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# Design Elements for Web-Based Interactive Scenarios

Rachelle Meyer Rogers & Douglas W. Rogers
*Baylor University*

Amanda Gardner
*Educational CVR, LLC*

Molly Bowen & Alexis D. Hooker
*Baylor University*

The authors conducted a secondary deductive analysis of 53 written reflections submitted by 12 middle-level mathematics preservice teachers (PSTs) who had each participated in up to five web-based interactive scenarios. The reflections were originally designed to gather data for a previous study about the development of professional judgement using web-based interactive scenarios. However, in reviewing the reflection documents, the authors concluded that there was sufficient data to support a secondary analysis that might inform future scenario development. The article describes the design framework and original development of the scenarios, written by a panel of retired public school administrators and university teacher education faculty members. In anticipation of continued and future development of additional scenarios, several technology delivery formats were used, including still photos with text-based dialogue, video clips with human actors, computer animated images with computer synthesized speech, and computer animated images with human speech dubbed in for audio. The analysis revealed five of nine design elements: commentary, artifacts, personal choices, technology-general, and products were mentioned most frequently by PSTs. The remaining four design elements: technology-positive, branching, control, and technology-negative, provided nuance to the recommendations for future web-based interactive scenario development.

As the COVID-19 pandemic gripped the world and the nation, higher education institutions in the United States made rapid and substantial shifts to virtual learning environments. According to the National Council of State Legislatures (NCSL), "The spring semester of 2020 was significantly disrupted by the spread of the coronavirus as more than 1,300 colleges and universities in all 50 states canceled in-person classes or shifted to online-only instruction" (Smalley, 2021). An additional dimension of these complex shifts occurred in teacher education programs that are dependent upon public school placements for preservice teachers (PSTs). Collectively known as field or clinical experiences, university students in teacher preparation programs spend extensive hours in public school settings.

These field experiences were greatly curtailed as states and public school districts made equally dramatic shifts to remote learning environments. In November 2020, the Hunt Institute reported that "nearly every school in the United States faced a swift transition … to some form of distance learning practically overnight" (Hunt Institute, 2020, para. 1). School and university partnerships struggled to find creative solutions that would satisfy state certification and licensure requirements, even as state legislatures made COVID-19 modifications to those requirements, including four states that waived licensure and certification exams, 28 states that temporarily suspended licensure exams, and 15 states that waived clinical/field experience requirements (American Association of Colleges for Teacher Education, 2020).

The near-universal transition to online instruction at both the public school and university level reignited faculty interest in the use of simulated experiences as part of the teacher preparation program. A previously published study conducted at our home institution concluded that interactive web-based scenarios were effective in developing PSTs' professional judgment (Rogers et al., 2017). Based on observations of numerous PSTs over the course of many semesters of field experiences, the primary investigators noted that some formative experiences are critical for all PSTs; however, these potentially formative situations may not occur in every field experience. Of paramount concern are those formative experiences that have many pitfalls and may be too critical for a PST to fail in the context of real-world circumstances. The previous study categorized clinical experiences as follows:

> Those in which a preparation program has orchestrated some significant level of control over a critical aspect of the experience, reducing risk. Clinical experiences can be repeated multiple times to demonstrate improved or altered PST performance. …Clinical experiences may be compared to flight and medical simulators that allow inexperienced operators to fail catastrophically without destruction of property or injury to humans. Performance error on the part of the PST carries less risk of creating problems for the K-12 student learner or future PST development. (Rogers et al., 2017, p. 246)

In response to the Covid crisis, the substitution of virtual experiences for face-to-face experiences strengthened the rationale for continued development of meaningful simulated experiences, such as the interactive web-based scenarios created for the original study. Additional

development on the scenarios was suspended when the teaching assignment for the primary faculty member implementing the scenarios was changed and when the software development platform used to create the scenarios was discontinued ("CS/CR Activity Walkthrough," n.d., para. 2).

Data related to the design elements incorporated into the scenarios used in the original study were captured and analyzed but not reported. As the program faculty began to consider extensive virtual experiences, the analysis of those earlier efforts seemed pertinent. A subsequent return of the primary faculty member implementing the scenarios within a methods course also stimulated new energy to find an appropriate software replacement, revise and expand the original scenarios, and reintroduce the simulated experiences.

The secondary analysis sought to answer two primary questions:

1. Based on the scenario design framework created by the authors and the technologies used to deliver the scenarios, which elements, if any, did participants identify?

2. In what ways did participants respond to the identified elements?

The present study used the term "interactive scenarios" to incorporate the potential that technology brings to case learning. The purpose of this research was to add to the body of literature on design elements that can be used in the creation of technology-delivered web-based interactive scenarios.

## Literature Review

The complex nature of teaching — managing relationships, adapting content, and responding to student needs — is an immersive experience for PSTs that is beneficial to their development. Common immersion practices in teacher preparation take place in the field, in clinical settings such as professional development schools, or through service-learning experiences with community partners (Resch & Schrittesser, 2021; Ridley et al., 2005; Ronfeldt, 2012).

An emerging area of teacher preparation and immersion involves case-based pedagogy (Levin, 2001; Şen Akbulut & Hill, 2020) and scenario-based pedagogy (Carroll et al., 1998), historically known as the case method (Brown & Kraehe, 2010; Levin, 1995; Merseth, 1991). Despite various terms, this style of learning is an instructional technique that uses descriptive documents, usually in narrative form, that present a real-life event (Merseth, 1996). The use of cases as teaching and learning tools is common in legal, medical, and business programs (Kelch & Malupa-Kim, 2014). These fields use cases and the case method to present students with real-world scenarios common in the professional field and as a way to place students in the role of the professional, which helps them develop fundamental skills. Empirical research on case learning in education has shown a positive impact on PSTs' experiential learning because the cases and scenarios strengthened the development of critical thinking and problem-solving skills required for the profession (Butler et al., 2006;

Kelch & Maluku-Kim, 2014; Merseth, 1996; Yan & Ottenbreit-Leftwich, 2023).

Despite this growing area of research on the use and impacts of case learning, there is little exploration and research focused on the design elements of the cases used. Kim et al. (2006) conducted a review and synthesis on the development of cases across disciplines and identified five core attributes of cases. The review of 100 studies from the fields of medicine, education, business, law, and others revealed that cases were (a) relevant, (b) realistic, (c) engaging, (d) challenging, and (e) instructional.

The relevant design attribute focused on student engagement and the cases' alignment with learning and instructional goals; while the realistic attribute looked at elements such as "authentic materials; distractors or non-pertinent features; and gradual disclosure of content" (Kim et al., 2006, p. 870). Kim et al.'s team identified engagement as a critical attribute, concluding that cases should be designed with multiple perspectives and rich and sufficient content, as well as provide students with opportunities to explore various outcomes and develop decision-making skills. These attributes provide an initial framework for teacher educators interested in designing cases for student learning.

Similarly, Şen Akbulut and Hill (2020) articulated five principles for designing effective cases for PST learning: (a) use authentic contexts; (b) promote social experiences; (c) include multiple perspectives; (d) provide chances for reflection; and (e) challenge learners' thinking. The first is similar to Kim et al.'s (2006) relevant and realistic attributes, as it calls attention to the need for cases to reflect the complexity of real-world situations.

The second principle, promoting social experiences, differs as it is situated in constructivism that aims to engage students in collaborating and working as members of a learning community, as opposed to working individually. The third principle explains that cases should provide students with opportunities to consider various perspectives and explore several alternatives. The final two principles advocate that students be allowed to discuss and contemplate the case, and the teacher operates as a facilitator and guides students through their understandings, awareness, and positions.

Simulations or role-play exercises are closely related to case learning and are defined as immersive experiences where students interact with and engage in a representation of a realistic scenario and can reflect on complex dynamics (Kaufman & Ireland, 2016; Shaw, 2017). Shaw's (2017) study focused on five steps in the design of these simulations and role-play exercises. The first step is to identify and define student learning goals. In Step 2 designers decide how long the simulations are to last. The third step requires planning time and space for group discussions and collaboration. The fourth step ensures that enough instructions and contextual details are included. The fifth and final step establishes a timeline to guide student progression through the simulation. Though it was not listed as a specific step, Shaw encouraged teachers to debrief with students after the simulation to reinforce their learning. Table 1 summarizes the design elements identified in the literature review.

**Table 1**
*Summary of Design Elements Identified in Literature Review*

| **Source** | **Design Element** |
|---|---|
| Kim et al. (2006) | Relevant<br>Realistic<br>Engaging<br>Challenging<br>Instructional |
| Şen Akbulut & Hill (2020) | Authentic contexts<br>Social experience<br>Multiple perspectives<br>Reflection<br>Challenge thinking |
| Shaw (2017) | Student learning goals<br>Length of simulation<br>Group discussion and collaboration<br>Instruction and contextual details<br>Timeline for progression<br>Debrief |
| Merseth (1996) | Multiple conclusions |

Despite the prevalent use of case-based learning across disciplines, there is limited literature on the development of cases. The prior studies were explicit in their aims to uncover or explore the necessary components needed to design effective and impactful cases for student learning. Though limited in scope and depth, the existing literature suggests some common elements. One such element is that case design should be sufficiently laden with details and information that allows users with multiple viewpoints to reach a variety of conclusions (Merseth, 1996). Emphasis on real-world contexts is vital for student learning. Another similar design element concerns allowing students time to reflect and discuss what they gleaned from the cases and ways they imagined or planned to apply any theoretical learning. A third design element that appeared across these studies was the attribute aimed at student learning and collaboration.

Both Shaw (2017) and Kim et al. (2006) explicitly called for defining student learning goals, while both Şen Akbulut and Hill (2020) and Shaw called for content that allows students to explore multiple perspectives and alternative solutions, as well as students collaborating with others regarding the case. Despite the difference in language used, case learning, simulation, or role-play, they share an identical purpose: to expose students to the complexities within their professional contexts and provide low-risk environments to support the development of professional skills.

## Methodology

While attending a professional conference, we learned of an application developed at the University of Wisconsin-Madison, Case Scenario/Critical Reader, "an interactive tool that instructors at UW began using in 2011. The CS/CR tool promoted active learning by allowing participants to read course materials and engage in simulation activities" ("CS/CR Activity Walkthrough," n.d., para. 1). We selected CS/CR to serve as the platform for developing interactive scenarios that would be delivered via the university's web-based learning management system (LMS). Scenario development began after verification that the CS/CR files functioned properly on the local campus LMS.

We compiled an initial list of potential scenario topics gleaned from our work experiences with PSTs and from the oral and written comments of previous PSTs. A panel of former K-12 administrators and retired teacher education faculty members that we recruited reviewed the list, brainstormed additional situations novice teachers often face and struggle to address effectively, and created a prioritized list for scenario development. The following items appeared at or near the top of the list:

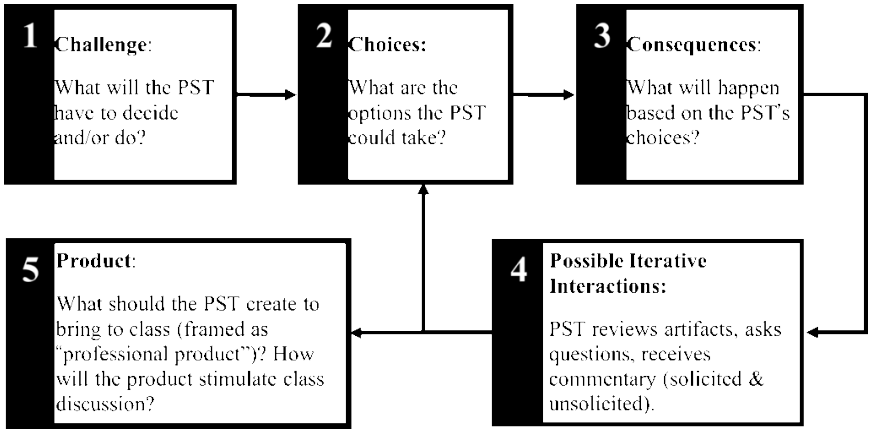
- an unexpected visit from a concerned parent;
- the difference between an effective and ineffective parent/teacher conference;
- a student reports others are bullying a student with Asperger Syndrome;
- a teacher dealing with pressure to change a grade; and
- a teacher accused of racism.

The convened panel of former K-12 administrators and retired teacher education faculty members selected these situations because they represented critical encounters, they could be generalized to many similar situations, and they occurred frequently enough that every PST should experience them prior to graduating from a teacher education program. Panel members received invitations to help write the selected scenarios.

Maintaining consistency among various scenarios required us to develop a simple framework for scenario writers. Figure 1 is the graphic shared with the scenario writers.

We reviewed the framework with the scenario writers and brainstormed elements that might be included in each scenario. As illustrated in Figure 1, the goal (Block 5) of each scenario was for the PST to create a product that would serve as the source of discussion in a seminar to be conducted by their university supervisor. While the primary challenge (Block 1) for each scenario was established by the expert panel, scenario writers were encouraged to create an iterative cycle of subchallenges that would allow PSTs to make choices and explore the consequences of those choices, as represented by Blocks 2, 3, and 4 in Figure 1.

**Figure 1**
*Scenario Framework for Scenario Writers*




As part of the iterative structure of each scenario, the writers were encouraged to think of artifacts that PSTs might examine, coaching and/or commentary that might be embedded within the scenario, and questions that could be framed to move the PSTs through the scenario. We reviewed drafts of each scenario and made suggestions to individual writers. After multiple review cycles, we accepted the draft scenarios and made final edits.

While the original study (Rogers et al., 2017) was designed to determine the effectiveness of web-based interactive case scenarios for developing professional judgement, in anticipation of future work along these same lines, a variety of formats were used to produce the final scenarios. The content, artifacts, final products, specific formats, and unique design elements for each scenario are summarized in the following paragraphs. The use of various production techniques provided critical experiences that would shape the potential for additional scenario development.

## Scenario Summaries

The Unexpected Visitor scenario required the PST to assume the role of a teacher who is confronted by a parent who arrives after school with no appointment to have an impromptu parent/teacher conference regarding the child's placement in future courses. The primary conflict in the scenario revolves around following school policy that requires parents to make appointments or teachers to conduct an impromptu parent conference with limited preparation. Three artifacts supported the scenario: a page in a grade book with the student's name and grades, all other student names and grades are masked (.jpg file); a scanned image of teacher-graded student test items (.jpg file); a photo of a page in a spiral notebook with the student's name at the top and dated handwritten anecdotal notes by the teacher (.jpg file). As the final product for this scenario, the PST was to compose a letter to the school counselor documenting the parent conference and the PST's recommendation with supporting rationale for maintaining or changing the student's current

placement. The delivery format for this scenario was still photographs and text-based dialogue. A unique aspect of this scenario was that it included multiple paths (accomplished through program branching), which based on the PST's responses within the scenario, led to different parent reactions; this resulted in unique PST products.

The scenario depicted in Fact or Fiction is a teacher's efforts to deal with an angry parent who believes the teacher has treated her child unfairly. Delivered through two video recordings, the PST observed the teacher perform poorly in one conference and perform admirably in a second conference. Eight artifacts supported the scenario: a handwritten note from the assistant principal to the teacher summarizing a 2-hour office visit with an angry parent, the result of which is a scheduled conference with the parent at which no administrator will be present (.png file); a typed summary of a professional development presentation by the campus principal titled "Ten Tips for Dealing with Parents" (.png file); two articles from professional journals related to dealing with angry parents (.pdf files); the student's first 6-weeks' mathematics grade (a single figure computer display = 75); a simulated computer generated gradebook displaying the student's current 6-weeks' grades (.png file); the teacher's typed notes on the student's in-class behavior (.png file); the student's attendance at tutorials for 4 weeks that illustrates the student was present two of eight sessions (.png file); a copy of a letter on school stationery, signed and dated by the parent, that contains the teacher's recommendation for the student to attend after-school tutorials (.pdf file); and a printed email message from the teacher to the parent requesting a conference (handwritten notes on the printout highlight the date the email was sent, the date the email was printed, and indicate "no response from parent").

The product completed by the PST consisted of a five-part form: Part 1 asked for observations about what went wrong during the first parent/teacher conference. Part 2 asked for pros and cons of three possible responses to the assistant principal's note. Part 3 asked for three recommendations based on the PST's review of teacher notes and articles. Part 4 asked the PST to make recommendations about what data to share with the parent during a conference. Part 5 asked for a review of positive differences in the second parent/teacher conference. The format of the scenario was two video recordings (.m4v files). Due to the time and potential costs of creating videos using human actors, this was the only scenario delivered in this manner. Rather than being a participant in the scenario, the PST is placed in the role of a colleague to the teacher.

In the Making a Choice scenario, the PST is a teacher to whom a student reports that one of her classmates was being bullied during lunch. As the scenario develops, the PST discovers that the victim is a student diagnosed with Asperger Syndrome. From that point forward, the scenario focused on creating a behavior intervention plan (BIP) for the student who was bullied. The bullying behavior was not the focus of the scenario. During the development of this scenario, it was decided that the bullying behavior that happened at lunch, not in the classroom, would most likely be handled by administrative personnel. Likewise, it was decided that the classroom teacher would most likely have to deal with the victim's behavior in response to the bullying, since there was some indication of previous outbursts.

Six artifacts supported the scenario: an undocumented display of information on students with Asperger Syndrome; a simulated excerpt of the antibullying policy from the district's employee handbook (computer display); a simulated excerpt from the district's student code of conduct (computer display); a simulated Individual Educational Plan (IEP) for the student (.pdf file); a simulated notice of Admission, Review and Dismissal (ARD) meeting (.pdf file); and a blank BIP form (.docx file). Based on a review of the student's IEP, the PST was to prepare a BIP for presentation at an ARD meeting.

The format of the Make a Choice scenario consisted of a short video recording of a student reporting the incident to the teacher (.mov file). All other displays were simple graphic images to represent the student victim and text-based dialogue. The unique element of this scenario was that all participants who completed the scenario were considered general education PSTs. They had limited if any, exposure to the forms and processes connected to students with exceptionalities.

The initial incident in the Campus Curriculum Decision scenario was a student accusing a teacher of being racist. The PST serves as a colleague on the faculty and must help the teacher assess her own behavior and must then act as a voting member of the faculty to approve or disapprove a recommendation that a unit on racism be taught campus wide.

Nine artifacts supported this scenario: an undocumented argument in favor of the racism unit (computer display); an undocumented argument opposed to the racism unit (computer display); the Campus Curriculum Committee ballot (.docx file); a simulated seating chart of the teacher's classroom (.docx file); simulated demographic data on students in the teacher's class (.docx file); simulated peer observation data gathered at the request of the accused teacher (.docx file); a simulated list of discipline referrals made by the accused teacher during the fall term, compiled at the teacher's request (.docx file); two simulated reflective journal entries composed by the teacher (device display); and an outline of the proposed Racism Unit created by the teacher (.docx file). The product created by the PST was a multipart response, including a vote for or against the Campus Curriculum Committee's recommendation to teach about race and racism; a rationale for the PST's vote; an analysis of data gathered by the teacher; and a final reflection synthesizing the PST's responses throughout the scenario. This scenario was delivered by computer-animated images using computer-generated speech. The sequences were converted to a video file format (.mp4 files) to facilitate easy delivery.

In the Right Decision scenario, a student is accused of cheating on a test. The PST, serving in the role of the teacher, decides to give the student a failing grade on the assignment, which results in the student being ineligible to participate in an extracurricular athletic event. The PST is pressured to change the grade to make the student eligible. Nine artifacts supported this scenario: a computer display of the student's first 6 weeks' grade; a computer display of a progress report for the student's second 6 weeks' grades; two student exams with identical incorrect answers (.pdf files); an excerpt from a simulated "Academic Dishonesty" policy from a student handbook (.pdf file); simulated electronic gradebook entries for the student (.pdf file); a simulated tutorial attendance log for the student (.jpg file); a simulated teacher log documenting communication with the

student's parent (.html file); an excerpt form a simulated student's file regarding instructional modifications; and a simulated email message from the principal requesting a conference with the teacher and coach at the end of the day. The PST product was a multipart response form including the PST's rationale for selecting one of four options presented in the scenario; a scripted outline of remarks to make to the student's coach when informing the coach that the student could not play in the weekly game; and the PST's rationale for agreement or disagreement with teacher's decision.

The delivery format for this scenario was computer-animated images with human voices dubbed in place of the computer-generated speech. The files were converted to video files (.mp4 files). The scenario content and delivery formats are summarized in Table 2.

**Table 2**
*Scenario Content and Delivery Formats*

| Scenario Title (Abbreviation) | Content | Delivery Format |
|---|---|---|
| The Unexpected Visitor (UXV) | Impromptu parent/teacher conference regarding student's course placement | Still photos and text-based dialogue, branching leads to different outcomes |
| Fact or Fiction? (FOF) | Unsuccessful and successful conference with angry parent | Two video clips using live actors |
| Making a Choice (MAC) | Student reports bullying of classmate; teacher must prepare BIP for victim | One brief video clip, still images, and text-based dialogue |
| Campus Curriculum Decision (CCD) | Student accuses teacher of racism; campus faculty to vote on a proposed racism unit to be taught schoolwide | Computer animated images and computer synthesized speech |
| The Right Decision (TRD) | A student is accused of cheating; teacher is pressured to change the grade | Computer animated images with human voices dubbed for audio |

## Data Collection and Analysis

The following narrative is a secondary analysis of data collected from the original study, previously published (Rogers et al., 2017). The secondary analysis sought to answer two previously stated primary questions. The purpose of this research was to add to the body of literature regarding design elements that can be used in the creation of technology-delivered web-based interactive scenarios.

The original study, conducted after institutional review, took place across two academic years and included a total of 12 undergraduate middle

school mathematics PSTs who were given an opportunity to opt in or out of the study; all 12 PSTs agreed to have their data included in the study. Personal written reflections by the PSTs, completed after a group discussion of each scenario, provided the primary data source for analyzing design elements. Fifty-three reflections, submitted electronically, were graded by the instructor of record during the term in which they were submitted. A graduate assistant assigned to a faculty member not associated with the undergraduate mathematics education program prepared the documents for analysis. Preparation included removal of or substitution for any personal identification contained within the document and standardizing the documents according to a template to facilitate electronic analysis of the reflections. A second graduate assistant verified the accuracy of the modifications. All analyses commenced after student grades were submitted.

Designed to gather data related to the initial project's articulated research questions, the reflection prompts did not focus on specific technology-oriented data gathering. However, PST comments containing references to technology and other design elements prompted us to undertake a secondary analysis of the reflections in hopes of supporting future expansion of the scenarios. Using NVivo 12 (QSR International, 2017) qualitative analysis software, three graduate assistants conducted independent reviews of the 53 reflections that were considered sufficiently complete to include in a secondary analysis. The analysis used a priori coding, based on a scheme created from the framework for scenario writers and observations made during the initial study. One of the two researchers arbitrated any discrepancies in coding.

The framework included nine categories. Table 3 contains a list of the categories, their descriptions, the number of statements coded by all three coders, and the number of unique files (reflection documents) represented in each category.

## Secondary Analysis Results

Three coders identified a total of 610 statements across the 53 reflection documents. The coding category appearing in most individual documents was Commentary, which appeared in 45 of the 53 documents (85% of the documents); followed by the Artifacts category, which appeared in 42 of the 53 documents (79% of the documents) and the Tech-General category, which appeared in 39 of the 53 documents (74% of the documents).

Three additional categories appeared in more than 30 documents, but not in as many as 40 documents: Personal Choices appeared in 36 documents (68% of the documents); "Products appeared in 36 documents (68% of the documents); and Tech-Positive appeared in 31 documents (58% of documents). Three coding categories appeared in fewer than 30 documents: Control appeared in 25 documents (47% of documents); Branching appeared in 22 documents (42% of documents); and Tech-Negative appeared in only 12 documents (23% of documents). Coding categories ranked by number of documents and number of statements appear in Table 4.

**Table 3**
*Coding Categories, Descriptions, Statements and Files*

| Coding Category | Description | Statements (*n* = 610) | Files (*n* = 53) |
|---|---|---|---|
| Artifacts | PST refers to use of/examination of artifacts provided. | 97 | 42 |
| Branching | PST refers to different paths/outcomes presented. | 39 | 22 |
| Commentary | PST writes about the pros/cons presented. | 159 | 45 |
| Control | PST desires to have more control of scenario elements. | 37 | 25 |
| Personal choices | PST refers to choices and/or considering a course of action based on the pros/cons presented. | 78 | 36 |
| Products | PST refers to documents created in response to tasks assigned in scenario. | 67 | 36 |
| Tech-General | PST refers to some general aspect of the technology. | 73 | 39 |
| Tech-Negative | PST refers to a characteristic of technology to be avoided or minimized. | 12 | 12 |
| Tech-Positive | PST refers to a characteristic of technology to be replicated or expanded. | 48 | 31 |

The rank order of coding categories by number of statements coded did not align with the rank order by documents, as illustrated in Table 4. The first two codes, Commentary and Artifacts, remained in the same rank order with 156 statements and 97 statements (26% and 16%, respectively, of the total 610 statements). The first change in the rank order, when comparing codes by number of statements, occurred at positions 3 and 4. The Personal Choices code was applied to 78 statements (13% of statements), which is five more than the 73 statements coded as Tech-General (12% of statements). This resulted in raising the Personal Choices code to position 3 and lowering the Tech-General code to position 4. Categories ranked 5 and 6, Products (67 statements, 11%) and Tech-Positive (48 statements, 8%), remained in the same order.

The second change in rankings occurred at positions 7 and 8. Based on the number of statements coded Branching (39 statements, 6%), it was listed ahead of the code Control (37 statements, 6%); the difference in percentage of statements was only .03 percent. The Tech-Negative code remained in the last position (12 statements, 2%). These data are summarized in Table 4.

**Table 4**
*Grouping and Rank Order of Categories by Number of Statements and Number of Documents*

| Grouping | Coding Category | Rank by Number of Statements (Statements) | Percentage of All Statements (*n* = 610) | Rank by Number of Documents (Documents) | Percentage of All Documents (*n* = 53) |
|---|---|---|---|---|---|
| High Frequency | Commentary | 1 (159) | 26 | 1 (45) | 85 |
| | Artifacts | 2 (97) | 16 | 2 (42) | 79 |
| Medium Frequency | Personal Choices | 3 (78) | 13 | 4 (36) | 68 |
| | Tech-General | 4 (73) | 12 | 3 (39) | 74 |
| | Products | 5 (67) | 11 | 4 (36) | 68 |
| Low Frequency | Tech-Positive | 6 (48) | 8 | 6 (31) | 58 |
| | Branching | 7 (39) | 6 | 8 (22) | 42 |
| | Control | 8 (37) | 6 | 7 (25) | 47 |
| | Tech-Negative | 9 (12) | 2 | 9 (12) | 23 |

## High, Medium, and Low-Frequency Categories

Based on the number of statements and the number of documents those statements represent, the coding appeared to fall into three groups, with minor variations in rank order within each group when comparing documents and statements. The first group, labeled High Frequency, consists of documents and statements related to the Commentary and Artifacts categories. The second group, labeled Medium Frequency, consists of documents and statements related to the Tech-General, Personal Choices, Products, and Tech-Positive categories. The low frequency categories included Control, Branching, and Tech-Negative statements and documents. Groupings are reflected in Table 4.

The two codes identified in Table 4 as High Frequency, the Commentary and Artifacts categories, account for 42 percent of all coded statements (a combined 256 statements out of 610). The next three categories, Personal Choices, Tech-General, and Products, were classified as Medium Frequency categories in Table 3; they accounted for 218 coded comments (36% of all comments). Nineteen comments separate the High-Frequency categories from the Medium-Frequency categories, and 19 comments separate the Medium-Frequency categories from the Low-Frequency categories. The Low-Frequency categories, Tech-Positive, Branching, Control, and Tech-Negative, accounted for the remaining 136 comments (22% of all coded comments).

## Informative Findings

Coding frequency counts were cross-tabulated by scenario and are summarized in Table 5. The cross-tabulated data indicate that, with minor exceptions, the five most frequently assigned codes (Commentary, Artifacts, Personal Choices, Tech-General, and Products) appear as the top five codes across all scenarios; therefore, the following narrative is organized by coding category. Context and observations related to the identified coding and the implications gathered for designing future interactive web-based scenarios are provided. Exceptions to the general observations are identified.

## The Commentary Code

As part of the original scenario design framework, the concept of commentary was included to provide multiple perspectives on situations within the scenarios, to provide counsel to inexperienced PSTs, or to identify the pros and cons associated with different courses of action. The Commentary code was assigned to 159 statements (26% of all coded statements). It was the most frequently assigned code in three of the five scenarios (Unexpected Visitor, Fact or Fiction, and Campus Curriculum Decision). Commentary shared the top ranking with Tech-General in the Right Decision scenario; both were assigned the same number of statements (11 statements each, 17% each of the statements coded for the scenario). The only exception to the first place ranking of the Commentary code appeared in the Making a Choice scenario, where it was the third most frequently assigned code (28 statements, 18% of coded statements in the scenario).

Statements coded in the Commentary category were focused on the presentation of alternatives, the articulation of different perspectives, or the identification of positive and negative aspects of a scenario element. One PST appreciated "the pros and cons for each person" represented in the scenario, while another PST enjoyed seeing the "pros and cons of different ways to handle the situation." There were only two characters in the Unexpected Visitor scenario (the teacher and a parent); however, as dialogue in the scenario unfolded, there were several choices to be made by the PST, who was serving as the teacher in this scenario. These decision points presented many opportunities for external commentary, about which the PSTs wrote, "I honestly had never thought through all of the ways, positive or negative, which a parent teacher conference could go."

Another PST considered the commentary advice: "I liked … the advice on how certain actions might pan out." In the reflections on the Making a Choice scenario, one PST wrote, "I also like that the pros and cons of some of the options were presented. I'm not sure I would have come up with such a well-developed list by myself."

**Table 5**
*Cross Tabulated Coded Statements by Scenario With Percentage of Statements Within Scenario*

| Code Category | MAC (%) | UXV (%) | FOF (%) | CCD (%) | TRD (%) |
|---|---|---|---|---|---|
| Commentary | 28 (18) | 41 (29) | 40 (30) | 39 (33) | 11 (17) |
| Artifacts | 36 (23) | 16 (12) | 17 (13) | 22 (19) | 6 (9) |
| Personal choices | 10 (6) | 20 (14) | 17 (13) | 21 (18) | 10 (16) |
| Tech-General | 18 (12) | 6 (4) | 23 (17) | 15 (13) | 11 (17) |
| Products | 31 (20) | 21 (15) | 7 (5) | 5 (4) | 3 (5) |
| Tech-Positive | 14 (9) | 11 (8) | 15 (11) | 3 (3) | 5 (8) |
| Branching | 4 (3) | 14 (10) | 11 (8) | 2 (2) | 8 (13) |
| Control | 14 (9) | 9 (6) | 3 (2) | 4 (3) | 7 (11) |
| Tech-Negative | 1 (1) | 1 (1) | 0 (0) | 7 (6) | 3 (5) |
| Totals ($n$ = 610) | 156 (26) | 139 (23) | 133 (22) | 118 (19) | 64 (10) |

The most frequently assigned code overall, Commentary, was assigned to 41 statements associated with the Unexpected Visitor scenario — the single highest occurrence across the entire analysis. The Commentary code was assigned to statements in 12 unique documents associated with the Campus Curriculum Decision scenario, 11 documents associated with the Unexpected Visitor scenario, 10 documents associated with the Making a Choice scenario, and nine documents associated with the Fact or Fiction scenario. Across the analysis, the Commentary code was assigned in 45 of the 53 files coded (85% of the documents). These data indicate that a majority of the 12 PSTs who completed the scenario reflections consistently mentioned the commentary included in the scenarios.

## The Artifacts Code

Overall, the Artifacts code was assigned to 97 statements (16% of all coded statements) and appeared in 42 of the 53 documents (79%). The Artifacts code was assigned to statements where PSTs wrote about the items they could access and review as a part of the scenario, such as samples of student work, email messages, teacher anecdotal notes, and so forth. The artifacts associated with each scenario were listed in the scenario summaries.

The Making a Choice scenario elicited the most comments that were coded to the Artifacts category (36 of 156 statements, 23%), a third more references than the next closest scenario, Campus Curriculum Decision, with 22 statements coded to the Artifacts category. These 36 statements appeared across all 12 reflections completed for this scenario, indicating that every PST who completed the scenario mentioned the artifacts associated with this scenario.

The Making a Choice scenario begins with a brief video of a female middle school student informing a teacher that she has observed some classmates bullying a fellow student during lunch. She acknowledges that the victim of this behavior has had some outbursts in class and that he appeared to be upset by the experience. The conflict in the scenario is based on the choices the teacher must make about dealing with what has been reported.

As the scenario develops, the PST discovers that the victim in this incident is a student diagnosed with Asperger Syndrome, and the focus of the remaining activity in the scenario is framed around helping create a behavior intervention plan for this student. The scenario does not address the bullying behavior reported by the female student. During the design phase, it was determined that PSTs needed more experience dealing with the issues surrounding students with exceptionalities rather than dealing with lunchroom behavior that would most likely be handled by administrative personnel. Future development might address the bullying behavior as well.

The 12 middle school mathematics PSTs that completed the Making a Choice scenario were classified as general education PSTs who had limited, if any, experience with the documents and procedures that must be completed for students with special needs. The introduction of these forms as artifacts in the Making a Choice scenario drew significant student comments, such as, "It gave me a chance to see forms and try to fill out forms that I know I will see as a teacher but had never experienced during my undergrad years." When prompted to identify the most significant benefit of the scenario, four different PSTs specifically identified the forms provided by the scenario, with one PST concluding, "I do not have a lot of direct experience with these things, so it was nice to see ones filled out and think about how I might fill one out for a student."

The same 12 PSTs completed the Campus Curriculum Decision scenario that dealt with a student's accusation that the teacher was racist. Ten of those PSTs mentioned the scenario's artifacts in their reflections:

- "I liked having all of the artifacts to analyze and make a decision."
- "I liked looking at all of the different forms of evidence (the seating chart, the discipline record, and the chart of teacher placement)."
- "I liked having all of the artifacts because it really opened my eyes to what we may do unconsciously as teachers such as spending all of our time in one corner of the room."

Similar statements appeared in other scenarios, though not as consistently as in the Making a Choice or Campus Curriculum Decision scenarios. One

PST's reflection on the Fact or Fiction scenario commented on the "real artifacts — they were pretty specific," and another from the same scenario commented on the "research to back it up (the articles we read)," which were included as artifacts that a teacher might reference in anticipation of a parent-teacher conference. As with the Commentary category, the data indicate that PSTs considered the artifacts within the scenarios a crucial element of the scenario experience.

## The Personal Choices Code

Closely related to the Commentary code that identified statements *about* multiple perspectives, the Personal Choices code was used to identify statements where PSTs discussed their personal considerations of the options presented and making selections. The coding attempts to distinguish comments related to the PSTs' *actions* based on their own perceptions of the situation from commentary *about* the perspectives. Seventy-eight statements were assigned the Personal Choices code (13% of all coded statements).

Two scenarios, Campus Curriculum Decision and Unexpected Visitor, account for more than half of the statements (41 of 78). The Campus Curriculum Decision scenario deals with a student's accusation that the teacher is racist, and the Unexpected Visitor scenario captures the experience of an impromptu conference when a parent stops by unexpectedly after school. One PST reflecting on the Unexpected Visitor scenario observed, "I was able to look at my choices critically," and a second PST went further: "I found out there were multiple ways to approach the situation and address the parent, but one option was always a better choice than the others." A third PST wrote, "With this activity, I could think through every thought that came to my mind and why it would be a good or not-so-good idea."

When asked about the greatest benefit of participating in the scenario, one student's statement included the essence of personal choice, "It gave me the opportunity to reflect on a scenario that I am guaranteed to be placed in while also having the chance to really pause and consider what the best responses to a parent would be." As part of the Campus Curriculum Decision scenario, the PST was required to make a personal decision about whether the accused teacher had acted in biased ways. Many connected the greatest challenge of the scenario to the personal choice that had to be made: "The greatest challenge was to make a decision about whether or not Ms. Peterson [the teacher in the scenario] was being discriminatory," and "'Judging' Ms. Peterson was hard to do."

Some PSTs identified a deeper level of personal choice when they wrote about their own actions: "The scenario caused me to reflect on myself," "This made me start to think about how I could respond," and "The greatest benefit from participating in this case study was getting to stop and think about … how I would handle being accused of being a racist." The Fact or Fiction scenario, based on a conference with an angry parent, generated 17 statements that were assigned the Personal Choices code. Eight of the 12 PSTs wrote comments about their personal choices, such statements as follows: "The greatest challenge was to think how I would have handled that situation," "It made me think about what I would do if

I was confronted by an angry parent," or "I was able to think through the situation and prepare a plan of action before ever having to experience the situation."

Despite the arbitrary designation as a medium frequency code, the Personal Choices code appears as one of the top three most frequently assigned codes in all five scenarios. This finding would seem to indicate that personal choice is a critical component of the scenario experience.

## The Tech-General Code

The Tech-General code was designed to capture all statements that mentioned technology but not a specifically positive or negative opinion about that technology; the additional categories of Tech-Positive and Tech-Negative were created for that level of detail. Overall, the Tech-General code was applied to 73 statements (12% of all coded statements) and ranked fourth according to frequency of occurrence; however, its rank related to specific scenarios varied greatly. The Tech-General code ranked as high as first for the Right Decision scenario (tied for the top ranking with the Commentary code) and as low as eighth for the Unexpected Visitor scenario. The Tech-General code ranked second for the Fact or Fiction scenario, while ranking fourth for the Making a Choice and Campus Curriculum Decision scenarios.

The high ranking of the Tech-General code in the Right Decision scenario drew immediate attention. A student is caught cheating in the Right Decision scenario, and the teacher is pressured to change a grade so the student can participate in extracurricular activities. The unique presentation technology for this scenario was computer animation with human voices dubbed into the audio. Eleven comments (the same number of comments coded in the Commentary category) in five reflections written about the Right Decision scenario were assigned the Tech-General code.

Eight of the 11 comments shared the same sentiment as recorded by one PST: "I loved the videos from this scenario." While this sentiment is generally positive, it does not provide sufficient detail about the video for the statements to be included in the Tech-Positive category. The three remaining statements addressed technical issues: the files would not play on a PST's computer, one PST preferred a different orientation for tests displayed as artifacts in this scenario, and a third desired more videos to address various options presented in the scenario. This finding could have design implications, because computer-animated videos with human voices dubbed in the audio are much easier to produce than videos using human actors.

The largest number of statements assigned to the Tech-General category appear in the Fact or Fiction scenario (described earlier as a conference with an angry parent). These coded statements represent 17% of the coded statements for the Fact or Fiction scenario. Two video segments using human actors portraying the parent and teacher are the delivery medium for this scenario. Unlike the other scenarios where the PST is a participant in the scenario, in this instance, the PST is an observer and does not play a role in the scenario. The PSTs (10 of 12) were united in their preferences

for the videos within this scenario. While understandable, as a design consideration creating videos with human actors is potentially time-consuming and expensive, which could delay or preclude future development.

## The Products Code

When we created the design framework for writing the scenarios, a critical component was embedding professional outcomes in each scenario. In the coding scheme, comments about these professional outcomes were assigned the Products code. Sixty-seven statements (11% of all coded statements) were assigned to this category. Two scenarios, the Making a Choice scenario and the Unexpected Visitor scenario, accounted for 52 of the 67 statements (78% of the statements in this category).

As mentioned previously, the Making a Choice scenario was built around the processes required to create a BIP for a student with exceptionalities. The forms associated with the process were essentially unknown to the general education PSTs who had limited exposure to the special education curriculum. This is one of three occurrences where all 12 PSTs wrote statements that were coded in the same category. Of the 36 comments coded in this category for this scenario, 26 referred specifically to "completing the BIP." Six more comments addressed completing the paperwork or filling out the form without mentioning the BIP specifically. One PST simply referred to it as "the SCARY form."

The second scenario with multiple comments coded in the Products category was the Unexpected Visitor scenario. At the conclusion of the Unexpected Visitor experience, the PST prepared a letter for the school counselor documenting the impromptu conference and any recommendations made to the parent about the student in question. Mention of this letter was coded in 21 statements (15% of coded statements associated with the Unexpected Visitor scenario). One PST considered the letter the "hook" for the scenario, "Being assigned to actually write a letter engaged me because it felt like the scenario just happened." Some PSTs considered writing the letter a daunting task, "My greatest challenge was writing the letter. I was not really sure what was important to address and how many details to give" or "When writing the letter, it was challenging to keep the letter positive, persuasive, informative and professional simultaneously."

For some, the letter prompted professional behavior, "I also learned that taking notes during conferences is beneficial as well as reflecting over the conference at the end." When describing the greatest benefit of the Unexpected Visitor scenario, one PST concluded that it was the "chance to experience writing a professional letter to document an account I have had with a parent."

## Low-Frequency Codes

The final four coding categories, Tech-Positive, Branching, Control, and Tech-Negative, include a total of 136 coded statements (22% of all coded statements); not one of these categories reaches an arbitrary threshold of 10%. Because so few statements were coded in these categories, it seemed

problematic to isolate design characteristics based on these categories; however, the data in these categories did provide support for a more nuanced interpretation of the first five categories and a more robust conclusion.

## Recommendations for Future Development

Based on the current analysis, we recommend the following elements be incorporated into future web-based interactive scenarios: (a) provide multiple perspectives through commentary; (b) incorporate realistic artifacts; (c) allow the participant to make personal choices; (d) frame products as professional work; and (e) use technology as a delivery mechanism. The following paragraphs provide additional discussion of each recommendation.

### Provide Multiple Perspectives Through Commentary

Overwhelmingly, the PSTs wrote about the opportunity to observe multiple perspectives, to receive advice on different courses of action, and to examine alternatives. While this feature is not exclusive to technology-based scenarios, when compared to a text-based scenario, technology can facilitate the delivery of commentary in multiple formats — particularly audio and video and can deliver that commentary in a nonlinear manner. The commentary can appear at a critical moment within the scenario.

Many PSTs wrote about pausing to think about perspectives they might not have considered without the commentary embedded in the scenario. This element is one of only three that were mentioned by all 12 PSTs. For these reasons, we consider commentary to be the most crucial aspect of future scenario development. This recommendation is consistent with Kim et al.'s (2006) description of engagement, as cases that are designed with multiple perspectives and rich and sufficient content, as well as provide students with opportunities to explore various outcomes. Likewise, this recommendation aligns with Şen Akbulut and Hill's (2020) third principle to include multiple perspectives.

### Incorporate Realistic Artifacts

The second most frequently assigned code was assigned to statements in which PSTs wrote about examining the various support items incorporated throughout the scenarios. During the design and development phase, significant effort was invested in gathering and creating realistic items professionals might access dealing with the situations presented in the scenarios. The PSTs wrote frequently about their use of the artifacts. They were especially articulate about seeing uncommon forms, such as those associated with interventions for children with exceptionalities.

One of the original purposes for creating the web-based scenarios was to give all PSTs exposure to incidents they are likely to encounter during their professional careers but are not likely to encounter during their highly controlled field experiences. This element is the second of three that were mentioned by all PSTs. While the use of artifacts is not restricted to

technology-based scenarios, technology does facilitate the delivery of substantial numbers of artifacts in a variety of formats.

In a narrative scenario, the presentation of substantial artifacts could increase the length of a document and prove challenging to organize. The fidelity of artifacts and the technological delivery of the artifacts included in the scenario contributes significantly to the realistic presentation of the scenario, and this analysis confirms that appropriate artifacts are critical elements of the comprehensive scenario experience. Kim et al. (2006) identified a realistic attribute that addressed the authenticity and inclusion of "pertinent information and unnecessary information to stimulate the real challenge…real world scenarios" (p. 870), while Şen Akbulut and Hill (2020) described the use of authentic contexts.

## Allow the Participant to Make Personal Choices

While this element was grouped with the medium frequency codes, we consider it a crucial element of the scenario experience because it was the third most frequently occurring code in four of the five scenarios. Making choices based on the variety of perspectives presented was a frequent topic in the reflections.

The Unexpected Visitor scenario drew special attention because the personal choices made during that scenario led to different outcomes, so the PSTs did not have identical experiences, which was generally viewed as a positive outcome. While not reported as a major finding, one code, Branching, was designed to capture this unique feature of the scenarios. More than half of the PSTs wrote about the branching in the Unexpected Visitor scenario. We interpreted the data to mean that PSTs *experienced* the effect of making choices, even if they did not recognize the *mechanics* of how those choices were managed in the technology (through branching). This is the essence of the interaction that technology provides that text-based scenarios cannot. As a result, we recommend that personal choices be a fundamental design component and that the more frequently those choices can lead to different outcomes for participants, the more realistic the scenario may appear and the more likely the scenario will generate robust postexperience reflection and conversation.

While not explicitly identified in the prior literature, personal choice is certainly consistent with calls for opportunities to explore various outcomes (Kim et al., 2006), consider multiple perspectives (Shaw, 2017), and explore alternatives (Şen Akbulut & Hill, 2020). This is an advantage of web-based interactive scenarios.

## Frame Products as Professional Work

As much as possible, the outcomes of the scenarios were framed as professional work, such as documenting a parent-teacher conference, completing formal paperwork, or voting on a curriculum proposal. The coders identified 67 comments that addressed the products associated with the scenarios. Many of the PSTs wrote about the professional nature of the experiences; some even wrote about emulating the products in their future classrooms. Scenarios that incorporate this element have the potential to model professional work before PSTs achieve that status.

All tasks within the scenarios took advantage of the technology platform — all forms were completed online, all documentation was created online, and all finished products were submitted online. While not specifically referenced by the PSTs, the participants engaged in professional behavior as a result of using the technology to create the products, which were intentionally framed as professional work. Existing literature makes clear that the professional context is critical to the design of cases (Kelch & Mluku-Kim, 2014; Kim et al., 2006; Şen Akbulut & Hill, 2020).

## Use Technology as a Delivery Mechanism

While the overall premise of the secondary analysis was to support the future development of web-based interactive scenarios, the reflection prompts made no mention of the technology used to create or deliver the scenarios. Three codes were created in anticipation of capturing any comments made by PSTs as they completed their scenario experiences: Tech-General for statements that mentioned technology but did not indicate a specific characteristic that could be replicated in future scenarios; Tech-Positive for statements that identified a specific positive feature of technology that could be replicated in future scenarios; and Tech-Negative for statements that identified a specific negative characteristic that should not be replicated in future development. The Tech-General code was assigned to 73 statements (12% of all coded statements), most of which expressed an appreciation for the use of video in the scenarios.

Due to the complexity of creating videos using live actors, only two of the five scenarios included such videos: the Making a Choice scenario incorporated a brief video showing a student reporting an incident she observed during lunch to a teacher, and the Fact or Fiction scenario used two video segments showing an unsuccessful and successful teacher conference with an angry parent. The other two scenarios, the Campus Curriculum Decision and The Right Decision scenarios, used computer-animated characters to create the video segments. The Campus Curriculum Decision scenario also used computer-generated speech, while the Right Decision scenario used human voices dubbed into the audio.

Both the Tech-Positive and the Tech-Negative codes fell in the Low-Frequency group because they were each assigned to fewer than 10% of all coded statements. Despite low frequency counts, these two codes did identify statements that added nuance to the video elements used to deliver the scenarios. More than half of the PSTs made negative statements about the computer-generated speech used in the Campus Curriculum Decision scenario. While this technology has improved since the original creation of these scenarios, the more realistic text-to-speech synthesis programs add expense to scenario development.

Likewise, the Tech-Positive code identified an interesting perspective related to the same Campus Curriculum Decision scenario, which is framed around a student accusing a teacher of being racist. Three PSTs indicated that the use of computer-animated characters in this scenario provided emotional distance to a sensitive topic. Considering these observations, we recommend the use of video that uses human actors as

much as possible, but computer-animated characters with human speech dubbed in could be an appropriate alternative for topics that might be considered especially sensitive for some members of the participating group.

Specific technology elements are not clearly defined in the previous literature, and while they fall within the Low Frequency category in the present study, they may provide preliminary insight regarding the future design of web-based interactive scenarios.

## Conclusion

The development of web-based interactive scenarios is consistent with a recommendation articulated in *Teaching in the Time of COVID-19: State Recommendations for Educator Preparation Programs and New Teachers* (AACTE, 2020): "encourage innovative approaches to clinical experiences including…simulated classroom environments that allow candidates to approximate teaching…" Based on the profession's response to the COVID pandemic, this recommendation parallels the rationale we used to create the initial scenarios. Web-based interactive scenarios

> …may be compared to flight and medical simulators that allow inexperienced operators to fail catastrophically without destruction of property or injury to humans. Performance error on the part of the PST carries less risk of creating problems for the K-12 student learner or future PST development (Rogers et al., 2017, p. 246).

While the response to AACTE's recommendation may diminish in a postpandemic world when classroom environments are once again hospitable to all occupants, the need for safe environments for catastrophic failure without catastrophic consequences continues to increase as those same classrooms become more and more complex.

The current secondary analysis, using an a priori approach, has identified crucial design elements to be incorporated into simulated environments, such as web-based interactive scenarios. The conclusions support and expand previous work on case-based learning, simulations, and role playing. While the recommendations are not exclusive to technology-oriented environments, it is the technology that facilitates the expansive and efficient delivery of scenarios that incorporate these recommend-ations.

The COVID pandemic energized this secondary analysis and heightened the demand for high-quality virtual experiences. However, these recommendations provide guidance as the profession moves beyond the lingering effects of the pandemic. In particular, these recommendations should be considered by those who would use technology and the emerging power of artificial intelligence to ignite the rapid development of virtual interactive immersive experiences where PSTs can learn professional skills in a risk-free environment.

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