Abstract: This study examines whether having mentors communicate with players through a virtual chat program rather than face-to-face changes anything about the players’ experience. Specifically, this study compares the virtual chat versus face-to-face conditions during the epistemic game, Urban Science, and examines the mentor and player discourse during reflection meetings. The results of this study suggest that mentoring via chat is a viable method for mentoring in the context of epistemic games.

A priori issues addressed

Virtual environments have the potential to allow young people to explore complex concepts in simulated form. In simulations, complex social and environmental problems that are too expensive, dangerous, or difficult for players to solve in the real world can be appropriately scaffolded in a dynamic model, giving young people opportunities to more easily interpret the interconnections in the model and develop professional thinking. Virtual environments can make the experience more widely available by simplifying logistics through using non-player characters (NPCs) to support players’ learning.

This paper examines a virtual environment called Urban Science, an epistemic game designed to simulate an urban planning practicum experience (Bagley, 2010). In Urban Science novices, called players, take action in a supervised setting and reflect on their results with peers and mentors. The mentors facilitate the novices’ work in the practicum by scaffolding tasks the novices are not yet ready to undertake and help them reflect on that work. Following this practicum model, mentors and players interact through planned reflection meetings where the mentor helps players discuss previously completed activities and plan next steps in the project.

This paper examines mentors’ and players’ reflection meetings in a face-to-face and a virtual condition and asks whether there were differences in the mentors’ and players’ discourse between the conditions.

There is a growing body of research that suggests that video games (used in both formal and informal environments) can support learning (Bagley & Shaffer, 2009; Barab & Dede, 2007) because games allow young people to explore complex concepts in simulated form. Yet, even with a complex model available, logistical concerns, such as identifying experts with adequate experience to mentor players make virtual environments difficult to implement in educational settings. Virtual environments have the potential to simplify logistics by providing students with interactions with a variety of virtual NPCs that can play the role of scripted mentors, community members, or colleagues in a fictitious firm. The NPCs’ performance can be automated, lowering the logistical overhead and making the virtual environment more widely available.

One type of virtual environment designed specifically for young people to explore complex concepts in simulated form with lower logistical overhead is the epistemic game. In epistemic games, novices inhabit a virtual environment in which they learn the epistemic frame—the combination of linked and interrelated skills, knowledge, identity, values, and epistemology of a particular profession by simulating professional training (Shaffer, 2007). Novices are supported by peers and mentors and by simulations that scaffold some of the skills and knowledge necessary for young people to build professional epistemic frames. Mentors in epistemic games facilitate cycles of real-world learning through frequent and strategically-placed reflective conversations with the novices (called players in epistemic games) about their authentic tasks. Mentors model a professional epistemic frame by asking players to reflect on what worked, what did not work, and why and scaffolding a way of seeing and solving problems that the players can adopt.

In epistemic games, mentoring has traditionally been conducted face-to-face with players. However, face-to-face mentoring has high logistical overhead and limits the availability of the game. One way to simplify logistics might be to have mentors communicate with players virtually. However, some are skeptical of virtual mentoring and argue that when communication goes electronic, the richness associated with face-to-face conversation diminishes and a considerable amount of information is lost (Bierema & Merriam, 2002). Brennan and Lockridge (2006) argue that in chat-based interactions, mentors have no access to the players’ body language, tone of voice, or the variety of other signals that can only be detected in a shared physical environment, and as a result, miscommunication can occur.

It is unclear whether the constraints of virtual mentoring, namely the possibilities for lost information and miscommunication, outweigh the affordances. Therefore, since there are practical and theoretical reasons to explore virtual mentoring, this study explores whether having mentors communicate with players through a...
virtual chat program rather than face-to-face changes anything about the players’ experience. To do so, we measured the quality of the reflection meeting discourse content in two conditions of the epistemic game, Urban Science, a virtual environment in which players work as interns at a fictional, virtual urban planning firm (Bagley & Shaffer 2009).

**Methods**

This section describes the setting and the activities for both conditions of Urban Science and then discusses the collected, segmented, coded, and analyzed discourse data from the reflection meetings.

**Participants**

21 high school aged players (11 females, 10 males) recruited by educators at the Massachusetts Audubon Society’s (MAS) Drumlin Farm Wildlife Sanctuary played a 10-hour version of Urban Science as part of a week-long Conservation Leadership Program in August 2010. The education specialists recruited young people who had previously participated in at least one MAS program and had no prior experience with urban planning.

The two mentors (called planning consultants) in the game were an education researcher (the primary author) and a Drumlin Farm educator. Both mentors completed a training that covered the urban planning profession, the game’s activities, and preferred mentoring strategies. The mentors were given a script to follow, and they were instructed to keep the conditions as similar as possible.

**Situation**

The data for this study were collected from two conditions of Urban Science. In the game, players were assigned to one of two conditions, face-to-face or virtual chat (typed, not video) and one of three teams representing a specific set of stakeholder concerns. Each stakeholder team worked with one of the two mentors. Aside from two adult chaperones being present in the chat condition room, everything about the two games was the same (or as close to the same as possible).

During Urban Science, received instructional emails from NPCs controlled by their mentor and were asked to produce land use plans for a community. Throughout the game, mentors were available to help the players if they struggled and to guide players’ reflection on their work. Mentors also held synchronous reflection meetings to ask players what they finished doing, what they learned during the last activity, what they thought should happen next, and what additional information would be helpful. The mentors were instructed to listen to the responses before interjecting, and after players responded, the mentor revoiced (Cazden, 2001) and extended the players’ responses to include specific epistemic frame elements pre-determined to be important for that specific point in the game.

**Data collection analysis and coding**

This study examines the mentors’ and players’ reflection meeting discourse collected in both the face-to-face and chat conditions of Urban Science. In the chat condition, all of the players’ and mentors’ reflection meetings were recorded by the online portal. In the face-to-face condition, the reflection meetings were audio recorded and transcribed. All records were de-identified by replacing references to usernames (names used to sign into the online portal) with pseudonyms.

Mentor and player discourse from four reflection meetings were analyzed to determine whether the discourse was different between conditions. The reflection meetings were segmented by conversational turn and coded using a set of 21 codes developed using (1) the American Planning Association’s (2011) description of what professional planners know, do, and care about and (2) epistemic frame theory as a guide for categorizing professional thinking. A set of representative excerpts were chosen from the full data set, and grounded theory (Strauss & Corbin, 1998) was used to develop a more specific set of qualitative codes representing aspects of urban planning expertise.

While coding the data, the coder read each excerpt separately and applied one code (presence 1, absence 0) at a time. The validity of the coding process was checked through an inter-rater reliability analysis in which an educational psychology researcher working in a non-planning domain was trained on the coding scheme and independently coded 150 randomly selected excerpts of the data. All codes had a Cohen’s Kappa greater than 0.6.

The qualitative analyses uncovered several themes in the reflection meeting discourse data, and an emerging quantitative technique called Epistemic Network Analysis (ENA) was used to triangulate the qualitative data and examine how the themes unfolded and whether or not they unfolded similarly or differently across conditions. ENA measures relationships among epistemic frame elements within an epistemic network (Shaffer et al., 2009) and was applied to the mentor and player reflection meeting discourse data. A classical multi-dimensional scaling (MDS) algorithm was applied to the reflection meeting adjacency matrices in order to identify the dimensions that captured the most variance in the data. In this paper, the first and second dimensions (the dimensions that captured the most variance in the data) are plotted. The plots with the reflection
meeting data were created from ad acency vectors that included both the mentor and player reflection meeting data.

**Results**

The results described below examine both the face-to-face and chat conditions of Urban Science. The first section explores the mentors’ reflection meeting discourse using qualitative and quantitative techniques, and the second section applies the same techniques to the players’ reflection meeting discourse.

**Mentors**

During Reflection Meeting (RM) 1 in both conditions, Elise, the People for Greenspace (PGS) team mentor, talked about stakeholders’ desires by asking players if they trusted the stakeholders to know what is best for the site. For example, in the chat condition Elise asked, “do we trust the stakeholders to know what’s good for the site?” and in the face-to-face condition she similarly asked, “do you guys trust that the stakeholders know what’s best for the site?” Elise’s discourse in the face-to-face condition contained similar content to her discourse in the chat condition, however her face-to-face discourse contained additional filler (Tannen, 1982) words (“like”) and repetition.

During RM 2 in both conditions, Elise talked about generating hypotheses with data or an interactive model by informing the players that iPlan measures the projected social and environmental impacts of zoning changes (Table 1). In both conditions, she discussed iPlan’s ability to test ways of making the site work for the stakeholders without bringing in actual bulldozers and ended that portion of the meeting by reminding players in both conditions that the site is a complex system, which means that changing one parcel impacts more than one indicator and that there may be trade-offs with every change. As in RM 1, Elise’s discourse in the face-to-face condition contained similar content to her discourse in the chat condition, however, her face-to-face discourse contained additional filler (Tannen, 1982) words (“well,” “so”) and verbal acknowledgements of what the players already said or knew: “but what all of you were saying is...”

Table 1: Excerpt from PGS’ RM 2 showing (in color) that Elise covered similar content in both conditions.

<table>
<thead>
<tr>
<th>Chat</th>
<th>Face-to-face</th>
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<tbody>
<tr>
<td>iPlan measures the projected social and environmental impacts of zoning changes, it allows you to test ways of making the site work for the stakeholders without bringing in actual bulldozers. You discovered that one characteristic of the site is that it is a complex system, which means that changing one parcel impacts more than one indicator. There may be trade-offs with every change.</td>
<td>iPlan can measure the projected social and environmental probability changes, it makes you test ways of making the site work for the stakeholders without actually bringing in bulldozers. Well you discovered one characteristic of the site, especially, but what all of you were saying is that it’s a complex system...That means that changing one parcel impacts more than one indicator...So there may be tradeoffs with every single change.</td>
</tr>
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</table>

Since Elise discussed similar content regardless of condition, her discourse showed similar patterns of epistemic frame co-occurrence between conditions. The similar patterns of epistemic frame co-occurrence in both conditions are illustrated by the locations of the mentor points (means) for each condition in Figure 1 where points closer together have more similar patterns of co-occurrence than points farther apart. For example, Elise’s discourse during RM 1 is located on the far right of the x-axis and her discourse during RM 2 is located high on the y-axis (Figure 1).

![Figure 1](image_url)  
*Figure 1. Mentors’ RM discourse (with means) showing that regardless of the communication mode, the mentors covered similar content during the RMs.*

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The mentors’ patterns of co-occurrence of epistemic frame elements were similar during RMs 1 and 2, and those similarities can be seen qualitatively (Table 2) in mentor excerpts and quantitatively in the ENA analysis (Figure 1). Meeting-by-meeting, t-tests on ENA-generated discourse means for both chat and face-to-face conditions showed no significant differences. In other words, the variance between the RMs was larger than the variance between the conditions, and regardless of the communication mode, the mentors covered similar content during the RMs.

**Players**

During RM 3 in both conditions, players in the S team discussed addressing stakeholders’ desires using a model (Table 2). For example, in both conditions, players talked about their experiences using i:lan to address the stakeholders’ desires and specifically mentioned Maven’s (one of the stakeholders) disapproval of their plans. In the chat condition, one player asked “Why Maven was mad?” and in the face-to-face condition a player also struggled with Maven’s feedback and told the team that “Maven called their plans completely unacceptable.”

Table 2: Excerpts from PGS’ RM 3 showing (in color) that players discussed similar content in both conditions.

<table>
<thead>
<tr>
<th>Chat</th>
<th>Face-to-face</th>
</tr>
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<tbody>
<tr>
<td>I just sent my 2nd map in also I see why Krista still doesn’t like traffic but why is Maven mad we cannot get it lower than 2...I found that CCl4 needs to be lower and thus we must lessen M1 and M2 areas.</td>
<td>...if you heighten up one thing and another thing goes down...I managed to even out most things, but for some reason, they [stakeholders] weren’t really like happy...Maven called our plans completely unacceptable...</td>
</tr>
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</table>

During RM 4 in both conditions, players talked about the practice of reporting data. For example, in both conditions, players announced that, “I found that” or “We got a more exact idea” indicating that they had data to report to the team. In the chat condition, one player reported that she learned that “the stakeholders have high demands”. Similarly, in the face-to-face condition, one player reported that the team had a better idea of “what they [stakeholders] wanted”.

Though the players’ discourse contained different filler (Tannen, 1982) words (“like”, “so”), regardless of condition, the players’ discourse showed similar patterns of epistemic frame co-occurrence between conditions. The similar patterns of epistemic frame co-occurrence in both conditions are illustrated by the locations of the player points (means) for each condition in Figure 2. For example, the players’ discourse during RM 3 is located to the left of the origin on the x-axis and their discourse during RM 4 is located below the origin on the y-axis (Figure 2).

![Figure 2](image_url)

Figure 2. Players’ discourse from reflection data (with means) showing that regardless of the communication mode, the players discussed similar content during the RMs.

The players’ patterns of co-occurrence of epistemic frame elements were similar during RMs 3 and 4, and those similarities can be seen qualitatively in player excerpts (Table 4) and quantitatively in the ENA analysis (Figure 2). Meeting-by-meeting, t-tests on ENA-generated discourse means for both chat and face-to-face conditions showed no significant differences, with one exception. The t-test comparing the first dimension of each condition in RM 1 did show a significant difference (p < 0.05). However, the difference between the conditions may be attributed to players in the chat condition becoming familiar with the online meeting style.
However, overall, the variance between the meetings was larger than the variance between the conditions, and regardless of the communication mode, the players covered similar content during the RMs.

Conclusions, limitations and implications
This study extends the research on virtual education by showing that regardless of the mentoring condition, players showed no significant differences in their RM discourse. Specifically, this study identified that mentors, whether face-to-face or virtual, used similar professional discourse to guide players through the game. Their mentoring led players in both conditions to likewise use similar professional discourse and develop similar epistemic frames. In other words, the co-occurrence of epistemic frame elements within the discourse for both the mentors and the players in each reflection meeting followed similar patterns respectively. These results suggest that the key function of the mentors, to communicate professional ways of thinking, was not diminished in the chat condition.

Bierema and Merriam (2002) suggest that the richness associated with face-to-face conversation often diminishes when communication goes electronic. However, in this study, the mentors were instructed to follow a script while leading reflection meetings. Therefore, the similar efficacy of the mentoring in each condition may seem less surprising. The players’ discourse, however, was similar between conditions without the benefit of scripts to follow, which suggests that if the mentors follow a script while leading reflection meetings, virtual mentoring can be just as effective as face-to-face mentoring at getting players to discuss specific topics, and thus build professional ways of thinking. Further, it is possible that what is lost in the limited communication medium of chat is either peripheral to the professional substance of the conversation or is provided somewhere else in the game. Nevertheless, that virtual mentoring can succeed equally as well as face-to-face mentoring with the same supports suggests that even the human interactions in a mentoring relationship can work virtually.

The study presented is, of course, limited. First, the small sample size means that any conclusions are limited to what the sample population did in the context of the epistemic game. Thus, the purpose of the significance tests presented in this paper were to show that additional observations made under the same conditions would show similar results. Second, while this study showed that the mode of communication used by the mentors did not affect the players’ reflection meeting content, this evidence does not support claims about why mentoring is important in epistemic games. Future studies will examine the important role of mentors in epistemic games. Third, the goal of this particular study was not to judge the specific merits of the particular epistemic frame developed: a question which has been examined before (Bagley & Shaffer, 2009; Bagley, 2010).

Since the mentoring condition did not affect the players’ reflection meeting discourse, the results of this study can influence the design, implementation, and assessment of virtual environments. Thus, learning in a virtual environment like Urban Science is viable and desirable because virtual environments can expand the range of what players can realistically do and thus also the problems they can address, the possible collaborations they can participate in, and the communities they can inhabit.

References