A Design Research Approach to Innovation in 3D Virtual Learning Environments

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iSocial is an internet-based 3D-Virtual Learning Environment (VLE) to support social and behavioral outcomes for youth with Autism Spectrum Disorders (ASD). The purpose of developing this system is to expand access to specialized training for developing social competence. iSocial seeks to adapt and implement in a 3D-VLE a clinic-based curriculum with demonstrated impact for improving social competence. It is being developed using the Open Wonderland virtual world toolkit (http://openwonderland.org/). Wonderland provides tools for building multi-user virtual environments (MUVEs).

iSocial (Laffey, Stichter & Schmidt, 2010; Laffey, Schmidt, Stichter, Schmidt, Oprean, Herzog, & Babiuch, 2009) has followed a design research approach through 2 years of pilot projects and continuing with funding support from AutismSpeaks and a $1.5 million award from the Institute of Education Sciences (IES). The IES award illustrates the design research approach as we iterate through the design and development of 5 units of the curriculum with usage tests for each unit and then 2 levels of field tests. Each test is an opportunity to advance our theory of social competence for youth with ASD and to advance the iSocial system so as to implement the curriculum and support social competence in a 3D-VLE. For example, in the first unit to be developed we conceptualized what was needed and important for the youth to interact effectively and learn from their social and cognitive experiences. This is especially challenging because the reason these youth need the training is that they are typically ineffective in social interaction. Following lessons learned in the first unit we advanced our conception of
what is needed and developed an implementation that better targets key needs and opportunities. As an illustration we are developing structures within the curriculum called “social orthotics” to scaffold the youth in social and group activity and as we move from one unit to the next we will recalibrate and adjust the approach to the specific orthotic tools so that they both resonate with the youth and achieve the desired results.

A typical session in iSocial involves students coming together in the online virtual world to undertake curricular activities. An example of a session is illustrated in figure 1 where several youths are engaged in tasks to design a restaurant. The youth first identify a type of restaurant they would like to build. This requires that the youth interact amongst themselves and make decisions about their preferences, and also come to a consensus for the choice that they will make. Figure 1 shows the youth in the environment where they are making a choice. As they make choices the restaurant is assembled and they get to walk around inside of it, as well as decide on decor and menu.

![Figure 1. A scene of several youth engaged in the restaurant building activity.](image-url)
Design Research Goals

Prior to answering the key question of whether youth can improve their social interactions with family, classmates and teachers by learning social competence in a 3D-VLE, our design research goal is to develop a system that supports learning behavior in a social VLE. Are participants able to be social in iSocial? iSocial needs to be both usable and useful to these youth and their online guide, and since there is no substantial nor sufficient research base for us to draw upon, we needed to learn how to make it social through our iterative design research process. Key to this approach was to develop an innovative data collection and analysis approach that we could use throughout usability, usage and field tests. Our poster shows the capabilities of the iSocial system and describes the research methods we use to improve our theory and systems through our iterative development cycle.

Data collection

Two types of data are collected in each test session. First every participant’s session is recorded using ScreenFlow. Screenflow records everything on the participants screen, the audio during the session, and video of the participants’ face. The record is exported to a .mov file that contains both the screen recording and participants’ face, using a picture-in-picture technology. Second, we developed an embedded logging functionality to record movement, gesture, verbalization, and actions of participants’ avatar in order to better automate the coding process. Each log entry contains the information of action done, by who, and timestamp.
Data analysis

The recordings of all participants in each session and the excel files produced by the logging functionality are imported to ELAN (see figure 2), an open source software system used for the creation of complex annotations for video and audio resources. Starting with the reciprocal coding scheme (Patterson & Reid, 1970) our team has worked through a number of iterations to customize a way of coding social interaction (a base form of “being social”) in youth behavior in iSocial. Three graduate students have been able to achieve inter-observer agreement at 80%-90% across all coding levels. The basic coding scheme consists of three levels of codes: reciprocal interaction level, interaction mode level, and context coding level.

Figure 2. Example of all-views analysis in action using the ELAN Linguistic Analyzer.

Reciprocal interaction level

Initiation, response and continuation (IRC) are the basic codes for conversational
analysis. For the purpose of understanding user behavior when learning social
compétence, the distinction between appropriate behavior and inappropriate behavior is
important. We divide IRC into two categories: appropriate initiation, response,
continuation and inappropriate initiation, response, continuation. Given the affordances
that 3D virtual environment can provide, we also define initiation, response and
continuation in more specific ways – whether these IRC are verbal or non-verbal. In the
virtual environment gesture, movement, mouse click, and text can contribute to the
interaction, just as nodding and gestures support initiation, responses, or continuation in
face-to-face interaction. Non-responsive is assigned if a response or continuation is
expected but the participant fails to acknowledge the interaction in any way within 3
seconds.

Table 1: Codes in reciprocal interaction level

<table>
<thead>
<tr>
<th>Appropriate</th>
<th>Initiation</th>
<th>Verbal</th>
<th>To:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Response</td>
<td>Non verbal (Include movement, gesture, mouse-click, text)</td>
<td>Teacher (online guide), Peers, Helper, Physical helper, Technical helper, task inside the Environment</td>
</tr>
<tr>
<td></td>
<td>Continuation</td>
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seconds. Non-responsive: A response or continuation is expected but the participant
fails to acknowledge the interaction in any way within 3 seconds.

Interaction Mode level

The logging system can record these interaction codes automatically. Whenever there is
an audio input from a client terminal, an audio record is logged. Additionally gestures,
movements, mouse-clicks, and text are recorded. These interaction codes enhance the
description of the reciprocal interaction level coding.

Table 2: codes in interaction mode level

<table>
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<th>Codes</th>
<th>Description</th>
</tr>
</thead>
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<tr>
<td>Audio</td>
<td>Any audio that input from the participant’s microphone</td>
</tr>
<tr>
<td>Gesture</td>
<td>Gestures used by the participants who are represented by avatars in the environment. E.g. nod, wave, clap.</td>
</tr>
<tr>
<td>Movement</td>
<td>Used to identify avatar movement within the virtual space</td>
</tr>
<tr>
<td>Mouse-click</td>
<td>Used to identify mouse click on elements in the environment</td>
</tr>
<tr>
<td>Text</td>
<td>Used to identify participant use of text chat.</td>
</tr>
</tbody>
</table>

Context

Because we are interested in analyzing how participant interactions may be influenced by
the various components of the virtual world and the areas in which the interactions take
place, our coding scheme considers three levels of context: where are the students?, what
task are they engaged in?, and what activity are they undertaking within the task? Such
contextual coding describes where in the virtual world the interactions are occurring and
what technological activity forms the specific context for those interactions.

Conclusion

Using this research process across the iterations of units and field tests allows us to
continually compare the social behavior of youth to prior or alternative forms of
implementation and guides our understanding of “being social” and our development of
iSocial.
