Research Ethics Application

Submission Date	2017-11-14 21:25:07
Title of Project	The design, development and evaluation of an adaptive learning domain model for post-primary mathematics.
REC Ref no.	REC-17-144
Lay Summary	This research proposal makes the case for the creation of adaptive learning content for mathematics. Adaptive Educational Hypermedia Systems (AEHS) and Intelligent Tutor Systems (ITS)are web-based teaching and learning systems that can adapt to a user's current knowledge of specific subject content (a domain) to provide the user with a personalized learning experience.

The essential components of an AEHS are: a User Model (UM), a Domain Model (DM) and a Teaching Model (TM). This research is focused on the DM. The UM stores information about a user's current knowledge and the TM is a set of pedagogical rules. The DM is a semantic structure of concepts and the relationships between these concepts.

The research design proposed stems from a constructivist perspective of how knowledge, concepts and skills are created and transmitted in the process of teaching and learning mathematics.

The research methodology will be a case study that will seek to describe the process of creating a digital artifact that will encapsulate the DM, and to qualitatively evaluate this artifact.

The evaluation of the domain model will involve sourcing and individually interviewing eight participants from the following categories:

(a) Mathematics teachers (2)
(b) Text book authors (2)
(c) Department of Education and Science mathematics inspectors (1)
(d) Lecturers in mathematics education in third level colleges (1)
(e) State Examinations Commission personnel (Mathematics) (1)
(f) Adaptive learning practitioners (1)

In order to build validity into the research process, I propose to ask a larger number of teachers to complete an online questionnaire. The teachers will be provided with a web link to the domain model and asked to evaluate aspects of the model by completing the questionnaire. I plan to contact these teachers through the Irish Mathematics Teachers' Association and I hope to get upwards of fifty responses.

Overall Aim of the Study	Since the author's experience is of the Irish post-primary sector, the scope of the proposed research is Junior Certificate Mathematics. This leads to my research question: "How can an adaptive learning domain model, for post-primary mathematics, be designed, developed and evaluated?" The overall aim of the research is to answer this research question. This aim may be broken down into the following objectives: (a) Identify topics in Strands 4 and 5 of the Junior Certificate Mathematics syllabus that have strong ontological connections, and use them in the domain model. (b) Design a domain model for the identified topics by using the syllabus and the recent past Junior Certificate examination papers. (c) Design and develop a digital artefact that will contain the domain model. (d) Evaluate the domain model embedded in the digital artefact. The creation of a digital artefact will be an essential part of the research project and is anticipated to be a two-part process. Part one of the design and development of the domain model will involve parsing the syllabus into a set of mathematical concepts for a 'Topic 1' (Patterns from Algebra - Strand 4) linked with another set of mathematical concepts for a (related) 'Topic 2' (Functions - Strand 5). Applications from the Microsoft Office suite will be used for Part one of the process. Part two of the design and development of the domain model will involve using Rhumbl Maps (https://rhumbl.com) and the GRAPPLE Authoring Tools (GAT) to create GAM code to build a domain model that will work in the GRAPPLE Adaptive Learning Environment (GALE) (http://grapple.win.tue.nl/home.html). GRAPPLE was a significant collaborative initiative, that ran from 2008 to 2011, comprising Technische Universiteit Eindhoven, University of Warwick, Trinity College, Dublin and other third level institutions and private companies. It received an EU contribution of EUR 3,850,000.
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Project Start Date	12-04-2017
Project End Date	04-06-2018
3.1 Your answer	No
5.1 Total number of Participants	531

5.2 Justification for this sample size	Participants for the electronic survey will be sourced from The Irish Mathematics Teachers' Association (IMTA). The IMTA is divided into branches throughout the country. Each branch keeps its own record of members' details. The council for the IMTA does not have a national database of members' details. The Dublin branch of the IMTA is the biggest branch in the country and in 2006 it had a total membership of 440 teachers. Given that roughly one-third of Ireland's population lives in the greater Dublin area, an estimate of the number of teachers in the IMTA is 440 multiplied by 3, which equals 1320. In a meta-analysis of 68 surveys, Cook et al (2000) reported that the mean response rate for the 68 surveys was 39.6% (SD = 19.6%). 39.6% of 1320 is 522.72 which rounded up is 523. When the 8 proposed interviewees are included, this gives an anticipated total of 531 participants. Cook, C., Heath, F., & Thompson, R. L. (2000). A meta-analysis of response rates in web-or internet-based surveys. Educational and psychological measurement, 60(6), 821-836.
5.3 Recruitment of Research Participants	5.3 Recruitment of Research Participants * (137/???) I will recruit subjects for the study using the following methods: Survey - I will ask the honorary secretary of each branch of the IMTA to email a link to the preliminary reading material, domain model artefacts, and electronic survey to all members. The email will also contain information about the project as a file attachment (Information Sheet A). Consent for the survey will be sought via the first screen of the electronic survey. Interviews - the eight potential interviewees (outlined in the lay summary) are key informants who will initially be contacted by telephone and then sent an email inviting them to participate as interviewees in the research study. The email will contain a link to the preliminary reading material, domain model artefacts, and electronic survey. It will also contain three attachments – information about the project (Information Sheet B), Consent Form B, and the semi-structured questions for the proposed interviews. Participants will all be over 18 years old and healthy subjects.
5.4 Will you provide any payment or remuneration to the participants?	No
5.6 Consent procedures	The survey part of the study will involve gathering qualitative and quantitative feedback via a questionnaire. This data will be stored electronically. Participants will not be asked for personal information such as name, address, telephone number, email address, employer or any other contact details. The interview part of the study will involve the use of key informants, with the vast majority having publicly available contact details. The principal investigator previously has a record of some of this information, and possibly other information. However, any details stored with reference to the study will be stored confidentially. As previously stated in section 5.3 of this application, an email will be sent to the secretaries of all branches of the IMTA. The secretaries will be asked to forward this email to the IMTA members (for the survey). Consent for the survey will be sought via the first screen of the electronic survey. The key informants (for the interviews) will have a consent form as an attachment (Consent Form B). This consent form will be will be printed out and signed by the proposed interviewees.

5.7 Consent form	Consent Form.pdf
5.8 Inclusion/exclusion criteria	The subjects involved in the survey are current members of The Irish Mathematics Teachers' Association. The membership is almost entirely comprised of teachers of the domain model of my research study (post-primary mathematics) The proposed participants for the interviews are key informants who are known to the principal investigator. They all have significant experience in their areas of expertise that has been outlined in the Lay Summary section on the first page of this application form. It is expected that the subjects will all be healthy adults and no minors will be involved in the study. No payment is being made to any of the participants.
5.9 Will any participants be a) under 18 years of age during the study or b) lacking in capacity to provide consent (e.g. due to incapacitation) or a vulnerable population?	No
5.12 Will any participants be your employees or students?	No
6.1 Will your research involve interviews,?	Yes
6.2 Please describe the type(s) of interview(s) to be used and how they will be carried out. In the case of structured or semi-structured interviews, questions and thematic areas should also be included.	The interviews will be semi-structured, exploratory and in-depth. The topics and issues to be covered will be specified in advance. I am very interested in acquiring unique, personalized views about how individuals believe the concepts that constitute a mathematics course (domain) should be granulated, sequenced and connected. The themes will be the same for all interviewees. This stimulus equivalence means that every respondent should understand the interview question in the same way without resorting to the exact same wording. Stimulus equivalence should make it possible to compare data collected across interviews although the interviews will be primarily exploratory in nature. The interviews will be face-to-face at a mutually agreed location such as the participant's workplace, the interviewer's workplace or other agreed location such as a hotel meeting room. As the interviewer, I will seek to establish an appropriate atmosphere such that the participant can feel secure to talk freely. This will be achieved by ensuring informed consent, guarantees of confidentiality and absolute clarity around the security/retention/destruction of the raw audio data and of any transcribed data. The participant will be made fully aware of the purpose, scope, nature and conduct of the interview, the use of the data, ethical issues and likely duration of the interview (maximum of one hour). This will be achieved by providing the participant with Information Sheet B and by offering the participant the opportunity to subsequently ask questions and to seek clarification in relation to the proposed interview. Therefore, the participant will be left in no doubt about what will happen during and after the interview.
6.3 Will the interviews be recorded?	Yes

6.4 Describe how data from the interview will be collected and recorded	The face-to-face interviews will be recorded live with a digital audio recording device. The device I will use is an Olympus DS-30 Digital Voice Recorder. This is a high-quality stereo recorder for recording memos, lectures, interviews etc. and it supports high-quality audio book, MP3 and WMA playback. The participant will be made aware of the specific times during the interview that the device is in recording mode. The guidelines on the DIT website for researchers indicate that data should be held securely for a minimum of two years after completion of a research project. I will adhere to this DIT guideline.
6.5 Will transcripts be made of recordings?	Yes
6.6 Please describe how the recordings will be transcribed and analysed.	The principal investigator will transcribe portions of the audio recordings deemed relevant and significant for the purposes of this research study. They will be transcribed by listening to the recordings and typing the transcripts using word processing software. The process for analysing the transcripts will involved the following six phases: Phase 1 - Reading I will browse through all of the transcripts, as a whole. Then I will make notes about my first impressions and then read the transcripts again, one by one. Phase 2 – Coding or Indexing I will label relevant words, phrases, sentences, or sections. Labels will include actions, activities, concepts, differences, opinions and processes. Repeated, surprising, interesting and important parts of the interviews will be coded. The parts of the interview that refer to published reports or journal papers will most likely be coded. Any parts of the interview that relate to concepts or theories will probably be coded. As is an exploratory case study, I will be aiming to code for conceptualisation of underlying patterns. Phase 3 – Rank codes in order of importance and create categories by amalgamating codes I will create new codes and categories by combining two or more codes. I will disregard codes that I now deem to be irrelevant from Phase 2. Phase 4 – Label, rank, connect I will label categories, decide on the most relevant categories and figure out how they are connected to one another. Phase 5 – Create a hierarchy amongst the categories I may display a hierarchy of categories using a mind map or concept map. Phase 6 - Write up the results Under a heading 'Results', I will describe the categories and how they are connected. Under a heading 'Discussion', I will discuss your results and write about my interpretation of these results. Finally, I will interpret the results in the light of any results from similar previously published studies, theories or concepts from the field of adaptive learning and any other relevant aspects.

6.7 Will the participants have an opportunity to review and approve transcripts?	Yes
6.9 Please explain the process to be used for reivew and approval of transcripts	The partial transcripts of the recordings will be emailed to the participants for review and approval. They will be asked to use the word processor's markup tool, which allows the principal investigator and the interviewee to track any changes made to the transcripts in the review process. If the interviewee suggests a change to the transcript that is inconsistent with the original recording, the principal investigator will email the relevant portion of audio to the interviewee and ask him/her to listen to it and reflect upon any suggested changes.
6.10 Supporting files for interviews	Information Sheet B.pdf Interview Questions.pdf
6.11 Will your research involve focus groups?	No
6.21 Does your research involve surveys, either pen-and-paper or electronic?	Yes

6.25 Please describe any other data collection activities which will be used (e.g. observation).	Electronic Survey Participants for the electronic survey will be sourced from The Irish Mathematics Teachers' Association (IMTA). The IMTA is divided into branches throughout the country. Each branch keeps its own record of members' details. The council for the IMTA does not have a national database of members' details. The Dublin branch of the IMTA is the biggest branch in the country and in 2006 it had a total membership of 440 teachers. Given that roughly one-third of Ireland's population lives in the greater Dublin area, an estimate of the number of teachers in the IMTA is 440 multiplied by 3, which equals 1320. In a meta-analysis of 68 surveys, Cook et al (2000) reported that the mean response rate for the 68 surveys was 39.6% (SD = 19.6%). 39.6% of 1320 is 522.72 which rounded up is 523. When the 8 proposed interviewees are included, this gives an anticipated total of 531 participants. Cook, C., Heath, F., & Thompson, R. L. (2000). A meta-analysis of response rates in web-or internet-based surveys. Educational and psychological measurement, 60(6), 821-836. I will ask the honorary secretary of each branch of the IMTA to email a link to the preliminary reading material, domain model artefacts, and electronic survey to all members. The email will also contain information about the project as a file attachment (Information Sheet A). Consent for the survey will be sought via the first screen of the electronic survey. The principal investigator will create the survey questions in Google Forms which is part of G Suite for Education (formerly Google Apps for Education) hosted by DIT. Google Forms data is stored securely in Google's data centres. Any data downloaded from Google Forms will be stored on the hard drive of the principal investigator's password-protected Mac computer. The data on this hard drive will be encrypted. This computer will be located at the principal investigator's secure residence in Dublin, Ireland. This data will be kept for two years after completion of the research project. The digital files of the survey will then be permanently deleted using the equivalent of the old Secure Empty Trash feature of Mac OS X. Details of this procedure may be found in the following link: http://osxdaily.com/2015/10/12/secure-empty-trash-equivalent-mac-os-x/
6.26 Supporting files for other data collection	Information Sheet A.pdf Domain Model (Survey) - Google Forms.pdf
6.27 Does your research involve collection of any biological samples? This includes, but is not limited to, samples of biofluids (e.g. blood, urine) and cells and tissue (human, animal or bacterial)	No
6.28 Will samples be collected prospectively and specifically for the purposes of this study?	No

6.37 Will previously collected sample material (i.e. retrospective samples) be used in this study?	No
6.38 Please describe how this material will be accessed and made available for use in the current study, and describe the consent procedures that apply to this material.	Not applicable.
6.39 Will biological material leave the institution where it was originally collected?	No
6.41 Will any genetic testing take place in this study?	No
6.45 Does this study involve the consumption of any foodstuffs (and/or food supplements)?	No
6.47 Does this study involve any medicinal products, including drugs or medical devices?	No

I confirm that:		Yes	No
	All research data will be encrypted and stored on a password-protected system or in a secure location (e.g. locked filing cabinet) in accordance with DIT data protection policy.	✔	-
	All research data will be retained in accordance with DIT data retention policy.	✔	-
	All health and safety policies applicable to the work will be upheld and risk assessments are in place for all research activity.	✔	-
	All researchers are competent to carry out the research and have received appropriate training.	✔	-
	All researchers are aware of their obligations under the national integrity policy.	✔	-
	Appropriate insurance and indemnity is in place for this research, at all participating sites and for each investigator (upload required).	✔	-

Please upload evidence in support of the insurance and indemnity provisions for this study.	DIT Insurance Office.pdf

Upload signature - PI

Gerard Kilkenny

Principal Investigator Signature.jpg