A Taxonomy of Multimedia Interactions

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ABSTRACT

Multimedia applications in the field of education have become increasingly more interactive. Interactivity has been recognised as the keystone to effective transference of knowledge and skills in on-line courses. However, there are different levels of interactivity and these levels can vary greatly between different multimedia applications. There exists a need to distinguish between these disparate levels of interactions. The ability to separate the levels of interaction will enable a better identification of the interactions which lead to more effective on-line courses. A taxonomy of interactions is proposed in this paper. The taxonomy comprises four domains: navigational, interrogative, reactive and tactical. The individual domains contain elements which are ranked in order of the complexity of the interaction. An example of the use of the taxonomy is discussed.

Keywords: multimedia, interactivity, on-line courses, taxonomy of interactions, classification of interactions.

1. INTRODUCTION

When the "Taxonomy of Educational Objectives" was first published, its editor (Bloom, 1956) wrote about teachers who believed that their students should "really understand", who desired their students to "internalize knowledge", and who wanted their students to "grasp the core or essence" or "comprehend". He asked if they all meant the same thing and expressed the hope that the taxonomy, which was devised as a set of standard classifications, would enable teachers to define the "nebulous terms" alluded to and which, in turn, would promote the exchange of information about curricular developments and evaluation devices.

Today, nearly a quarter of a century later, educators talk about virtual universities, on-line learning, multimedia and interactions. Many believe that increasing the multimedia content and interactions in on-line courses will enhance students' understanding and retention. The range of interactions that are possible today is quite large. At one end of the scale is the simple interaction of turning over an electronic page through a mouse click or the push of a key. At the other end is the highly complex interactions that are found in the simulator of a plane, a train or a car, where visual, audio and tactile elements are incorporated seamlessly to deliver a stunning realistic experience. There is clearly a need then to devise a

taxonomy that will differentiate between the different types of interactions in a multimedia application and which will facilitate the exchange of information about development of effective on-line courses.

A rudimentary taxonomy of interactions has been proposed about ten years ago by Shneiderman (as cited in Tannenbaum, 1998). The five categories in this taxonomy are:

1. Menu selection
2. Form fill-in
3. Command language
4. Natural language and
5. Direct manipulation.

Shneiderman's taxonomy is inadequate for modern multimedia applications. It was devised before the graphical user interface was popularised by Microsoft through its Windows operating system. However, the fact that it exists is an indication that the need for a taxonomy of interactions was evident then.

2.   PURPOSE OF THE TAXONOMY

On-line courses are sprouting up in great profusion as part of the e-learning revolution sweeping the world. In New Zealand, 9 out of 23 polytechnics and universities who are members of NACCQ have advertised on-line courses on their websites. Many on-line courses could be considered boring and ineffective but occasionally one encounters a course in which the learning is effortless and the knowledge and skills learnt are retained. The ability to identify the interactive elements of such a course would help instructional designers and course developers produce better on-line courses. The classification of interactions is the purpose of this taxonomy.

3.   TERMINOLOGY

A multimedia application has elements of text, graphics, images, sound, animation and video. It may be an e-learning course, promotional material on a website, a source of information on a CD-ROM, an electronic game or an on-line test. An interaction may be defined as an action initiated by either the user or the computer during the running of the multimedia application. Interactions are involved in navigating through the application, in answering questions and in receiving feedback. Interactions are also the result of instructional tactics. It is thus convenient to classify interactions into 4 domains, namely,

1. Navigational
2. Interrogative
3. Reactive and
4. Tactical.

4.   NAVIGATIONAL DOMAIN

Interactions in this domain pertain to navigation within the application. A navigational interaction is a basic interaction required in all multimedia applications. This is the only type of interaction found in an electronic page turner or in some promotional material. The interactions in this domain in order of increasing complexity are:

1.1 Unidirectional
1.2 Bi-directional
1.3 Structured multidirectional and
1.4 Unstructured multidirectional.

A forward button or the 'press any key' command is an example of an unidirectional interaction. Bi-directional interaction is indicated by a forward and a back button. There is a variation of the bi-directional interaction where buttons to go to the first screen and to the last screen are provided. A menu is a structured multidirectional interaction while a hypertext link is an unstructured multidirectional one.

5.   INTERROGATIVE DOMAIN

This domain comprises the interactions that define the testing environment. These interactions are used in on-line courses, on-line tests and games. The interactions in order of increasing complexity are:

2.1 Binary choice
2.2 Multi-choice
2.3 Completion of text
2.4 Matching of objects
2.5 Identification of an object
2.6 Identification of an instant
2.7 Free form text entry

The simplest interaction in this domain is the binary choice question where the response can be 'yes/no' or 'true/false'. A multi-choice question decreases the success rate of a randomly selected answer and a well-designed question with plausible distractors can raise its complexity beyond the next interaction, completion of text. For the next interaction, the objects

to be matched can be words, images or sounds. The objects to be identified can be an image or a sound. Identifying an instant require the user to evaluate properties which are changing with respect to time. It could be watching a video showing the view out of the windscreen of a car and identifying the moment when the emergency brakes must be applied. The last interaction is free form text entry.

6.   REACTIVE DOMAIN

Interactions in this domain are initiated by the computer and are essential for on-line courses as they provide feedback to the learner. There are 3 types of interactions:

3.1 Uniform feedback
3.2 Random feedback
3.3 Progressive feedback

The simplest feedback is 'correct/incorrect' or 'right/wrong'. The same feedback is given for all correct answers and likewise, the same feedback is provided for all wrong answers. The feedback can also be graphical, a tick or a cross. At the next level, a suitable message is selected randomly from a bank so that there is a variation in the feedback for all the correct or wrong answers. The last interaction is often provided when the learner is given multiple attempts for a question. A hint is provided when the first answer is wrong. More and more hints are shown if the learner keep giving the wrong answer.

7.   TACTICAL DOMAIN

This domain apply to interactions which belong to the interrogative domain. The tactical domain consists of the following interactions:

4.1 Sequential
4.2 Random question bank and
4.3 Adaptive testing.

Sequential interaction refers questions which are delivered one after the other to the learner. The next level of interaction minimises the risk of learners memorising the questions and passing on the information to their friends. A set number of questions are drawn at random from a bank. The adaptive testing interaction is based on the learner's performance at the test. If a student passes the first lot of questions, the next lot of questions delivered gets harder and harder.

8.   APPLICATION OF THE TAXONOMY

The taxonomy was tested with an electronic course on word processing. When an interaction was encountered in the course, its domain type was determined. It will be navigational, interrogative or reactive. Its type within the domain was then noted. At the end of the course the interaction type in the tactical domain was noted. The highest interaction level in each domain was recorded. The results for the course are given below:

Navigational domain: 1.3 - structured multidirectional
Interrogative domain: 2. 5 - identification of an object
Reactive domain: 3.3 - progressive feedback
Tactical domain: 4.1 - sequential.

9.   DISCUSSION

I felt that the effectiveness of the electronic course used in testing the taxonomy rates quite highly when compared to many of those that I have experience of. It was supplied by an e-learning company whose products are in use at UNITEC. The general impression of their electronic courses from students and lecturers is quite favourable. This is in agreement with my assessment.

The classification of the course according to the taxonomy is fairly high in the navigational and reactive domains, reasonable high in the interrogative domain, but is at the first level of the tactical domain. This would indicate that the course tested has a fairly high level of interactions and can be expected to be effective as a training tool.

It would appear that the taxonomy is reasonably accurate in the classification of the interactions in the single course tested. This result is sufficiently encouraging to warrant subjecting the taxonomy to more extensive tests using a wide variety of courses and a group of assessors.

REFERENCES

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