an experience in the virtual simulation classroom in a planned and distributed practice session outside their comfort zone where they were provided timely feedback. Second,

participants engaged in guided self-reflection after viewing their practice simulation video and mentor feedback. Third, participants engaged in abstract conceptualization through the online self-paced skill development modules to create and expand their mental model of the skill set and desired goals. Fourth, participants actively focused on an isolated skill by reteaching the lesson. The first week through the cycle focused on the skill of questioning, and the second week focused on discussion and student participation. They repeat the Kolb's cycle for each skill. Later the skills are practiced together to integrate the two desired skills. All feedback was based on the external Danielson (2013) rubric allowing transferability of findings to other settings and independency of experts administering the feedback.

## Findings

Findings from teaching scores and participant self-ratings indicated a gradual increase in questioning and discussion skill growth. The growth from the first virtual synchronous teaching session to the final session is evident in the analysis of recorded sessions. The pre-service teachers are asking more analytic and inference style questions to engage the avatar students to use their own background knowledge of the topic and apply their thinking. This approach allowed pre-service teachers an opportunity to practice an aspect of their field in a safe and constructive environment.

Also, interview data revealed an increase in confidence along with skill growth through repeated practice. Mentor feedback throughout the process was identified as the most helpful element to skill growth. Interview data revealed the importance of mentor feedback with guided and engendered student self-reflection, which confirms that reflection should be paired with expert feedback (Prayson & Rowe, 2017).

Furthermore, students reported both the synchronous and the asynchronous components were very helpful. This confirms that structured online learning activities can contribute to learners' skill development (Klassen et al., 2021). Noteworthy is that participants reported benefiting more from the asynchronous learning activities (the abstract conceptualization stage) while being more engaged and motivated from synchronous teaching (the *active experimentation* stage). This result aligns with the theoretical framework of this study and provides support for embedding deliberate practice with the experiential learning cycle to improve skill development. Additionally, many students emphasized the importance of the asynchronous learning experiences in Canvas between each virtual simulation teaching. If the holistic virtual platform combining synchronous and asynchronous learning experiences is provided within a thoroughly designed learning environment, the effect is amplified (Kim et al., 2021).

## Conclusion

The combination of using a virtual simulation with an online learning management system to create the holistic virtual simulation platform worked well in the study. The model of deliberate practice produced effective results, where participants received timely feedback and reflected after the synchronous experience and completed additional practice with feedback during the asynchronous learning component. Pre-service teacher expressed positive experiences after using the platform. Also, building upon the study's theoretical framework, which combined Kolb's (1984) experiential learning theory and Ericsson's (2007) deliberate practice, was effective in providing the overall stages of the learning cycle with specific activities within each stage.

Positive impacts of the virtual simulation preparation for pre-service teachers' skill development were evident. Pre-service teachers can hone their skills prior to entering classroom or online teaching. The platform provides a safe environment from COVID-19 transmissions while allowing the pre-service teachers to make mistakes without negatively impacting students. However, the study only measures the skill growth in a short period of time, which does not ensure the long-term impact of results. Learning transfer from the preparation to classroom teaching can be considered for a future study.

Implications for practice are far reaching. Use of virtual simulations is an effective strategy in preparing pre-service teachers for both synchronous and hybrid teaching environments. Using this approach could help mitigate challenges for pre-service teachers who may not otherwise have access to this technology or these learning opportunities due to geographic location or time constraints. The platform provides a more equitable solution to pre-service skill development since its components can be made available to anyone with internet access. Not only does it highlight the importance of innovative practice in teacher education, but the approach could also be replicated across other knowledge domains.

Future studies should consider incorporating additional avatar types to simulate teaching students with special needs and multilingual students, as well as additional lesson topics to give participants more variation in simulations. Future studies may also consider implementing more immersive environments, such as full virtual reality; however, caution should be taken so that the ability to record the participant during the simulations is not obscured, which would subsequently impact the quality of feedback given.

## Scholarly Significance

This study leverages virtual simulation technologies to enhance the fundamental teaching skills of asking effective questions and leading discussions. Additionally, this study expands the knowledge base of previous research on virtual simulations. Broader implementation of the holistic virtual simulation platform can help further expand the knowledge base of the use of synchronous virtual simulations and asynchronous learning platforms for the pre-service teachers' skill development.

Finally, the program is purposefully designed to enable remote, virtual participation. This promotes a COVID-19 transmission-free environment, as well as a safe place for participants to improve their skills without negatively impacting students. Thus, this study provides a mechanism to afford pre-service teachers robust experiences during the pandemic, or even post-pandemic, if online and virtual learning become a *new normal*.

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## References

- Danielson, C. (2013). *The framework for teaching evaluation instrument, 2013 Instructionally focused edition*. <https://usny.nysed.gov/rttt/teachers-leaders/practicerubrics/Docs/danielson-teacher-rubric-2013-instructionally-focused.pdf>
- Dearani, J. A., Gold, M., Leibovich, B. C., Ericsson, K. A., Khabbaz, K. R., Foley, T. A., Julsrud, P. R., Matsumoto, J. M., & Daly, R. C. (2017). The role of imaging, deliberate practice, structure, and improvisation in approaching surgical perfection. *The Journal of Thoracic and Cardiovascular Surgery*, 154(4), 1329-1336. <https://doi.org/10.1016/j.jtcvs.2017.04.045>
- Dias-Lacy, S. L., & Guirguis, R. V. (2017). Challenges for new teachers and ways of coping with them. *Journal of Education and Learning*, 6(3), 265. <https://doi.org/10.5539/jel.v6n3p265>
- Ericsson, K. A. (2007). Deliberate practice and the modifiability of body and mind: toward a science of the structure and acquisition of expert and elite performance. *Int. J. Sport Psychol.* 38, 4–34.
- Ericsson, K. A., & Harwell, K. (2019). Deliberate practice and proposed limits on the effects of practice on the acquisition of expert performance: Why the original definition matters and recommendations for future research. *Frontiers in Psychology*, 10, 2396. <https://doi.org/10.3389/fpsyg.2019.02396>.
- Ericsson, K. A., & Pool, R. (2016). *Peak: Secrets from the new science of expertise*. Boston, MA: Houghton Mifflin Harcourt.
- Goodwin, B. (2012). Research says new teachers face three common challenges. *Educational Leadership*, 69(8), 84-85.
- Hardin, S., & Freeman-Green, S. (2015, June). Infusing culturally responsive strategies in STEM instruction for special education teachers. In Bousfield, T., Hynes, M., Hughes, C., Straub, C., Dieker, L. & Ingrahm, K. (Eds.), *Proceedings of 3rd National TLE TeachLive™ Conference 2015: Dissecting Education*, Orlando, FL: University of Central Florida, 19-22.

- Karbownik, K. (2014). Job mobility among high-skilled and low-skilled teachers (No. 2014: 14). Working Paper, IFAU-Institute for Evaluation of Labour Market and Education Policy. Retrieved from <https://www.econstor.eu/bitstream/10419/106267/1/788272802.pdf>
- Kim, M., Feliciano, K., Welty, T., & Pecore, J. L. (2021, November). *Virtual deliberate practice platform for pre-service teachers' skill development* [Concurrent presentation]. Association for Educational Communications and Technology (AECT), Chicago, IL.
- Klassen, R. M., Rushby, J. V., Maxwell, L., Durksen, T. L., Sheridan, L., & Bardach, L. (2021). The development and testing of an online scenario-based learning activity to prepare preservice teachers for teaching placements. *Teaching and Teacher Education, 104*, 103385.
- Klette, K., Hammerness, K., & Jensen, I. S. (2017). Established and evolving ways of linking to practice in teacher education: Findings from an international study of the enactment of practice in teacher education. *Acta Didactica Norge, 11*(3), Art-9.
- Knowles, M.S., Holton III, E. F., Swanson, R. A., & Robinson, P. A. (2020). *The adult learner: the definitive classic in adult education and human resource development* (Ninth edition). Routledge.
- Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*. Englewood Cliffs, NJ: Prentice-Hall, Inc.
- Kolb, D. A., Boyatzis, R. E., & Mainemelis, C. (2001). Experiential learning theory: Previous research and new directions. In R. J. Sternberg & L. F. Zhang (Eds). *Perspectives on Thinking, Learning, and Cognitive Styles* (pp. 227-248). Mahwah, NJ: Lawrence Erlbaum.
- Lamb, R., & Etopio, E. A. (2020). Virtual Reality: a Tool for Preservice Science Teachers to Put Theory into Practice. *Journal of Science Education & Technology, 29*(4), 573–585. <https://doi-org.ezproxy.lib.uwf.edu/10.1007/s10956-020-09837-5>
- Le, N. T., Shabas, A., & Pinkwart, N. (2018, June). A question generation framework for teachers. In *International Conference on Artificial Intelligence in Education* (pp. 182-186). Springer, Cham. [https://doi.org/10.1007/978-3-319-93846-2\\_33](https://doi.org/10.1007/978-3-319-93846-2_33)
- Lee, C. W., Lee, T. D., Castles, R., Dickerson, D., Fales, H., & Wilson, C. M. (2018). Implementation of immersive classroom simulation activities in a mathematics methods course and a life and environmental science course. *Journal of Interdisciplinary Teacher Leadership (JoITL) Vol, 2*(1).
- Levine, A. (2006). *Educating schoolteachers*. Washington, DC: Education Schools Project.
- Mikeska, J. N., Howell, H., & Straub, C. (2019). Using performance tasks within simulated environments to assess teachers' ability to engage in coordinated, accumulated, and dynamic (CAD) competencies. *International Journal of Testing, 19*(2), 128-147. <https://doi.org/10.1080/15305058.2018.1551223>.
- Peercy, M. M., & Troyan, F. J. (2017). Making transparent the challenges of developing a practice-based pedagogy of teacher education. *Teaching and Teacher Education, 61*, 26-36. <https://doi.org/10.1016/j.tate.2016.10.005>.
- Piro, J., & O'Callaghan, C. (2019). Journeying towards the profession: Exploring liminal learning within mixed reality simulations. *Action in Teacher Education, 41*(1), 79-95.
- Prayson, R. A., & Rowe, J. J. (2017). Effective feedback in the workplace. *Critical Values, 10*(3), 24-27.
- Reisman, A., Cipparone, P., Jay, L., Monte-Sano, C., Schneider Kavanagh, S., McGrew, S., & Fogo, B. (2019). Evidence of emergent practice: Teacher candidates facilitating historical discussions in their field placements. *Teaching and teacher education, 80*, 145–156. <https://doi.org/10.1016/j.tate.2018.12.014>
- Sasaki, R., Goff, W., Dowsett, A., Parioissien, D., Matthies, J., Di Iorio, C., ... & Puddy, G. (2020). The practicum experience during Covid-19—Supporting pre-service teachers practicum experience through a simulated classroom. *Journal of Technology and Teacher Education, 28*(2), 329-339. <https://www.learntechlib.org/primary/p/216244/>
- Von Der Embse, N. P., Sandilos, L. E., Pendergast, L., & Mankin, A. (2016). A mediation analysis of teacher stress, self-efficacy, and job satisfaction. *Learning and Individual Differences, 50*, 308-317. <https://doi.org/10.1016/j.lindif.2016.08.001>
- Walkoe, J., & Levin, D. M. (2018). Using technology in representing practice to support preservice teachers' quality questioning: The roles of noticing in improving practice. *Journal of Technology and Teacher Education, 26*(1), 127-147.