Using Student-Computer Interactions to Categorize Educational Software

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Abstract

A successful and comprehensive multi-dimensional categorization system for educational software would benefit many facets of the software life cycle. In this paper we consider the categorization of one particular dimension, namely, student-computer interactions.

1. Introduction

A categorization would enable the comparison of software, help identify and isolate sections of software for evaluation, enable the matching of software to teachers’ needs and facilitate discussion between teachers and software designers.

Several different approaches to classifying software, [1][2][3][4] were studied before the idea of a multi-dimensional metric approach was chosen. Each dimension categorizes the software based on one attribute of the software. The combination of all of the dimensions form the metric used to classify software. This categorization of student-computer interactions has been developed through studying both teacher-student classroom interactions and the student-computer interactions of existing software.

2. Student-Computer Interactions

There are two main types of interactions found in educational software; navigational and educational.

Navigational Interactions :- do not directly affect the learning about a specific topic; the interaction only facilitates the movement between or through educational tasks.

Educational Interactions :- involve the student interacting with the computer to construct or confirm their knowledge about a topic.

Navigational interactions can easily be separated out and mapped into diagrams very similar to site maps commonly found in large web pages [8]. Educational interactions contain two main entities, the computer and the student, which can perform the actions summarized below to form interactions.

<table>
<thead>
<tr>
<th>Computer</th>
<th>Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide Question</td>
<td>Enquire</td>
</tr>
<tr>
<td>Provide Answer</td>
<td>Provide Answer</td>
</tr>
<tr>
<td>Provide Information</td>
<td>Enquire</td>
</tr>
<tr>
<td>Respond to Answer</td>
<td>Provide Answer</td>
</tr>
<tr>
<td>Respond with Question</td>
<td>Enquire</td>
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</tbody>
</table>

Provide Question/Enquire: to generate a statement that has an answer that may be supplied by the other entity.

Provide Answer: to return an answer in response to a specific question which has been asked by the other entity.

Provide Information: to convey the entity’s stored knowledge about a topic.

Respond to Answer: to provide feedback about an answer that has been supplied by the other entity.

Respond with Question / Suggestion: to provide a question or suggestion in response to a question supplied by the other entity.

The interaction between these two entity’s, using the specific actions listed above, generate five fundamental chains (labelled (a) to (e) below) which form the building blocks of all student-computer interactions. No smaller chains of educational value can be formed and all larger chains are combinations of these fundamental chains. Definitions of these chains, together with the consequential logic diagrams of the interactions are discussed below and illustrated with examples:

(a) Resource

A resource chain involves the computer providing information to a student about a given topic. The computer is providing the information necessary to impart knowledge about a subject area to the student.

Example: Microgravity: Fall into mathematics [10].

(b) Tool

A tool is a chain started by a student who wishes to know the answer to a specific question, to which the computer responds with the answer.

Example: Calculator Collection [7] allows students to find the facts about a supplied number like whether it is odd or even, or show a list of multiples and factors, etc.

(c) Assess

An assess is a chain whereby a computer is used to record a student’s response to a specific topic. The computer initiates this chain and the student receives no direct feedback on their responses.

Example: Beamer’s Flashcard Workshop [6] monitors a student’s progress, accuracy and the level of difficulty, as they answer basic number fact questions.
(d) Drill
A drill is a chain in which a computer is used to give a student practice in answering certain questions. The computer initiates the chain by setting/asking a question; the student then responds by providing an answer to that question; the computer then completes the chain by responding to the answer provided (essentially marking it and/or providing the correct answer or explanation).

Example: Alan's Maths [5] allows students to practice addition, subtraction, multiplication and division through a sequence of questions. Student’s responses to each question are marked immediately.

These four chains represent the basic interactions between a student and a computer. These chains can be concatenated together to define more complex interactions. This concatenation occurs with the overlap of only one entity, e.g. a resource chain finishes with the student, that student then provides a question to a computer and hence starts a new chain.

There is one additional fundamental chain that involves slightly different interactions.

(e) Guided
A guided chain begins as per a tool chain; however, instead of the computer providing an answer, it responds to the question with a question. The intent is to lead the student so as to self-discover the solution. At this point a new chain can begin, if required.

Example: Gamco Whole Numbers – Multiplication and Division [9] in practice mode: Answer step by step. In practice mode the software leads the student through a problem step by step, asking the student to perform each step leading the students to solving the original task.

3. Joining the Chains
When analysing existing software it quickly becomes apparent that the above fundamental chains can, and are, joined together in more ways than just concatenation. In order to replicate the decision cycles of humans, and to account for the possible interactions of the student, software is commonly designed to have processes which branch, loop and even run in parallel. Branching is like the logical OR statement, allowing the computer or student to choose from multiple paths. The number of branches within software is an indication of the flexibility or responsiveness of the software to the students needs. Running chains in parallel is like the AND statement. This is necessary because often a computer screen can present a student with a combination of actions. (For example, a screen-shot of a software program may reveal the computer providing the student with information AND asking the student a question.) Finally, due to the recursive nature of programming, loops are also commonly used. Loops involve the same student-computer interaction chain being repeated until either the computer or student stops the cycle.

7. Conclusions
The categorization is based on a logical premise that all interactions are combinations of several fundamental chains, where each chain is constructed from combining several actions performed by the entities. These entities can be described fully by a list of actions. The strength of this categorization is in its ability to justify its categorizations terms through both informal descriptions and logic diagrams. The most powerful strength of this categorization is its inclusion into the larger classification system, given that most software is not constructed to fall solely into one category. The key is not only in identifying which categories the software falls within, but also which parts of the software are in what category.

References

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