Using Immersive Simulations to Develop Intercultural Competence

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Abstract. This chapter describes a simulation-based approach to cultural competency training realized in the Alelo family of learning products. It is intended to help people who may not be cultural specialists to quickly develop the cultural skills they need to be effective in intercultural settings. This includes the knowledge and skills necessary to handle common situations involving intercultural interactions, as well as the adaptability needed to cope with unexpected intercultural interactions. Crucially, it utilizes simulations of intercultural encounters that learners are likely to experience in the course of carrying out their jobs or missions, which help learners develop the skills and confidence necessary to be effective in those situations. The approach also supports the assessment of cultural competence by testing trainees in simulated intercultural encounters. The approach makes use of a number of innovative technologies, but most importantly immersive game and artificial intelligence technologies.

Keywords: Cultural competence, cultural skills, agent-based computing, simulation-based learning environments, serious games.

1 Introduction

Intercultural skills are increasingly recognized as important for many jobs and everyday situations. The workforces of multinational corporations are frequently organized into multinational teams in which people from various cultural backgrounds need to work together effectively. Companies that deliver products internationally need to understand the cultural backgrounds and perspectives of their potential customers in each target market. Professionals engaged in health care, law enforcement, education, humanitarian relief, and peacekeeping operations all require skills in interacting with people with other cultural backgrounds [2], [5], [10], [11], [14].

This need for intercultural knowledge and skills poses a significant educational challenge. Experts in the language education community, such as the American Council on the Teaching of Foreign Languages (ACTFL), commonly assert that true intercultural competence arises only after years of immersion in the target culture, as part of a language education program [9]. Unfortunately, relatively few specialists in other professions get the opportunity to devote that much time to cultural training. Thus a major challenge for cultural skills training is finding ways to help people develop the intercultural skills they need, in the time they have to learn.

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The approach makes use of a number of innovative technologies, but most importantly immersive game and artificial intelligence technologies. Immersive game technologies are used to simulate the intercultural encounters that serve as the context for skills training. Artificial intelligence technology is employed to create interactive computer characters that can engage in dialog with the learners, in a culturally appropriate way.

2 Example Courses

Many users of Alelo courses are members of military services around the world, who require training in cross-cultural communication skills so that they can perform missions overseas, such as reconstruction and humanitarian assistance, and work together with coalition military partners. Fig. 1 shows a scene from one such course, the US version of the Operational Dari language and culture trainer. Operational Dari includes interactive lessons that teach task-relevant communication skills and interactive scenarios in which learners can practice those skills. In the example in the figure, the learner, playing the character on the left, is engaged in a meeting with the elders in an Afghan village. He needs to develop rapport with the elders in order to gain their trust and cooperation. To play the scenario, the learner must speak into the microphone in Dari, speaking phrases appropriate for his or her character in the scenario, and the non-player characters respond accordingly. The dialog history is shown in the top center of the figure. This is a relatively advanced scenario; more elementary modules and scenarios help trainees who initially have no knowledge of Dari get to the point where they can engage in such conversations with confidence.

We also develop learning materials for other platforms to provide comprehensive, anywhere-anytime learning and refresher training. We deliver interactive lesson content on iPods and other handheld devices. This can be used either as a low-cost self-contained learning tool or as a refresher practice supplement. We have also developed an artificial intelligence plug-in for popular immersive multi-player training environments, making it possible to populate virtual worlds with artificially intelligent characters playing a range of different roles. This makes it possible to integrate language and culture training seamlessly with other types of job training.

Fig. 1. Operational Dari language and culture training system

Fig. 2. Exercise from the goEnglish Web site

This scenario-based approach is being applied more broadly to teach language and culture. For example, Fig. 2 shows a dialog exercise from goEnglish, a Web site developed for Voice of America to teach American culture and language worldwide.

The site is designed for learners who have acquired a basic reading knowledge of English in school, but have a limited understanding of American culture, and have had a limited opportunity to develop and practice their conversational skills. It contains a set of lessons that focus on the language and culture of situations that arise in everyday life in the United States, as well as cultural topics of particular interest. To develop the set of topics, we interviewed recent immigrants to the United States to find out what situations they found particularly surprising or challenging. The site contains a set of lessons where they learn conversational language and cultural points relevant to these situations and topics, and exercises in which they practice in simulated conversational situations. A speech recognition plug-in is loaded into the user's Web browser, enabling learners to speak English into a microphone and have the non-player characters in the situation respond to what they say. In the situation shown in Fig. 2, the learner is getting to know an acquaintance named Malika and is talking about their relationships. The learner has found out that Malika has a boyfriend (see the dialog history in the top center of the figure) and can now ask further questions, such as when and where they met. If the learner is uncertain as to what to say, he or she can consult a menu of hints about conversational topics (top left, in Chinese) and possible ways of expressing each particular topic (center left). The learner's score for the exercise depends upon the total number of dialog exchanges, and the extent to which the learner relied on hints to get through the scenarios.

There are multiple versions of the goEnglish Web site, aimed at different learner communities. In addition to the Chinese site shown in Fig. 2, there is a site in Persian, and sites for speakers of Russian and other languages are currently under development.

3 Cultures Modeled to Date

Developing Alelo courses requires knowledge of the culture being taught. This is used both to develop learning materials that teach about the culture, and to develop animated agents that behave in accordance with the norms of the culture, as in Figs. 1 and 2. Depending upon the target audience and the learning objectives of the course, some courses provide extensive instruction in the local language, and include characters that understand and speak only the local language, while others include a more limited amount of language instruction and engage in conversation in the learner's native language.

It is also important to have a good understanding of the learner's culture to help ensure that the learning materials and objectives are presented in a style, and with language and phraseology, that match the learner's expectations. As noted above, goEnglish is available in multiple languages. Likewise, Operational Dari is available in versions intended for use by the military services of the United States, Australia, the United Kingdom, Germany, and other NATO countries. The instructional language of the one for Germany is in German; all the others are in English. Course details vary slightly in each case to reflect the learner's culture. Differences include uniforms and physical appearance of game characters, artwork, as well as terminology, spelling, and phraseology. Voiceovers and narrations may be recorded

using voice actors from the local country. Military services and other large organizations have their own distinctive subcultures with specialized terminology and writing style, which we try to respect where possible. The extent to which a particular course needs to be adapted to the local culture typically depends upon the size of the country. For example, the German and British versions required extensive adaptation for the local culture, while most smaller NATO countries are willing to use more generic courses.

To date we have developed courses with cultural instruction and extensive language instruction for the following countries: Iraq, Afghanistan, Indonesia, French-speaking sub-Saharan Africa, and the United States. The United States courses include a course on the majority language (goEnglish), as well as a pilot course in a Native American language (Cherokee). More culture-focused courses have been developed for the countries of the Horn of Africa, and additional courses are being developed for Northern Africa and other countries.

4 Course Structure and Development Methodology

Cultural knowledge potentially encompasses a broad range of topics, such as social structure, material culture, economics, political structure, art, as well as the culture of day-to-day life. It is difficult to cover all these topics in enough depth that learners can competently and effectively apply the cultural knowledge they gain. We employ a course development methodology that enables us to identify which types of situations are most important, and what cultural skills are needed to master those situations. We then design the courses to help learners develop and master those skills. This offers practical benefits for learners, because it gives them cultural competencies that they can immediately put to use when interacting with people from the other culture. It helps learners develop confidence in their ability to engage in intercultural interaction. Once learners start becoming effective in interacting with people from the other culture, they will learn more about the culture from those interactions, and are likely to continue to broaden and deepen their cultural knowledge on their own.

This course development methodology, called the Situated Culture Methodology (SCM) [3], [15], works as follows and is illustrated in Fig. 3. The first step, outlined in the top left corner of the figure, is to determine scope of the course. This takes into account the situational contexts in which learners are likely to employ their cultural skills. First, it is necessary to identify the intended scope of the course, in terms of the breadth of the geographic region being covered and the duration of the course. To further focus the course, we work with cultural subject matter experts to identify the particular jobs and missions that learners will likely want to train for. This process identifies typical scenarios that require intercultural skills, situations that learners might encounter during those scenarios, and tasks that learners might need to perform in those situations. Given these situations and tasks, it is then possible to identify specific *situated culture learning objectives*: knowledge and skills that learners need to acquire in order to be effective in those situations. If the learners must employ the local language in these situations, then a set of situated language learning objectives are implied as well.

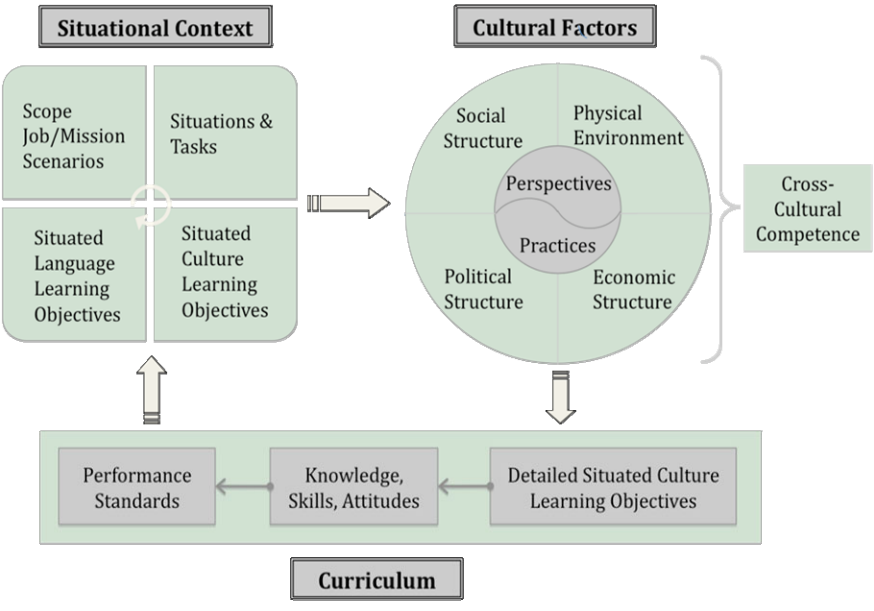

Fig. 3. Situated Culture Methodology

Once these situated learning objectives are defined, we go through a process of identifying the specific cultural factors that need to be covered in the course to meet these objectives. These factors are grouped in the following general categories: the physical environment or milieu in which the culture is situated, and the political, economic, and social structures common within the culture. The perspectives that are typical of people within the culture are important, such as people's attitudes toward time, personal relations, work, and the role of the individual within the community. We also identify relevant cultural practices, including norms of conversational interaction and nonverbal communication.

Note that the process of identifying the relevant cultural factors often involves research and the development of data about culturally appropriate interaction in the target situations. Published sources of cultural information frequently lack sufficient detail about how people in the culture would actually behave in a given situation. Using a combination of ethnographic interviews and role-playing with subject matter experts, we elicit details of how people typically interact in these situations. We then codify this information in the form of dialogs that illustrate how people in the culture interact with each other, and annotate them with explanations of the dialog moves and indications of how people in the culture commonly interpret them. These dialogs serve as the basis for designing simulated dialog exercises and the agents that play appropriate roles within those exercises.

In addition to specific knowledge about particular cultures, learners also require general cross-cultural competence, i.e., general skills for handling intercultural situations [8]. Cross-cultural competence helps learners recognize and understand cultural differences, and provides a general set of skills for coping with such differences when they arise in intercultural contexts.

Fig. 4. A goEnglish lesson page

Once the particular cultural factors are identified, they are used to develop the specific curriculum content to be included in the course. Detailed learning objectives are defined for each relevant cultural factor. These typically comprise *knowledge* about the culture, intercultural *skills*, and *attitudes* that are conducive to success in intercultural settings. The knowledge and skills tend to be interrelated; learners first acquire knowledge about the culture and then acquire the skills necessary to apply this knowledge to intercultural situations. We then identify the target performance standards for each learning objective, e.g., demonstrate the ability to apply the cultural skills in particular simulated scenarios.

The result is a computer-based curriculum containing lesson pages that introduce language and cultural knowledge, exercises that reinforce knowledge and develop intercultural skills, and simulated scenarios for practicing and assessing those skills. For example, Fig. 4 shows one of the lesson pages in goEnglish that introduces the language and cultural knowledge that learners apply in the simulated small talk scenario in Fig. 2. This page explains that, in modern American culture, being "single" indicates not only that a person is unmarried, but also that they do not have boyfriend or girlfriend. The page also gives the learner the opportunity to practice asking someone whether they are single, and giving an appropriate reply. The learner speaks the phrase into the microphone, and the quality of their speech is scored. Learners advance through a series of progressively more difficult practice exercises

until they are ready to practice in a simulated scenario such as those seen in Figs. 1 and 2.

Once the course has been developed and fielded, we evaluate trainee performance in the course and seek feedback from learners who have tried to apply what they learned in real-life intercultural interactions. This results in an iterative process, in which experience in the field results in revisions to the situational contexts, cultural factors, and detailed learning objectives of the course.

5 Cultural Modeling Technologies

Immersive simulation technologies, together with other supporting technologies, play critical roles in developing and implementing these courses. Knowledge management tools are being developed to capture and organize the cultural knowledge. Authoring tools have been developed to help authors create interactive lessons and activities for teaching cultural knowledge, skills, and attitudes. Immersive simulation technologies, incorporating intelligent agents, are used to simulate culturally appropriate behavior and assess the learners' ability to behave in culturally appropriate ways.

These technologies come together in the conversational agent architecture used in Alelo courses to generate the behavior of the non-player characters in the simulated scenarios. Fig. 5 gives an overview of the agent architecture common to the learning environments described here, and its interaction with the learners and the immersive game environment. Further details are available in [4]. The most fully developed implementation of this architecture is in the Virtual Role-Player (VRP) system, a system that enables trainers to populate immersive environments with artificially

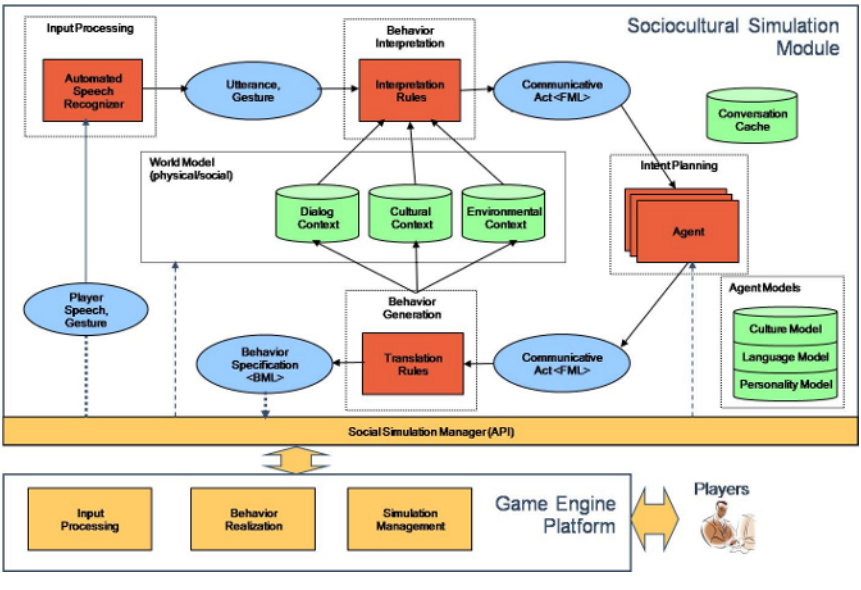

Fig. 5. Conversational agent architecture

intelligent non-player characters that are capable of producing culturally appropriate behavior in 3D multi-player training scenarios. This discussion will focus primarily upon the VRP implementation, which is being developed for military mission rehearsal training. Other Alelo learning environments, such as Operational Dari and goEnglish, currently employ simplified versions of this architecture, but are migrating to the new VRP architecture.

5.1 Game Engine Platform

Game engines commonly incorporate features for creating virtual worlds, populating those worlds with objects and animated characters, and interface controls that enable users to interact with the objects and the animated characters. We build on these to create a set of software platforms for building and running virtual environments for learning culture. These platforms have a common set of capabilities, whether they support 3D interfaces as in Fig. 1, or 2 ½ D Web-based interfaces as in Figs. 2 and 4. This is labeled the Game Engine Platform in Fig. 5.

The game engine platform provides a conversational interface that allows the learners to choose which non-player characters to talk to, and a set of graphical user interface controls for managing the dialog, as shown in Figs. 2 and 4. These include buttons for starting and stopping speech input (top right corner in the figures), and controls for choosing nonverbal gestures for the learner's character to perform. The interface provides other information such as a summary of the objectives to complete in the science, hints about what to say and what to do, and a transcript of the dialog.

The game engine platform is also responsible for generating the behavior of each character. This includes speech, animated gestures, and body movement. We record a set of possible spoken lines for the characters to say and gesture animations for the characters to perform, and load them into the game engine platform. The characters are then able to perform any combination of speech and gesture, as directed by the social simulation module, which selects the appropriate speech and gestures.

The game engine platform includes a simulation management capability that keeps track of the location of objects, characters, and landmarks in the virtual world, many of which have cultural significance. It controls and tracks the movement of people and objects in the virtual world, and can trigger event notifications in response, e.g., cause a non-player to react when a player approaches within a set distance.

5.2 Sociocultural Simulation Module

The Sociocultural Simulation Module is responsible for controlling the behavior of the non-player characters in the simulation, and ensuring that they behave in culturally appropriate ways. The agent dialog models follow an interpretation-decision-behavior cycle, in a variant of the SAIBA agent architecture [16].

The first phase of processing starts with interpreting the learners' spoken utterances and gestures. We develop speech recognition models for each language, specially designed for learners of foreign languages. Acoustic models are trained on both native speech and the speech of learners of the language, to ensure that the speech recognizer is tolerant of the accents of language learners. The recognizers utilize grammar-based language models constructed from a database of sample

utterances in the language. As course developers author scenario dialogs and other learning materials, the example utterances in these materials are entered into the database and then used to create the language models. The speech recognition system runs using the Julius speech recognition decoder, an open-source speech recognition engine developed under the leadership of Kyoto University [6].

Next, the agent evaluates and interprets the communicative intent of the learner's utterance and gesture. Communicative intents are represented using a library of communicative acts, derived from speech act theory originating in the work of Austin [1], and further developed by Traum and Hinkelman [13]. Each communicative act has a *core* function, i.e., the illocutionary function of the utterance (to greet, inform, request, etc.), and *grounding* function, i.e., the role of the utterance in coordinating the conversation (e.g., to initiate, continue, acknowledge, etc.). The grounding functions help to determine the current dialog context, which in turn can influence how subsequent utterances are interpreted. At each point in the dialog, the agent is expecting to hear and respond to one of a set of possible communicative acts, which changes over the course of the conversation. If the learner says something that is not appropriate at that stage of the conversation, e.g., greeting a character at the end of the conversation instead of the beginning, the agent will act as if the learner said something odd that does not make sense.

Note that the interpretation of the utterance and gesture depends upon the particular culture being modeled. The mapping from utterances to communicative acts is specified for each language. Some gestures have meaning only in certain cultures, e.g., placing the palm of the right hand over the heart in greeting only has meaning in Islamic countries. Some gestures are appropriate only in some social contexts; for example, American culture and Arab cultures differ as to when it is acceptable to shake hands with the opposite sex, or kiss the cheek of someone of the same sex.

Depending upon the type of dialog exercise, the agent may not just evaluate the appropriateness of the learner's communication, but also identify and classify the learner's mistakes. Operational Pashto and goEnglish both include so-called mini-dialog exercises, in which learners practice individual conversational turns with a non-player character and receive feedback regarding any mistakes they may have made. Detected errors include grammatical errors, semantic errors (e.g., confusing words with similar meanings), and pragmatic errors (e.g., inappropriate use of expressions of politeness, honorifics, etc.).

Once the learner's input is interpreted, the intent planning stage occurs, in which each agent in the conversation decides how to respond. Intent planning is challenging because it must address multiple conflicting needs: accuracy, versatility, authorability, and run-time performance. The agents should choose communicative acts that are culturally appropriate, e.g., that match the dialog examples created in the cultural data development process described in section 4. However the agent models cannot simply follow the example dialogs as scripts, but need to be versatile enough to respond in a culturally appropriate way regardless of what the learners might say. The agent modeling language needs to be powerful enough to achieve such versatility, yet be authorable by instructional designers who lack the computer science background required for sophisticated agent programming languages. It also is important for the intent-planning module to have good runtime performance, so that the intent planning

process does not interfere with speech processing or 3D scene rendering, both of which require significant amounts of computing resources.

Our most common approach for specifying agent intent planning is through finite state machines. Our dialog authoring tools allow authors to specify the phases of each dialog, the communicative acts the learner might perform at each phase, and the acts that the agent should choose in response. This approach is highly authorable and has been used to create hundreds of dialog models for a variety of different cultures and agents. Unfortunately, it is somewhat lacking in versatility; agent models must be authored specifically for each agent in each scenario. To address this limitation, VRP provides a rule-based intent-planning engine that enables authors to specify cultural behavior rules. Each rule specifies a learner communicative act that the agent should respond to, a set of conditions that must be met, and the effects of applying the rule. Conditions can refer to properties of the learner's communicative act (e.g., its degree of politeness), the state of objects in the virtual world, and properties of the social relationships between the characters in the scenario. For example, the response of a non-player character such as the village elder in Fig. 1 depends upon the extent to which the learner has developed the village elder's trust, which in turn depends upon what the learner has said and done up to that point.

Once each agent in the conversation chooses an action to perform, the sociocultural simulation module generates behavior to realize the action. This typically includes selecting an utterance that realizes the utterance in the target language, as well as one or more animated gestures. These in turn are passed to the game engine platform for execution.

Using the agent behavior authoring tools, we create libraries of reusable agent models. Authors can then create cultural training scenarios by taking a virtual world representing the cultural environment, populating it with non-player characters, and assigning agent models to each character appropriate for that character's role in the scenario. Example roles include village elders, shopkeepers, and passers-by on the street. Each agent will respond to the learners in a manner appropriate for the culture, the agent's role in the scenario, and the current state of the unfolding situation. Authors can extend and modify the rule sets of the agents if needed to reflect the specific characteristics of the scenario.

6 Evidence of Effectiveness

The effectiveness of this approach has been documented in various published studies (e.g., [12]). The most dramatic evidence of effectiveness comes from a study conducted by the US Marine Corps Center for Lessons Learned (MCCLL) [7], which studied the experience of the 3rd Battalion, 7th Marines (3/7 Marines) in Anbar Province, Iraq in 2007. Prior to deployment to Iraq, the battalion assigned two members of each squad of approximately thirteen marines to spend forty hours in self-study training with Alelo's Tactical Iraqi course. It should be noted that (1) forty hours is not a long time to spend learning a foreign language, (2) Arabic is a difficult language for most English speakers, and (3) self-study computer-based language learning tools often fail to produce significant learning gains. However the 3/7's experience drew attention both prior to deployment and after deployment. In final

exercises prior to deployment, Iraqi speaking role players commented that the 3/7 demonstrated Arabic language ability far beyond the skills of typical marine units preparing for deployment. During their entire tour of duty in Iraq, the 3/7 Marines did not experience a single combat casualty. The MCCLL interviewed officers in charge of the unit and conducted surveys of the individual trainees, and found numerous instances where language and cultural skills contributed directly to mission effectiveness. Most importantly, it demonstrated an appreciation and willingness to learn about Iraqi culture, which caused the Iraqis to be more positive and cooperative, and set in motion a virtuous cycle of cooperation leading to operational effectiveness leading to mutual trust, leading to further cooperation, etc.

7 Current Work

We are now working to extend our sociocultural models and apply them to new types of learning environments. An important area of development is in the area of environments that support multiple learners as well as multiple non-player characters. When learners reach a sufficient level of communicative proficiency, multi-player learning environments can become advantageous, as a way to motivate learners and encourage further practice. We are using the Virtual Role-Player (VRP) architecture to create multi-player mission rehearsal environments in which teams of trainees work together on mission rehearsal scenarios. Trainees must interact with non-player characters representing local people in order to complete their mission successfully. We plan to extend the VRP framework so that a player can assume control of one of the local people characters and direct its actions without the learners being aware of it. This makes it possible to offer the best possible combination of human-human interaction and human-agent interaction in intercultural skills training. Individuals with communicative competence in the target language and culture can play roles within the scenario and artificially intelligent virtual role players can fill in and play additional roles as needed.

Another learning game under development, the ISLET Game, takes the concept of multi-player game-based cultural learning even further. The ISLET Game is part of a larger language learning environment called ISLET (Integrated System for Language Education and Training), that is exploring methods for making language learning highly motivating, so that learners will devote their free time to learning a language, just as they would an entertainment game. The ISLET Game incorporates a sophisticated reward system, similar to what is found in multi-player entertainment games such as *World of Warcraft*, that motivates learners to keep practicing and developing their communication skills. It incorporates engaging multi-player quests which encourage collaboration between learners. It also supports team conversations (see Fig. 6), in which learners work together in conversing with a non-player character and learn from each other in the process.

The CultureCom project is developing formal models of the cultural influences underlying dialog and utilizing them to increase the flexibility and realism of the behavior of non-player characters in training simulations. The work is being conducted in collaboration with Dr. Michael Agar of Ethknoworks and Prof. Jerry Hobbs of the University of Southern California. Cultural and linguistic

Fig. 6. Scene from the ISLET Game

anthropologists are developing validated sociocultural data sets for Afghanistan and other cultures of interest, consisting of annotated dialogs of cross-cultural interactions. Experts in artificial intelligence then use these data to develop logical models of sociocultural behavior in different cultures, based upon a formal ontology of microsocial concepts underlying interpersonal communication. This in turn is being used to create an enhanced version of the VRP architecture in which agent intent planning utilizes explicit validated models of sociocultural reasoning for different cultures, which can be swapped in and out to enable agents to model a variety of different cultural characteristics.

The following example illustrates how CultureCom cultural models will be developed and used. American culture and Afghan culture differ in the way they express promises and commitments. Afghans sometimes agree to a request as a way of being socially agreeable, without making a firm commitment. In CultureCom, we explicitly model the sociocultural inferences that can be made from communicative acts, such as whether a statement of agreement constitutes a firm promise and commitment. This in turn can be used to ensure that the non-player character's actions are consistent with the culture throughout, and can also provide helpful feedback to the learner. For example, it can help learners to recognize when intercultural misunderstandings can arise due to different views of what has been promised and agreed to.

The C-CORE project is developing a set of authoring tools and workflow management tools to facilitate the creation and maintenance of cultural models. It enables culture researchers to incorporate sociocultural data from a variety of sources,

including subject matter expert first-person accounts, field reports, hand-authored dialogs and dialog transcripts, and other sources. It supports the process of managing, processing, and utilizing streams of updates to sociocultural data to keep the cultural models up-to-date as new information is obtained or properties of the cultural environment changes. It provides tools for comparing the behavior produced by different character models, and for comparing different versions of the same character model resulting from changes in the sociocultural data. The output of C-CORE will be specifications for cultural simulations, including the cultural environment, scenario logic, non-player characters and their behavior.

C-GAME, developed in coordination with C-CORE, is extending the overall approach for cultural competence training, and developing it into an interoperable framework that can be utilized with a variety of game engines and artificial intelligence models. The cultural simulations in C-GAME will serve as rich learning environments in which learners can develop their knowledge and awareness of the culture, and then develop intercultural skills, all within the same environment.

The scenario construction toolset will enable trainers to develop their own sociocultural training scenarios through a combination of libraries of reusable sociocultural models and authoring tools. It will include mechanisms for incorporating current sociocultural and human terrain data into the scenarios (e.g., from C-CORE), to keep them up-to-date. It will provide a way to annotate a variety of entities in the virtual world in terms of their cultural significance, so that learners can learn their meaning in the context of the culture. This may include clothing and other examples of the material culture, locations (public, private, or sacred places), food and other items associated with cultural practices, and even nonverbal gestures and other human behaviors. These elements will be drawn from an ontology of cultural entities developed in C-CORE, which in turn will relate back to the dimensions of culture shown in Fig. 3.

C-GAME will also provide a way for trainers to define trainee cultural performance standards. Trainers will be able to assess those performance standards themselves by participating in or observing the training scenario, and they can rely on automated cultural skills assessments built into the non-player characters.

The C-GAME run-time execution engine will incorporate instrumentation to compare trainee performance to the training objectives and provide automated performance review and remediation capabilities. This includes assessment of trainee performance at each stage in the interpretation-decision-behavior cycle of the virtual role players. In the interpretation phase, whenever learners say or do something that is linguistically or culturally inappropriate, the role players will attempt to analyze and classify the nature of the action. This analysis is similar to the analysis that takes place in mini-dialogs, as described in section 5, but can apply to any immersive scenario. Learners will get feedback on their cultural competence both from the moment-to-moment reactions of the non-player characters and from the performance review and the end of the scenario.

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