White Paper:
The Design of Scaffolding in Game-based Learning:
A Formative Evaluation

by

Sheri D. Weppel
Director
GP Strategies™
Abstract

Instructional games appear to fluctuate considerably between “restricted play” and “free play.” Highly structured games with lots of corrective feedback can be less engaging and unsatisfying, whereas unstructured gaming environments with minimal feedback can lead to frustration. This study investigated how designers might strike the balance between too much and too little learner support in instructional game design by giving varying types of support to the subgroups. Findings from the qualitative and quantitative data indicated that the students in this study preferred intrusive and prescriptive scaffolding. However, the groups’ frustration and lack of understanding denote a need for additional scaffolding.

Educational theorists have explored the benefits of play for enhancing learning for some time. Both Piaget (1952) and Vygotsky (1978, 2007) concluded that play is an important part of the developmental process that holds great promise as an instructional strategy. Piaget argued that play facilitates accommodation and assimilation—the necessary process learners go through to grasp new information and make it a part of their own knowledge set. According to Piaget, through playful imagination and pretending, learners simulate and experiment with real-world scenarios, often performing far beyond their developmental age. Vygotsky also observed that, through interactions with more capable peers or adults when playing, children are able to understand complex content above their expected cognitive level.

Over the years, researchers have similarly extolled the promise of computer-based play to motivate learners (Malone, 1980, 1981) and bring real-world experiences into the classroom (Papert, 1980). According to Rieber (1996), serious play within an instructional game can facilitate discovery, self-regulation, mindfulness, and experimentation to arrive at the prescribed learning goal. Cameron and Dwyer (2005) argued that gaming’s authentic interactions, competition, practice, and feedback guide learning in ways that can translate into increased satisfaction and achievement. Similarly, Dickey (2007) suggested that instructional games encourage the development of higher order, critical thinking skills by requiring learners to plan and strategize rather than simply answer questions to complete a task.

Despite the promise of instructional gaming, contended Shelton and Wiley (2007), there are still questions to be answered about best approaches to educational game design. It seems not all instructional games are equally motivating to learners (Lucas & Sherry, 2004) or well matched to the natural way in which learners think and reason (Kalyuga, 2007). In particular, instructional games appear to fluctuate considerably between too much structure (restricted play) and too little structure (free play) (Salen & Zimmerman, 2004). At one extreme, learners can find highly structured games with lots of corrective feedback less engaging and unsatisfying (Csikszentmihalyi, 1991; Moreno, 2004). At the other extreme, unstructured, complex environments with minimal feedback can lead to a heavy cognitive load, frustration, and difficulty succeeding (Sweller, 1999; Vogel, Greenwood-Ericksen, Cannon-Bowers, & Bowers, 2006). How might designers strike the proper balance between too much and too little learner support in their instructional game designs?

A Learner Support Model

Cates and Bruce (2000) explored how learner support might be more systematically implemented in computerized instruction. As depicted in Figure 1, the authors envisioned a “learner support space” made up of four quadrants that span from intrusive to nonintrusive (left to right along horizontal axis) and from prescriptive to nonprescriptive (top to bottom along vertical axis). In the upper-left corner, intrusive/prescriptive support overtakes the screen without being requested by the learner and dictates the “proper” manner for task completion (“You need to do this next”) while often also taking control of the mouse.

In the lower right corner of the Cates and Bruce model, nonintrusive/nonprescriptive support waits for the learner to seek it out and then makes unobtrusive, thought-provoking suggestions (“Have you thought about what you might do next?”). In the upper-right corner, nonintrusive/prescriptive support similarly waits until prompted by the learner to supply assistance but then provides step-by-step guidance (“Now that you’ve tried, click here and I’ll give you the answer”), whereas in the lower-left corner, intrusive/nonprescriptive support interrupts to supply hints about how to proceed (“Take a look at this idea!”).
The authors suggested that designers use this conceptual model to find an optimally effective learner support balance to address the motivational and cognitive load needs of learners. However, the feasibility of the Cates and Bruce model has never been tested. This problem and my interest in scaffolding for game-based learning led to my involvement in the MyRulerMaker project and the study described here.

**MyRulerMaker**

MyRulerMaker introduces middle-level learners to artificial intelligence and computer programming. MyRulerMaker is an easy-to-use “interface shell” that “wraps around” IBM’s freely available artificial intelligence game engine, CodeRuler. The object of CodeRuler is to overcome an opposing army and steal the flag from the enemy’s castle by programming in Java. By itself, however, CodeRuler is too highly technical for most younger learners to work with easily. Adding the MyRulerMaker interface circumvents the need to learn complicated syntax by asking learners a series of natural language “programming” questions and communicating their decisions as pseudocode “rules” that are executed under particular conditions as the game unfolds (Figure 2).

Learners watch as MyRulerMaker then executes the learners’ decisions toward either a winning (friendly army captures enemy’s castle) or a non-winning (enemy army captures friendly castle) final outcome (Figure 3).

![Figure 2: Code Ruler Interface](image)

**Figure 2: Code Ruler Interface**

MyRulerMaker is being collaboratively designed and developed by Dr. Munoz-Avila (Computer Science), Dr. Bishop (Education), myself, and a development team of computer science students. As lead instructional designer and project manager, I was responsible for designing the interface functionality and storyboarding in consultation with Dr. Bishop. After project-managing the initial development and several revisions of the tool with Dr. Munoz-Avila and the development team, we piloted a prototype with 19 eighth- and ninth-grade students enrolled in Lehigh University’s Launch-IT program (Summer 2008). The purpose of Launch-IT is to propel underprivileged students toward college and careers in information technology.

At this point in the development of MyRulerMaker, working with the fairly computer-savvy group of Launch-IT students gave us some good preliminary indications of the tool’s instructional design and usability. During the pilot, students worked in pairs, which allowed us to observe their verbal negotiations of choosing a strategy and often having to defend their point of view to their teammate. In the post-activity questionnaire, which used a Likert scale rating system (1=Not True, 2=Just a Little Bit True, 3=Sort of True, 4=Mostly True, 5=Totally True), students generally agreed that they enjoyed using MyRulerMaker (M=4.2, SD=1.1) and that completing the activity gave them a sense of accomplishment (M=4.1, SD=1.2); however, they were not confident that they knew what they were supposed to be learning from the activity (M=3.5, SD=1.3) or that they could learn the content (M=3.6, SD=1.6). Our observations confirmed these findings. Thus, while it appeared MyRulerMaker was motivating and supported learners’ code generation as they worked in a relatively linear fashion, it clearly required additional learner support to meet the instructional needs of the target population. In particular, the tool may have allowed too much free play; it did not explain the decision-making to pseudocode connection and did not supply structured guidance on how to make the most effective choices to win the game.

Therefore, we reasoned the next step in the development of MyRulerMaker was to conduct a more in-depth, formative evaluation that would help us identify what additional learner support students required so that we might incorporate it into a future release of the tool.

The research questions guiding this study were:

1. What is the optimal balance of learner support necessary to win the game while still keeping learners satisfied and engaged?
2. How much and what kind of additional scaffolding is necessary to help learners connect the game to the desired content?
Methods

User-centered design advocates argue that real users should be involved from the start of the design process by interacting with evolving prototypes of the software to accomplish realistic tasks in authentic settings (Corry, Frick, & Hansen, 1997). Usability testing is the term used to describe the research methodology that involves users throughout the design and development process and focuses on the whole system—including issues involving interface design, logistical concerns, accessibility, learner support, and the like (Sugar & Boling, 1995). While the terms formative evaluation and usability testing are sometimes used interchangeably, formative evaluations tend to occur a bit later in the design and development process and are more narrowly focused on particular pedagogical strategies or instructional effectiveness (Richey & Klein, 2007). Therefore, to answer my questions at this stage in the development of the MyRulerMaker game about specific learner scaffolding techniques that are best suited to instructional gaming, we conducted a mixed-methods, formative evaluation with a group of 21 middle-level learners (grades six to eight).

Participants

The 21 student participants were asked to provide demographic information in a pre-activity questionnaire that included questions on gender, age, grade, race, computer use, video game use, and learning styles (see Appendix A). Students reported being in grades six and seven, and as shown in Table 1, they were almost evenly split by gender and age. More than half the students (n=11) reported that they identified as Hispanic, with the remaining students split among the other races.

When asked about their computer usage, three quarters of the sample (n=15) reported using the computer less than five hours a week. Almost all students reported having a computer at home (n=19) but were just about evenly split between needing permission to use it (n=9) and being able to use it whenever they chose (n=10). When specifically asked about video games, most of the students reported having video games at home (n=17) and that they could use them whenever they chose (n=16). Roughly half of the students reported that they play video games all the time (n=10), and the other half play video games once or twice a month (n=7). Most students had played video games in school (n=16), typically reading and math games.

The final portion of the pre-activity questionnaire asked the participants for their thoughts on learning. When asked about their learning style, the majority reported that they learn best when they hear information (n=8) or read information (n=6) as opposed to do it (n=2) or write it (n=1). Finally, when asked what they do when something does not work, the majority of students either reported that they take it apart (n=6) or ask an adult for help (n=8).

Instrumentation

In addition to the pre-activity questionnaire discussed above, this study also employed a post-activity questionnaire. The post-activity questionnaire consisted of three major sections: motivation (20 items), content/learner support (5 items), and overall impressions (8 items) (see Appendix B).

Because the amount of scaffolding and structure in instructional games can impact learners’ motivation to complete the task and learn the desired content, the first part of the post-activity questionnaire was based on Keller’s (1987) 36-item Instructional Material Motivation Survey (IMMS). Huang, Huang, Diefes, and Imbrie’s (2006) validation study reduced Keller’s 36-item instrument to 20 items (r=0.852, n=875) and checked the items for reliability. The instrument comprises four scales that mirror Keller’s ARCS model of motivation: attention (a learner must be focused on the task in order to be affected by any stimulus to learning), relevance (a learner must feel that he or she personally needs to learn the information and that it will serve a purpose), confidence (the feeling learners experience when they have control over their own success), and satisfaction (learners’ overall satisfaction with the learning experience and outcomes). As recommended by Huang et al., the IMMS was further altered for this context and piloted in the earlier study; items were edited subsequently to address readability issues. Appendix B supplies the original items from Huang et al. along with those used in the study reported here.

In addition to the motivation items, two other categories were added to the post-activity questionnaire for this study. The content/learner support section included five items to see if students made the connection between the activity and the underlying content. The overall impressions section explored the learners’ general reactions to the software in eight additional items. Two instructional designers and an expert in instructional technology use with mid-level learners validated both the pre-activity and post-activity questionnaires.

Procedures

Prior to the start of the study, the 21 student participants were divided into pairs (with one male student left over), and the pairs of students were divided into four learner support “quadrant groups”: Prescriptive/Intrusive, Prescriptive/Nonintrusive, Nonprescriptive/Intrusive, and Nonprescriptive/Nonintrusive as shown in Table 2. The students were split into groups purposefully to balance for gender and age. However, due to high absenteeism that day, one student was randomly assigned to balance out the groups. Throughout the study, students were kept unaware that there were differences among the groups.

Also prior to the start of the study, two videos were developed to explain MyRulerMaker and CodeRuler to the students: one Prescriptive and one Nonprescriptive. Additionally, the
“Prescriptive” video included brief instruction on artificial intelligence and an explanation of the connection between the activity and the content (see Appendix C for video storyboards). These videos were posted online and linked to four separate Webpages, one for each of the quadrant groups. For the Prescriptive/Intrusive Webpage, the Prescriptive video was linked and the interface required the students to watch the video before going on to play the game, whereas the Prescriptive/Nonintrusive Webpage text simply informed the students that the video was available if they wanted to watch it. Similarly, the Nonprescriptive/Intrusive group was required to watch the Nonprescriptive video, whereas the Nonprescriptive/Nonintrusive group was just made aware of the video as an additional resource.

At the start of the session, each student received a colored nametag (red, yellow, blue, and purple), which identified each student’s group, Website, and coach. Students were seated into their predetermined pairs at computers with microphones and headphones, and individually completed the pre-activity demographic questionnaire previously discussed (Appendix A). Next, students were instructed to review their assigned Webpages and follow the instructions included there. Learners were then given 30 minutes to work with MyRulerMaker in pairs while a Camtasia video-based screen capture program recorded their comments to each other and their interactions with the software throughout the activity. Due to site license restrictions, not all pairs could be recorded; however, the available site licenses were evenly split among the groups.

Additionally, each quadrant group was assigned a coach who provided the appropriate learner support within that subgroup. The coach received specific instructions on how to play his or her support role during the activity (see Appendix D). Thus, students in all four groups played MyRulerMaker under the appropriate guidance of their assigned quadrant coach. After completing the activity, learners filled out the postactivity questionnaire previously discussed (Appendix B). The entire time from when the students entered the room to when they left the room was 60 minutes.

Data Analyses
The video recordings were saved to DVDs, and I later transcribed them for further qualitative analysis using Annotation Transcriber, an application that allows transcription and time stamps to be added to a video. The use of qualitative analysis can uncover new patterns by describing an overview of the entire learning experience (Glesne, 1999). Learners’ transcribed conversations were coded to look for themes and patterns in order to identify strategies used, thought processes, the nature of any problems that arose, and responses to any learner support received from the coaches. Any evidence of apathy (“Ok, whatever”), intrusive coaching, off-task behaviors (student blowing into the microphone), asking the coach a question, excitement (“Oh SNAP!”), frustration (“What the heck!”), or understanding (“Maybe if I had changed our choices we would have won more!”) was highlighted and then counted for frequency.

The postactivity questionnaire was analyzed quantitatively to identify learners’ motivation, how learners described the type of support they received, and their experience with the game itself. The raw data from all measurements were entered in a Microsoft Excel spreadsheet to calculate frequency counts, means, and standard deviations. The postactivity questionnaire items were divided into the four ARCS subscales and the content/learner support and overall impression sections, and analyzed by subscale and group. The data for each subscale were then placed into separate tables for closer examination to determine what patterns emerged.

Findings
This mixed-methods study resulted in the collection of both qualitative and quantitative data. Each set of findings is presented in the following sections.

Qualitative Findings
The videos were transcribed and analyzed for frequencies of coaching instances by type and learner behaviors such as time off task, frustration, and understanding. Those data are presented in Table 5.

Analysis of the transcripts indicated that the four coaches stayed true to their support roles throughout the activity with “Prescriptive coaches” providing far more specific support than “Nonprescriptive coaches” as shown in Table 5. Additionally, the means of the frequency counts across all of the Intrusive students showed that the Intrusive students received more unsolicited scaffolding (M=25.9, SD=8.57) than their Nonintrusive counterparts (M=0.8, SD=0.88). And, looking specifically at pairs within the quadrant groups, the Intrusive/Prescriptive pairs received the most instances of unsolicited scaffolding (f=37, 35, 38), whereas the Nonintrusive/Nonprescriptive pairs received the least amount of unsolicited scaffolding (f=0, 1).

The Nonintrusive/Nonprescriptive group also had the highest frequency of time off task (f=11, 13) and frustration behaviors (f=7, 7). However, Pair A in the Intrusive/Nonprescriptive group exhibited the same number of frustration behaviors (f=7) and even more off-task behaviors (f=18) than the two pairs in the Nonintrusive/Nonprescriptive group. All other pairs had relatively low frequencies of off-task and frustration behaviors.
During the game play, only one pair (Intrusive/Prescriptive) indicated from their comments that they understood how to play the game such as “If they go by the ruler’s castle the other one and they get captured” or “Java I think” (f=6). Three pairs in the Intrusive/Nonprescriptive group (f=2, f=1, f=3) and one pair in the Intrusive/Prescriptive group (f=1) less frequently indicated some understanding. The remaining four pairs in the Nonintrusive/Nonprescriptive and Nonintrusive/Prescriptive groups showed no outward sign (f=0) that they understood how the game functioned.

Quantitative Findings
Means and standard deviations for the motivation, understanding, and satisfaction with coaching items were calculated in Excel and analyzed by subscale and group. Those data are presented in Tables 3 and 4.

Motivation. Generally, the pairs who received the Intrusive/Prescriptive scaffolding rated highest on the post-activity questionnaire on all four of the motivation subscales: attention (M=3.5, SD=1.39), relevance (M=3.9, SD=1.21), confidence (M=3.9, SD=1.53), and satisfaction (M=4.2, SD=1.40); all other groups were in the midrange (sort of true) classification as shown in Table 3. However, when examining the confidence items, the Nonintrusive/Prescriptive (M=4.0, SD=1.58) averaged slightly higher than their Intrusive/Prescriptive counterparts.

Frustration. When asked if they were frustrated by MyRulerMaker in the post-activity questionnaire, the Intrusive/Nonprescriptive (M=2.2, SD=1.30) and Nonintrusive/Nonprescriptive (M=2.8, SD=1.71) groups rated the item between “just a little bit true” and “sort of true”; the Intrusive/Prescriptive (M=1.2, SD=0.41) and Nonintrusive/Prescriptive (M=1.8, SD=0.98) groups rated the item close to the “just a little bit” to “not true” rating.

Understanding. Three of the quadrant groups rated the item “I could relate the content of MyRulerMaker to things I have seen, done, or thought about before” between “just a little bit” and “sort of true” (Intrusive/Prescriptive M=2.8, SD=1.47; Nonintrusive/Prescriptive M=3.0, SD=1.90; and Nonintrusive/Nonprescriptive M=2.5, SD=1.29). The Intrusive/Nonprescriptive (M=1.8, SD=1.30) pairs rated that item below the “just a little bit true.” When examining the item “There were a lot of things I didn’t understand about MyRulerMaker,” the Nonintrusive/Prescriptive group rated this item the lowest “just a little bit true” (M=4.2, SD=1.60, scores normalized); the rest of the groups rated the item in the “sort of true” range as shown in Table 4.

Satisfaction with coaching. Quadrant groups receiving prescriptive scaffolding reported being most satisfied with the support they received with the Nonintrusive/Prescriptive group falling between “sort of true” and “mostly true” (M=3.8, SD=1.40) and the Intrusive/Prescriptive group falling just above “mostly true” (M=4.2, SD=1.17). Additionally, as shown in Table 4, both Prescriptive quadrant groups rated the item “The coaches in the room gave me too much help…; I wanted to figure out more of it on my own” between “a little bit true” and “not true” (Nonintrusive/Prescriptive M=4.7, SD=0.82; Intrusive/Prescriptive M=4.5, SD=0.84).

Data from the pre- and post-activity questionnaires were triangulated against the qualitative data to determine what recommendations might be made based on the findings. The next section presents that discussion.

Discussion
While Vygotsky (1978) argued that play is a form of scaffolding learning, it was clear from the findings that students required additional scaffolding to succeed and maintain motivation throughout the experience. Students in the Intrusive/Prescriptive group scored higher on the ARCS motivational questions, showed a better understanding of game functionality, and reported it was only “a little bit true” that they had received too much support from their coaches. Additionally, the prescriptive scaffolding resulted in the highest satisfaction rating among the four quadrant groups. This aligns with Dickey’s (2007) conclusion that, along with having choices and options within the gaming environment, scaffolding is important to help the students learn and progress through the game. As shown in Table 4, none of the groups reported strongly that they received too much scaffolding, and the groups were consistent by prescriptiveness. This finding might be explained, in part, by the pre-activity questionnaire data that indicated most of these students often ask adults for assistance when they are confused.

Pairs received scaffolding in two ways. The first was through coaching presented as being part of a particular quadrant group. When looking closely at these interactions, Nonprescriptive coaches would often take longer to guide the learner than their Prescriptive counterparts because the Nonprescriptive scaffolding was more vague. This vagueness resulted in a higher frequency of coaching as well as signs of frustration “What the heck!” and disengagement “I’m bored” from the Nonprescriptive/Nonintrusive group. These pairs were also more frequently off task displaying behaviors such as playing with the microphone as shown in Table 5. It is common for students to disengage when frustrated or faced with a higher cognitive load (Sweller, 1999; Vogel, Greenwood-Ericksen, Cannon-Bowers, & Bowers, 2006). Lim, Nonis, and Hedberg (2006) also found lack of scaffolding increased cognitive load, which can cause learners to disengage from the content.
The second manner in which a student received scaffolding was by soliciting it by asking questions. It appears from these findings that there may not be many differences between the Intrusive and Nonintrusive pairs because when placed in a position where the coach was not intrusive with scaffolding, the students were asking questions to get a better understanding of what they needed to do. Often the students asked questions of each other, and generally, one team member took the lead in each pair. Despite the students’ willingness to ask for assistance, it appears from the qualitative findings that the Nonprescriptive pairs were more frustrated than the Prescriptive pairs, which may point to the type of scaffolding they received as shown in Table 5. When examining the coded transcripts, rarely did any of the pairs make any observations showing they understood how the game functioned. Only one of the Intrusive/Prescriptive pairs made comments that implied they understood how to play the game such as “we picked the wrong one, capture castle ruler.” However, this pair’s primary strategy for winning was simply to pit their ruler against the weakest rulers supplied in the game—a fairly low-level tactic. The other pairs made occasional comments that showed understanding, but most pertained to how the students identified which castle was theirs or which program to use and when. No students showed any understanding of the programming logic they were creating using MyRulerMaker, and there was no discussion of the pseudocode generated by the program to help them see the game-to-programming connections. Due to this lack of understanding, the students appeared to be unable to transfer what they were learning to other conceptual knowledge they already had.

Based on these findings, it appears that prescriptive support (regardless of intrusiveness) may have provided the students with the confidence they needed to succeed. Levels of intrusiveness may be less important because students seem to have learned to seek out the support they need whether it is offered or not. However, when learner motivation is also considered, an intrusive/prescriptive style appears to lead to higher levels of satisfaction with the task. Regardless, the level of support provided during this study did not assist the learners in connecting the activity to the underlying content or to the learners’ prior knowledge. From these findings, it appears that more specific scaffolding may be required for learning acquisition and transfer to occur from an instructional gaming environment.

Limitations
Due to the small sample size, there were only two or three pairs for each coaching style. This precluded the use of more sophisticated quantitative analyses to determine whether there were significant differences among the groups, a cause for concern given the high standard deviations reported here.
The answer is a qualified yes. To harness the true power of gaming, an organization does not need to create its own Multiplayer Online Role-Playing Game (MORPG) or create its own virtual world. While these experiences may be enjoyable for a learner, a corporation must also be concerned with the time it would require to complete the activity, and gain and measure the desired knowledge. Rather, we should take a look at what makes these games so enjoyable and engaging, and implement those concepts into a more traditional online learning solution. We will break this into two parts: the elements and the design.

**Gaming Elements**

The most cost-effective way to introduce gaming into the workplace is to emulate the gaming environment in an online solution. To illustrate the concepts, a sample eLearning game will be used. This series of modules was created to teach Lean Six Sigma concepts in 2009. The original solution was a one-day, in-person simulation game, which was recreated in an online format. This module was so successful for that organization that it was later translated into Italian and French, and still receives hits each month in 2014 with active users.

**Time.** One of the most common elements of a gaming solution is a restricted amount of time as shown in Figure 4. Most online games have a time element included either in a countdown clock, trying to beat your own time, or number of lives (chances) to complete your mission. The entire module does not need to employ this method; however, key interactions such as decision points or activities can use a time element to increase engagement. Even the element of time passing can increase the game-like feel to a learning strategy. This scaffolding provides the learner with a finite amount of time to be engaged, reducing learner burnout while increasing the challenge element.

**Character.** Gaming allows learners to step outside themselves and temporarily become someone else. Instead of having a learning solution talk to a person, allow the learner to choose from a series of characters to act on behalf of. Once you have transitioned into the module, you can resume a first-person view like most MORPGs, and that character is no longer seen because the learner is seeing through their eyes as shown in Figure 5. This character scaffolding allows learners to feel comfortable failing, as it is their character that is failing and not the employees themselves.

**Score.** Much like the timing element, a score should be given to the learner to keep them informed on their progress as shown in Figure 6. Unlike the end of a traditional module (you need to have an 80% to pass), gaming will present the learner with much larger numbers with no maximum score. The learner can then either play the game multiple times to beat their own score or compete against others with a published leader board. Score can also be communicated simply by using a status bar with score being represented as red/yellow/green status.
**Design**

**Mission.** A clear mission or objective is identified at the beginning of a game. Whether you are saving the princess, making the bird fly, or eliminating the enemy, there is a clear objective to be reached. Most corporate training has a clear objective (to complete it), but that objective could be used to motivate the learner instead. For example, the learner had the objective to reduce the backlog of advertisements. The mission scaffolding provides the learner with context and a story to support their knowledge construction.

![Figure 7: Mission](image)

**Designed path.** The most important component to develop corporate gaming is the illusion of a user-controlled environment. An element of MORPG that resonates with learners is the flexibility to control their own destiny, which has led companies to try to create virtual worlds where learners can construct their own knowledge. However, a more successful approach is to create the illusion of control by providing the learner with options to choose a different path without knowing that there are a finite number of available paths to select. This requires a solid instructional design and path mapping, as shown in Figure 8, prior to beginning game development.

![Figure 8: Designed Path](image)

**Helpful hints.** In alignment with the preceding study, support needs to be provided to the learner, particularly in non-traditional learning solutions. Hints are available to the user, but they are not required information abiding by the non-intrusive, yet prescriptive, findings of the study. These hints can include additional information as shown in Figure 9, ideas to get the learner started, or specific advice or direction on what to do next.

![Figure 9: Hints](image)

**Conclusion**

In conclusion, game-based learning can be achieved in a corporate environment. When game-based learning is considered, simplicity is best. A simple mini-game such as the one shown in Figure 10 can provide the elements of gaming in an easy and cost-effective manner, providing both the company and the learner with the results they both need to be successful.

![Figure 10: Mini-Game](image)
References:


Sweller, J. (1999). Instructional design in technical areas. Camberwell, Australia: ACER.


Appendix A

Pre-Activity Questionnaire

[NOTE: This questionnaire was web-based and administered to learners prior to their playing the MyRulerMaker game. Subsection labels did not appear in the final version that students saw.]

Today you are going to use a piece of software to teach you a little about computer programming. Before we get started, please take some time to tell us a little more about yourself and what you think about computer programming. There are no correct or incorrect answers, so just complete the form honestly with the first answer you think of to each question.

Demographic Information

1. What is your gender?
   - Male
   - Female

2. What is your age?
   - 10
   - 11
   - 12
   - 13
   - 14
   - 15
   - 16
   - Other

3. What grade are you in?
   - 6
   - 7
   - 8
   - 9

4. When asked about my race, I say I am...
   - Asian
   - Multi-racial
   - Black
   - Native American
   - Hispanic
   - a Pacific Islander
   - Inuit or Yupik
   - Southeast Asian
   - Middle Eastern
   - White

5. Do you know what you want to be when you grow up?
   - Yes, definitely.
   - I have a few ideas, but I’m not sure.
   - Never thought about it.

Computer Use

6. On average, how much time do you spend on the computer each week outside of school hours?
   - None
   - 10-20 hours
   - Less than 5 hours
   - 20 or more hours
   - 5-10 hours

7. Do you have a computer at home?
   - No, there is no computer in my house.
   - Yes, there is one in my house but I can’t use it.
   - Yes, there is one in my house and I can use it, with permission.
   - Yes, I have my own computer that I can use whenever I want.

Video Game Use

8. Do you like to play video games?
   - No.
   - Sometimes, depends on the game.
   - Sometimes, but only if my friends are playing.
   - Yes.

9. Do you have video games at home?
   - No, there are no video games in my house.
   - Yes, there are video games in my house but I can’t use them.
   - Yes, there are video games in my house and I can use them, with permission.
   - Yes, I have my own video games that I can use whenever I want.

10. How often do you play video games?
    - I never play video games.
    - I play video games 1-2 times a year.
    - I play video games 1-2 times a month.
    - I play video games 1-2 times a day.
    - I play video games every chance I get every day.

11. Have you ever played video or computer games in school?
    - Yes.
    - No.
    - If yes, what did you think of them?
Appendix A (continued)

Perceptions of Computer Science and Programming

12. What does a computer scientist do? (Pick one.)
   - Buildings computers.
   - Sells computers.
   - Repairs computers.
   - Programs computers.

13. Which of these people is most likely to be a computer programmer? (Pick one).

14. What is artificial intelligence?

Learning and Problem-Solving Styles

17. I remember best when I? (Pick one.)
   - Hear it.
   - Read it.
   - Do it.
   - Write it.

18. Where do you learn best? (Pick one.)
   - Teachers
   - Parents/Guardians
   - Museums
   - Internet
   - Television
   - Movies
   - Other (explain):

19. What do you do when something doesn’t work right? (Pick one.)
   - I ask an adult for help.
   - I ask a friend for help.
   - I take it apart and see how it works.
   - I look up information on the Internet.
   - I give up.

15. How does artificial intelligence work?
   - The computer thinks and acts without any human intervention.
   - A programmer tells the computer what to do whenever a decision needs to be made.
   - A computer programmer gives the computer rules about what to do whenever a decision needs to be made.
   - A computer does whatever it thinks is best.

16. Can a computer think?
   - Yes.
   - No.
   - Maybe.
   Explain your answer:
Appendix B
Post-Activity Questionnaire
[NOTE: This questionnaire was web-based and administered to learners subsequent to their playing the MyRulerMaker game in the formative evaluation. The motivation items (1-20) were modified for an age-appropriate reading comprehension level. For validation purposes, the original 20 items validated by Huang et al. (2006) (with their factor loadings in parentheses) are included in italics below each item.]

<table>
<thead>
<tr>
<th>Motivation</th>
<th>Not True</th>
<th>Just a Little</th>
<th>Sort of True</th>
<th>Mostly True</th>
<th>Totally True</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. As soon as I saw MyRulerMaker, I was interested.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>There was something interesting at the beginning of M-Tutor that got my attention.</em> (A, 0.663)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. MyRulerMaker is neat to look at.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>M-Tutor is eye catching.</em> (A, 0.743)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Everything was written well, which helped me pay attention.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The quality of the writing in M-Tutor holds my attention.</em> (A, 0.0753)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. The way the questions were organized helped me pay attention.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The way the information is arranged on the M-Tutor pages helped keep my attention.</em> (A, 0.738)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. MyRulerMaker has things that made me curious.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>M-Tutor has things that stimulated my curiosity.</em> (A, 0.742)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The different actions I could choose from helped me pay attention.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The variety of reading passages, exercises, diagrams, etc. helped keep my attention on M-Tutor.</em> (A, 0.725)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I saw that this is similar to things I have done before.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>I could relate the content of M-Tutor to things I have seen, done, or thought about in my own life.</em> (A, 0.644)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I enjoyed MyRulerMaker so much that I would like to know more about this topic.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>I enjoyed M-Tutor so much that I would like to know more about it.</em> (A, 0.794)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>I really enjoyed learning with M-Tutor.</em> (A, 0.802)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. The assistance from the teachers in the room while I was using MyRulerMaker helped me feel rewarded for my effort.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The working of the feedback and/or the links to go back and review material after the exercises made me feel rewarded for my effort.</em> (A, 0.773)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. It was a pleasure to work on such a well-designed program.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>It was a pleasure to work with M-Tutor.</em> (A, 0.76)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. There were examples of how people use the content.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>It is clear to me how the content of M-Tutor is related to the course.</em> (R, 0.776)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. There were examples to show me why this is important to some people.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>There are sufficient diagrams and examples that showed me how M-Tutor could be important to some people who are learning MATLAB.</em> (R, 0.571)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. The content MyRulerMaker will be useful to me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>The content of M-Tutor will be useful to me in terms of learning the course effectively.</em> (R, 0.646)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Motivation

15. I didn’t understand what I was supposed to do and had a hard time paying attention.  
   *M-Tutor is so abstract that it was hard to keep my attention on it.* (C, 0.684)

16. MyRulerMaker was too difficult to use.  
   *The exercises in M-Tutor were too difficult.* (C, 0.712)

17. There was too much on the screen; I couldn’t figure out what to do.  
   *Many of the pages contained so much information that it was hard to pick out and remember the important points.* (C, 0.759)

18. After working on MyRulerMaker for a while, I think I can play CodeRuler without MyRulerMaker.  
   *After working on M-Tutor for a while, I was confident that I would be able to pass a test on MATLAB.* (C, 0.630)

19. There were a lot of things I didn’t understand.  
   *I could not really understand quite a bit of the material in M-Tutor.* (C, 0.705)

20. The amount of repetition in MyRulerMaker made me bored sometimes.  
   *The amount of repetition in M-Tutor caused me to be bored sometimes.* (S, 0.640)

### Content/Learner Support

1. MyRulerMaker was an instructional program.

2. I understood the point of playing with MyRulerMaker.

3. The adults in the room gave me support when I needed it.

4. The adults in the room told me what I needed to know in order to be successful.

5. The adults in the room gave me too much help...I wanted to figure out more of it on my own.

### Overall Impressions

1. MyRulerMaker was like other things I’m interested in.

2. When I started, I thought playing MyRulerMaker was going to be easy.

3. As it turned out, MyRulerMaker was harder than I thought it was going to be.

4. Winning at MyRulerMaker was important to me.

5. I thought MyRulerMaker was boring.

6. I was frustrated by MyRulerMaker.

7. Sometimes MyRulerMaker surprised me.

8. I thought MyRulerMaker was ugly.

---

What was the point of playing with MyRulerMaker? [Open ended]
### Appendix C

<table>
<thead>
<tr>
<th>Slide #</th>
<th>Slide</th>
<th>Nonprescriptive</th>
<th>Prescriptive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><img src="image" alt="MY RULERMAKER" /></td>
<td><strong>Welcome to MyRulerMaker!</strong> In this game you will get to make decisions for your characters and tell them what to do. You are the ruler...and you get to make them do what you think is best.</td>
<td><strong>Welcome to MyRulerMaker!</strong> While playing this game, you will learn about programming and artificial intelligence. You will use MyRulerMaker to generate Java code, which will tell the knights, peasants, and castles what you want them to do in order to win the game.</td>
</tr>
<tr>
<td>2</td>
<td><img src="image" alt="WHAT IS THE OBJECT OF THE GAME?" /></td>
<td>The object of the game is to capture your computer opponent’s castle. Of course, don’t forget that the computer is trying to capture your castle at the same time! If neither castle is captured before time runs out, you get points for capturing enemy characters such as knights, peasants, and castles. You also get credit for land that is your color. Finally, when time is up, you will get points for the characters you still have.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><img src="image" alt="WHAT ARE MY TOOLS?" /></td>
<td>To begin, you will have one castle that can make knights and peasants. You will start with 10 peasants who can claim and work the land. You also have 10 knights who can both defend your castle and capture enemy characters like other knights, peasants, and castles.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><img src="image" alt="WHAT DO I HAVE TO DO?" /></td>
<td>This is the battleground. As you can see, there are two castles in the upper-left and lower-right corners. One of these is going to be yours! The blue and purple dots are knights and peasants, who can capture castles and other knights and peasants. In the upper-right corner you will find the score of the game, and in the lower-right corner is the timer. When the sundial completes an entire day, the game is over and whoever has the most land, castles, peasants, and knights wins!</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><img src="image" alt="WHAT DO I HAVE TO DO?" /></td>
<td>So all you have to do is choose what you want your castle, peasants, and knights to do during the game. There are many choices to make, and in order to win, you need to think about what will work best since you are the ruler.</td>
<td>So all you have to do is choose what you want your castle, peasants, and knights to do during the game. The more enemy characters you capture and the more land you own, the more chance you have to win. Finally, when time is up, you will get points for the characters you still have...which means you need to keep your characters safe, too. So, in order to win, you’ll want the castle to be building lots of peasants to claim and work the land...an important part of overpowering your opponent’s position. You’ll also want the castle to continue building knights for you. Be sure to split your knights into two groups: one to protect your castle and the other to capture the enemy. For your knights and peasants, you will also need to choose how you want them to travel. Traveling in groups is best because, for example, you can have half the knights guarding the castle while the other half is capturing the enemy castle.</td>
</tr>
</tbody>
</table>
### Appendix C (continued)

<table>
<thead>
<tr>
<th>Slide #</th>
<th>Slide</th>
<th>Nonprescriptive</th>
<th>Prescriptive</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td><img src="image1.jpg" alt="Image" /></td>
<td>You will make these decisions before the battle begins on a screen that looks like this. In the middle of the screen will be a question listed and a series of choices. Use the buttons to select the option you think will work best. Each decision you make will be coded for you in the Java programming language.</td>
<td>You will make these decisions before the battle begins on a screen that looks like this. In the middle of the screen will be a question listed and a series of choices. Use the buttons to select the option you think will work best. Each decision you make will be coded for you in the Java programming language.</td>
</tr>
<tr>
<td>7</td>
<td><img src="image2.jpg" alt="Image" /></td>
<td>[Show this screen, but say nothing here... use a sound effect to “click” through it and have the pseudocode appear... ]</td>
<td>At the bottom of the screen, it will show you a simplified form of what that code would look like for your choice. You should be sure to take a look at what your decisions would look like in a “programming language!”</td>
</tr>
<tr>
<td>8</td>
<td><img src="image3.jpg" alt="Image" /></td>
<td>The Next button will take you to the next question. Continue this way until you have made all of your choices.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td><img src="image4.jpg" alt="Image" /></td>
<td>You can also click on the labels indicating group, winning, and losing to review those decisions and change your choice if you need to.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td><img src="image5.jpg" alt="Image" /></td>
<td>When you are done, there will be a button that says Generate Code. Clicking that button will “lock in” your decisions for the battle.</td>
<td>When you are done, there will be a button that says Generate Code. Clicking that button will “lock in” your decisions and write the Java code that you will use for the battle.</td>
</tr>
<tr>
<td>11</td>
<td><img src="image6.jpg" alt="Image" /></td>
<td>When the popup appears, you can just click OK. Then open Eclipse, which should be already running on your computer.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td><img src="image7.jpg" alt="Image" /></td>
<td>There might be a box that tells you the code has changed. You can click OK on that. In the center of the screen are different rulers listed to choose from by clicking the Add button. You are usually listed as the No Name ruler. Then click to add an opponent.</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix C (continued)

<table>
<thead>
<tr>
<th>Slide #</th>
<th>Slide</th>
<th>Nonprescriptive</th>
<th>Prescriptive</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td><img src="image1.png" alt="Image" /></td>
<td>When you have added your ruler and an opponent, click the Run button</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td><img src="image2.png" alt="Image" /></td>
<td>Good Luck!</td>
<td></td>
</tr>
</tbody>
</table>

The Websites can be found at:

- Nonintrusive/Nonprescriptive
- Nonintrusive/Prescriptive
  http://www.sheriweppel.com/MyRulerMaker/Prescriptive-NonIntrusive.html
- Intrusive/Nonprescriptive
- Intrusive/Prescriptive
  http://www.sheriweppel.com/MyRulerMaker/Prescriptive-Intrusive.html
Appendix D
Instructions for Coaches

Background
Cates and Bruce (2000) explored how various sorts of feedback might be more systematically implemented to support learning in computerized instruction. They envisioned a “learner support space” made up of four quadrants that span from intrusive to nonintrusive (left to right along horizontal axis) and from prescriptive to nonprescriptive (top to bottom along vertical axis). In the upper-left corner, Intrusive/Prescriptive support overtakes the learner’s screen and dictates the “proper” manner for task completion (“Stop. I have a better way,” p. 89). In the lower-right corner, Nonintrusive/Nonprescriptive support makes unobtrusive suggestions and provides options (“I have ideas,” p. 89). In the upper-right corner, Nonintrusive/Prescriptive support waits to give learners the answer (“Ask me when you’re ready and I’ll tell you how to do it,” p. 89), whereas in the lower-left corner, Intrusive/Nonprescriptive support interrupts to tell the learner about an idea (“I have some advice I want you to see,” p. 89).

Procedures
After filling out the pre-activity questionnaire, the group will be divided in half and sent to either a “Prescriptive” computer or a “Nonprescriptive” computer. Once there, the subgroups will be divided further into two “Intrusive” groupings that will be seated as far apart as possible. This will result in four learner support “quadrant groups” of approximately seven to eight students: Prescriptive/Intrusive, Prescriptive/Nonintrusive, Nonprescriptive/Intrusive, and Nonprescriptive/Nonintrusive. Each group will be assigned a coach who will play the appropriate learner support “role” within that treatment condition. Students in both groups will watch a demonstration of how to use MyRulerMaker. Additionally, students in the “Prescriptive” groups will receive brief instruction on artificial intelligence, and the connection between the activity and the content will be explained to them. Students in all four groups will then play MyRulerMaker under the appropriate guidance of their assigned quadrant coach.

Specifics About Your Roles
Nonintrusive Coaches: Nonintrusive coaches should offer assistance only when prompted by the students, e.g., if they ask you a question, have an issue, or in another way solicit a response from you.

Intrusive Coaches: Intrusive coaches should actively look for opportunities to offer assistance throughout the activity. Do not wait for the students to request assistance, but instead, do so regularly throughout the hour...regardless of whether the students look like they need redirection or request assistance.

Prescriptive Coaches: Prescriptive coaches should always supply the answer. For example, a Prescriptive coach might say things like “Try using two groups; that will help you win,” “In order to win, you need to protect your castle,” or “If you don’t have your castle-building knights, you don’t have a chance.”

Nonprescriptive Coaches: Nonprescriptive coaches should never supply the answer, but rather make suggestions about things to think about when proceeding, e.g., “Have you thought about why you chose the grouping that you did?” “So, why do you think they captured you castle?” or “What do you think you could do differently?”
Table 1

Demographic Information on Age, Gender, and Ethnicity of Participants From Self:
Report Pre-Activity Questionnaire

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Multiracial</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Native American</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>White</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>None of the</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>above</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decline to</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Comment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 2

Breakdown of Groups by Pair and Gender

<table>
<thead>
<tr>
<th>Pair</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrusive/Nonprescriptive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair A</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Pair B</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Pair C</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonintrusive/Nonprescriptive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair E</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Pair G</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrusive/Prescriptive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair I</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Pair J</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Pair K</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrusive/Prescriptive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair M</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Pair N</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Pair O</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3

Mean Scores for Attention, Relevance, Confidence, and Satisfaction Subscales on the Post-Activity Questionnaire

<table>
<thead>
<tr>
<th>Group</th>
<th>Attention</th>
<th>Relevance</th>
<th>Confidence</th>
<th>Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Nonintrusive/Nonprescriptive (n=4)</td>
<td>M=3.0</td>
<td>SD=1.44</td>
<td>M=2.9</td>
<td>SD=1.69</td>
</tr>
<tr>
<td>Nonintrusive/Prescriptive (n=6)</td>
<td>M=3.1</td>
<td>SD=1.67</td>
<td>M=2.4</td>
<td>SD=1.53</td>
</tr>
<tr>
<td>Intrusive/Nonprescriptive (n=5)</td>
<td>M=3.1</td>
<td>SD=1.55</td>
<td>M=2.5</td>
<td>SD=1.48</td>
</tr>
<tr>
<td>Intrusive/Prescriptive (n=6)</td>
<td>M=3.5</td>
<td>SD=1.59</td>
<td>M=3.9</td>
<td>SD=1.53</td>
</tr>
</tbody>
</table>

1=Not True, 2=Just a Little Bit True, 3=Sort of True, 4=Mostly True, 5=Totally True

Table 4

Frustration, Understanding, and Satisfaction With Coaching by Group

<table>
<thead>
<tr>
<th>Group</th>
<th>Post-Treatment Items</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I was frustrated by</td>
</tr>
<tr>
<td></td>
<td>MyRulerMaker,**</td>
</tr>
<tr>
<td></td>
<td>There were a lot of</td>
</tr>
<tr>
<td></td>
<td>things I didn’t</td>
</tr>
<tr>
<td></td>
<td>understand about</td>
</tr>
<tr>
<td></td>
<td>me too much</td>
</tr>
<tr>
<td></td>
<td>MyRulerMaker,**</td>
</tr>
<tr>
<td></td>
<td>help… I wanted</td>
</tr>
<tr>
<td></td>
<td>to figure out</td>
</tr>
<tr>
<td></td>
<td>more of it on my</td>
</tr>
<tr>
<td></td>
<td>own. **</td>
</tr>
<tr>
<td>Nonintrusive/Nonprescriptive</td>
<td>M=3.3</td>
</tr>
<tr>
<td>Nonintrusive/Prescriptive</td>
<td>SD=1.71</td>
</tr>
<tr>
<td>Intrusive/Nonprescriptive</td>
<td>M=4.2</td>
</tr>
<tr>
<td>Prescriptive</td>
<td>M=2.8</td>
</tr>
<tr>
<td>Intrusive</td>
<td>M=3.8</td>
</tr>
<tr>
<td>Prescriptive</td>
<td>SD=1.30</td>
</tr>
<tr>
<td>Intrusive</td>
<td>M=4.8</td>
</tr>
<tr>
<td>Prescriptive</td>
<td>SD=0.41</td>
</tr>
</tbody>
</table>

**Normalized

5=Not True, 4=Just a Little Bit True, 3=Sort of True, 2=Mostly True, 1=Totally True
Table 5

Frequency Counts of Coaching Types, Off-Task Behaviors, Frustration, and Understanding by Pairs

<table>
<thead>
<tr>
<th>Qualitative Results</th>
<th>Nonintrusive/Nonprescriptive</th>
<th>Intrusive/Prescriptive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair</td>
<td>Unsolicited Solicited Prescriptive</td>
<td>Non-Off Task Frustration Understanding</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>E</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>G</td>
<td>37</td>
<td>9</td>
</tr>
<tr>
<td>A</td>
<td>35</td>
<td>14</td>
</tr>
<tr>
<td>B</td>
<td>38</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>J</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>I</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>M</td>
<td>16</td>
<td>4</td>
</tr>
</tbody>
</table>

About the Author

Sheri Weppel is the Director of Training and eLearning Development at GP Strategies. Sheri joined GP Strategies 6 years ago and has over 15 years’ experience designing, developing and delivering interactive computer-based and web-based learning modules. Her role is to drive innovative ISD techniques into the processes and provide valuable input on the state of learning and best-in-class practices. Sheri recently completed her MS in Learning Sciences and Technology with a focus in gaming for instruction at Lehigh University. She has also earned an MS in Instructional Design and Development from Lehigh University and a BS in Art Education from Kutztown University.

For more information contact
Sheri D. Weppel
Director
GP Strategies
sweppel@gpstrategies.com