Introduction

Intelligent tutoring systems (ITS) are computer-aided learning (CAL) systems which personalise their learning content for an individual based on learner characteristics such as existing knowledge [1]. A recent extension to ITS is to capture student learning styles using a questionnaire and adapt subject content accordingly [2], however students do not always take the time to complete questionnaires carefully, so may not be shown the most effective learning material. This paper describes a web-based conversational intelligent tutoring system (CITS) called Oscar which aims to mimic a human tutor by conducting a tutoring conversation whilst dynamically predicting and adapting to a student’s learning style. By implicitly modelling the student’s learning style during the tutoring conversation, Oscar can personalise the delivery of material for each individual learner which improves the effectiveness of the tutoring. An initial pilot study is presented using the domain of SQL database programming for undergraduate University students. The study produced encouraging results in predicting learning styles through conversational tutoring and improving student test scores.

Design

Oscar is a novel CITS which aims to imitate a human tutor by estimating and adapting to an individual student’s learning style during a tutoring conversation. A detailed description and the methodology for constructing Oscar CITS is reported in [3] and [4]. An initial study was conducted, applying Oscar CITS to the tutoring of undergraduate Science and Engineering students using the Index of Learning Styles (ILS) model [5]. There were 17 hypotheses to be tested, considering learner behaviour and language during the tutorial in relation to the four ILS dimensions. This paper presents two hypotheses (H) which consider the processing (1) (Active/Reflective) and understanding (2) (Sequential/Global) ILS dimensions:

H1: a student’s learning path through the tutorial is indicative of learning style.

H2: choosing to be guided through a process (or not) is indicative of learning style.

53 students were asked to complete the formal ILS questionnaire [5], followed by a test to assess their existing SQL knowledge. The students then engaged in a personal tutorial led by Oscar CITS, involving completing tasks and answering questions, being given hints and help as required. Finally students repeated the test to measure learning.

Results

Table 1: Experimental Results

<table>
<thead>
<tr>
<th>Learning Style [5]</th>
<th>Hypothesis</th>
<th>Prediction Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>H1</td>
<td>100%</td>
</tr>
<tr>
<td>Reflective</td>
<td>H1</td>
<td>0%</td>
</tr>
<tr>
<td>Sequential</td>
<td>H1</td>
<td>76%</td>
</tr>
<tr>
<td></td>
<td>H2</td>
<td>73%</td>
</tr>
<tr>
<td>Global</td>
<td>H1</td>
<td>31%</td>
</tr>
<tr>
<td></td>
<td>H2</td>
<td>80%</td>
</tr>
</tbody>
</table>

23 students were excluded as they did not complete the entire tutoring session. Table 1 shows the results of 30 students. There was a mean 22% improvement in test scores over the group.
Discussion

The results of the initial study are promising, with Oscar predicting Sequential/Global learners with 76%/80% accuracy and Active learners with 100% accuracy. However, Oscar was unable to predict Reflective learners, which may be due to the nature of reflective learners who examine and manipulate information introspectively. A larger study is required before firm conclusions may be drawn.

Overall, Oscar seemed to help students learn, with a mean 22% improvement in test scores. In using tutor-led conversation rather than a student-led CAL, Oscar CITS enables a constructivist style of tutoring to be employed and is a familiar format for students. Oscar CITS can assist in widening participation by offering students the flexibility (in terms of time and place) to attend a one-to-one online tutorial in support of or in place of classroom activities.

References


1 learners process information Actively (discussion) or Reflectively (introspectively).

2 learners progress towards understanding Sequentially (continual steps) or Globally (large jumps).

Keywords: Intelligent tutoring system, Conversational agent, Learning style