Project information

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Executive Summary

The aim of the CHERMUG project is to design, develop and test a game to support the teaching of introductory research methods and statistics to nursing and social science students and to disseminate information about the game widely to the community of nursing and social science staff and students across Europe who are taking such courses and who might benefit from the game.

Designing, developing and testing a game is a highly complex task and requires a range of knowledge and skills. The CHERMUG project brings together five academic partners and a business partner who together have a range of complementary skills and expertise in games design and development; knowledge of and experience in teaching research methods and statistics to nurses and social scientists; research experience across a range of learning and e-learning projects including the use of serious games and experience of taking part in and running European projects.

Designing the game involved three parallel activities of carrying out a literature review which looked for existing research about effective teaching in this area; a user requirements analysis which examined the needs and requirements of potential users of the game and a cognitive task analysis which involved interviewing research methods experts about the key skills required and difficulties encountered by beginning students in understanding research methods and statistics.

The results of these preliminary studies fed into the development of the game ensuring that the desired learning outcomes were at the heart of the game. The literature review indicated that although there are several games and e-learning applications to teach statistics, there were few which address research methods.

The cognitive task analysis confirmed that experts view the research methods cycle as playing a key role in organising understanding of methods around a cyclic structure with different stages. Mini-games have been developed to support the different tasks which are carried out at the different stages. There is an introductory game which supports students in gaining an understanding of the two distinct approaches to research, qualitative and quantitative and separate games have been developed to support quantitative and qualitative data analysis. The first prototype of the game has been produced recently.

Once the game has been developed, training guides will be written for tutors to provide guidance about how they can integrate the game most effectively into the teaching of their module. A large scale pilot study will be carried out with selected groups of students from partners’ institutions. These groups will represent a range of students on introductory courses with differing focus such as basic introductory courses, critical analysis courses and project based courses, online and traditional, and from the different countries represented in the partnership. A sample of these studies will be written up as case studies to illustrate best practice to teachers.

The results of these evaluations will be disseminated via conferences and academic paper for the academic audience but will also be disseminated via more popular channels for nursing and social science students and tutors across Europe. A paper about the project has already been accepted for publication in Nursing standard, a popular publication for nurses in the UK. Given the key role of research methods in many other subject disciplines, the CHERMUG game has great potential as a means of supporting research methods.

The project website can be found at www.CHERMUG.eu
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1. Project Objectives

1.1 Project Objectives

The aim of the CHERMUG project is to design, develop and test a game to support the teaching of introductory research methods and statistics to nursing and social science students and to disseminate information about the game widely to the community of nursing and social science staff and students across Europe who are taking such courses.

The idea for the CHERMUG project emerged from discussions amongst colleagues about long standing difficulties they experienced in engaging students in the higher-level thinking that is required for understanding methodology and statistics. The lack of engagement amongst students in the early days of teaching such courses and the difficulty that students have in learning how to apply their knowledge about research methods and statistics led us to the view that teaching methods and statistics might benefit from a games-based approach. The UWS staff on this project had recently carried out a literature review on digital games and we had seen little evidence that games were being used in this way.

Research methods and statistics are recognised as areas of core competence for nursing and social science students. All students in these disciplines are required undertake a module or modules on research methods and statistics so that they can understand and evaluate research evidence, design effective research studies and apply their knowledge to their practice.

The need for a more engaging method of teaching has long been recognised by those who teach it. Traditionally methods and statistics have been taught in a rather abstract way with an emphasis on computation but a games-based approach appeared to offer a more active and engaging approach where learners can apply their knowledge and skills to tackle real-world methodological and statistical problems that are typical of their subject domain. Learning will also be assisted when learners tackle a variety of problems from different perspectives that require them to use their knowledge in slightly different ways and where learners have access to support from more able individuals. Games seem to provide such activities, which will help the learner develop a usable knowledge base that they can deploy to solve real-world problems. A games based approach would also be part of the blended learning approach, which is currently promoted in nursing education.

At the same time there was emerging interest in the use of games as a new teaching tool and it seemed that games might offer a solution to providing a more engaging way of teaching methods and statistics. The CHERMUG project was conceived against this background of finding more effective and engaging ways to teach research methods and statistics and the recognition that a games-based approach might be useful in this respect.

1.2 Benefits to a specific community of users and how they are involved in the project

The game was originally conceived as a game for teaching research methods and statistics to nurses and social science students and it is these students that the game has been targeted at. The students chosen to participate in piloting the CHERMUG games are nursing and social science students in higher education and vocational training in the European countries of the partners involved in the project, i.e. the UK (UWS), Spain (UCM), the Netherlands (OUNL), Finland (SAMK) and Romania (UMFCV). The staff and students from these institutions will be the first members of the community of users.

The large scale pilot will start in February/March 2013. Piloting was not meant to start until month 16 but the game clearly has to be tested when the relevant modules are running. Several of them start at the start of semester 2 which is February 2012 (month 14). To leave piloting until October 2013 would
be too late. This causes a problem in terms of game development since the game needs to be ready earlier than thought.

The research methods and statistics modules which are run in partners’ universities are very varied in their aims, students who take the module and mode of delivery. Modules include traditional introductory modules, evidence based practice modules, research project modules, online modules, distance learning modules, blended learning modules, masters modules etc. The piloting will be carried out with students on a variety of these modules. UMFVC are work package leaders on piloting and they will put together a list of the pilot institutions which will be involved. The business partner, PLAYGEN, will also be involved in piloting the game via their play panels.

However the potential of the game is huge since research methods and statistics are also core competences across other subject disciplines including science, business and IT and, if successful, the game could easily be adapted for use across other disciplines. The game content, obesity and specifically food choices and diet and exercise, have been chosen to be of personal relevance and interest to most people.

1.3 Potential impact upon and benefits to the target user group

The game is targeted at students who are currently taking an introductory module in research methods and statistics and consequently addresses issues which are considered to be most relevant to beginners. To play the game successfully students should have some knowledge of basic ideas in research methods and statistics. The game is not intended to be a replacement for a research methods and statistics module. Rather it is assumed that students are taking a module in parallel. The game aims to provide students with practice in applying their knowledge and skills in tackling typical problems, hopefully in a fun way. A game based approach is particularly attractive in this content area since students perceive it as difficult and a game might help to engage students and stimulate interest.

The game has three separate sections: the paper dissection game, which is an introduction to research methodology, the qualitative analysis game and the quantitative analysis game. The game is intended to be integrated into labs which support these specific skills. So a normal use of the game would be for three lab sessions, the first an introduction to research methodology, the second on qualitative analysis and the third on quantitative analysis game. Tutors would not necessary use all three games since each game is relatively self-contained.

However the game could also be an ideal support for student-centred learning since it allows students to practice skills on their own until they can demonstrate a good level of knowledge, for example in choosing the correct design for a study, hypothesis testing etc. Students can play the game in their own time, practicing and acquiring skills in an active (and hopefully) engaging way. The game is an example of blended learning, combining the face-to-face teaching of the basics in the classroom with the digital game based activities on their own. Having acquired he knowledge in class, students are able to apply these skills in their own time. The focus of the game is on application of ideas learned in class. Given the increasing numbers of students in higher education this allows students to practice and to be given feedback on their answers in a cost effective way.

While targeted at students taking research methods modules it is also possible that the game could be used by others. The knowledge and skills-base required in developing a good understanding of research methods and statistics is very large and even experts in methods probably have areas of weakness. For example a qualitative expert might find the quantitative game useful and vice versa as a means of extending their knowledge.
2. Project Approach

Methodologies
Despite the phenomenal growth of interest in serious games in recent years, there is still little systematic guidance concerning how to design a game from scratch. For example there is still a lack of understanding about which kind of game is better for which purpose and how to ensure that the game fits the instruction required. As a result, developing a game can be quite an experimental process.

In designing and developing the CHERMUG game, guidance was collected from various sources. The design tasks outlined in the project proposal included a literature review, a stakeholder and user requirements analysis and a cognitive task analysis. In addition to these sources of guidance, books about research methods and statistics were consulted, the accumulated knowledge of the partners about research methods and statistics, game development, pedagogy and instructional design were tapped into.

Literature review (deliverable 12: Systematic review of the literature on computer games for education)
UWS had published a general systematic literature review of empirical evidence on Computer Games and Serious Games in 2012 (Connolly et al, 2012). The systematic literature review aimed to identify empirical research “on the use of educational games relevant to this project”. While there are games in nursing and social science, we defined games-based approaches to teaching research methods and statistics as most relevant to the CHERMUG project. Search terms used in the literature review were derived from a previous search carried out on the evaluation of computer games (Connolly, Stansfield and Hainey, 2008) and included terms for the variety of digital games that might be played, terms relating to the twin goals of games in learning and engagement as well as the terms relating to research methods and statistics.

The databases searched included those identified as relevant to education, information technology and social science and nursing. The pooled knowledge and expertise of partners was also used as a source of evidence about relevant literature. A number of further criteria were specified to select appropriate studies for inclusion in the review. To be included in the review, papers had to (a) date from January 2000 to May 2012 and (b) include an abstract. Since our interest in carrying out the literature review was in finding ideas for the development of the game there was no stipulation that the papers should report empirical research relating to the evaluation of a game. Empirical papers, review papers and papers describing the development and use of games in teaching research methods and statistics were all included.

User requirements analysis (Deliverable 13: Requirements Analysis)
The user requirements analysis adopted a focus group approach. Research methods tutors and students were interviewed in separate groups concerning their views about and experience with digital games, their attitudes to games-based learning generally as well as their views of and ideas about using games in this particular content area. Three students took part in the focus group and two research methods tutors.
The cognitive task analysis (Deliverable 14: Cognitive Task Analysis)

It is generally acknowledged that an important requirement for a successful educational game is that it should support the learning outcomes required by the teacher. In designing the game much consideration was given to how best to characterise the desired learning outcomes for students on a beginners’ module in research method and statistics. At the kick-off meeting in January 2012 partners identified the following topics as those which the game should try to convey to the students: the research methods cycle, research design (strength of evidence), understanding variance, identifying main hypotheses, operationalising variables (from verbal descriptions). It was recognised that while these are discrete topics there are also connections between them.

A technique which has been developed to help analyse the higher level cognitive functioning required in tackling complex tasks is Cognitive Task Analysis (CTA). CTA is defined as “the extension of traditional task analysis techniques to yield information about the knowledge, thought processes and goal structures that underlie observable task performance” (Chipman, Schraagen and Shalin, 2000, p. 3). Cognitive task analyses have been used for a number of different purposes including the development of training. Of interest to the current project is its use in curricular design.

Two different kinds of CTA were discussed initially. Think aloud protocols are frequently used to establish what students are thinking as they tackle specific methodological or statistical problems. These provide an idea of the difficulties and misconceptions that students encounter and consequently where they might require support in a game.

An alternative approach which was considered to be more useful was finally adopted. Experts in teaching research methods to nursing and social science students were interviewed about the development of knowledge and skills as well as difficulties experienced and misconceptions which arise as students develop a working knowledge of research methods and statistics. The experts were tutors who teach research methods to nursing and social science students.

The evaluation strategy, approach, results etc

It is increasingly acknowledged that game evaluation starts before a game is developed with an assessment of whether potential users would generally find such a game acceptable in principle. The user requirements analysis provided confirmation that potential players would find a game to support learning about research methods and statistics valuable.

Evaluation of games is complex and multidimensional since it involves evaluation not just of whether there is an improvement in performance on the desired learning outcomes, but also evaluation of the user acceptance of, engagement with and satisfaction with the game. Consequently evaluation of the game will examine not just whether game players performed better on the desired learning outcomes but will also look at whether the game helped to involve player in the game activities and how much the players liked these activities.

Evaluation of the game will also be multi-method using both quantitative analysis and qualitative analysis. Quantitative analysis will be used to establish whether the game actually results in improved performance on research methods and statistics. Ideally a randomised control trial (RCT) will be used to assess this. Qualitative analysis will also be used throughout to provide more detailed accounts of players’ views of and experiences with the game.

In an RCT participants are randomly allocated to a game group or a non-game group and their performance before and after the game intervention will be tested. Since the RCT is the gold standard for evaluation, the best time to carry this out is towards the end of the piloting when teething problems with the game have been ironed out through the formative evaluation. The RCT may take place with a trimester 3 module in the 2012-2013 session (or possibly a first semester module in the 2013-2014 session).
In practice there are ethical issues attached to carrying out an RCT in that students who do not get to use the game (especially if it turns out to be beneficial) might complain that they were disadvantaged on the module. This is particularly true where an intervention (game) is used as part of a module. The way round this is to test the game at the beginning of the module and then release the game to everyone towards the end of the module to ensure that there are not issues with unfairness before the exams.

Formative and summative evaluation are both important in developing and testing the game and much of the piloting of the game will be formative piloting. The scope of the pilot is to establish whether the prototype is okay or whether adjustments are required especially with respect to intelligibility, logic, difficulty level of the material, incorporating the game into the students’ educational experience etc.

Much of the piloting will be carried out on mock ups and prototypes of the game to ensure that we are providing students with the support that they need in using the game. In the project proposal we have promised that 750 nursing students and nurses will use the game in some way, with 100 teachers trained. This figure refers to the total number who will take part in the piloting, not just the number in the RCT.

While the original project proposal suggested that 20 institutions would be involved in piloting it was decided at the partners’ meeting in Madrid that it would be more useful to use 20 cohorts of students from partners’ universities as this would ensure that we would have more control over the pilot and staff would be more likely to take part. All university partners UWS, UCM, OUNL, SAMK and UMFCV will take part in the pilots and will provide different kinds of beginners’ student groups with different approaches to and needs from research methods and statistics modules.

The dissemination and exploitation strategy and activities

There were several channels for dissemination on the project as described below.

**Dissemination strategy (deliverable 29)** The dissemination Strategy describes the roles of each partner and lead partner in Europe-wide dissemination. The dissemination plan was divided into two channels: Online and Offline. Planning and dissemination activities commenced from the start of the project and extend till the end. The use of Internet communication channels for dissemination permits a Europe-wide dissemination to a huge number of educators.

**Dissemination brochure for the project (deliverable 30)** A brochure and postcards have been produced outlining information about the project and an invitation to all stakeholders to participate in it. The brochure is available in both printed (for distribution at conferences, seminars, workshops and other events) as well as in digital (for email distribution to a wider audience) formats.

**Web site (deliverable 31)** A public web site has been created (www.CHERMUG.eu) for dissemination purposes. The web site is an important means of communicating about the project to the outside world and increasing awareness of the project. Web 2.0 (Social media, social networking, tagging, Twitter) strategies will also be employed.

**Refereed academic & professional papers (deliverable 32)** Throughout the course of the project, several refereed papers will be produced which will be presented at key European e-learning related conferences (e.g. ECGBL, EDEN, EADTU, Online EDUCA), as well as published in refereed academic...
and professional journals. One paper on the Cognitive Task Analysis has already been presented at the ECGBL conference in Cork in October 2012 (Boyle et al 2012). An article about the aims of the game has been accepted by Nursing Standard, the leading popular journal for nurses in the UK and should help to raise awareness of the game amongst this group (Boyle et al, in press). To make links with the wider nursing community we plan a presentation at the International Family Nursing Conference in June 2013 in Minnesota. An abstract about the development of the game was submitted to a special edition of the journal Learning and Instruction, but this was not accepted. A further submission will be sent to another journal early in 2013.

**European conference (deliverable 33)** We aim to have a mini-track on the different aspects of the project at European Conference on Games Based Learning which will be held in 2013 in Porto, Portugal. There are funds in the budget for six tutors to attend this conference and present their experiences of using the game.

**Newsletters (deliverable 34)** 2 electronic newsletters will be produced and distributed via the Internet throughout Europe, as well as globally, highlighting the current work being undertaken by the project, initial findings and results, news and views, as well as promoting future events that the team will be either hosting or participating in. Key stakeholder groups will be invited to contribute features to the newsletter as well, ensuring that it is of continued interest to the extensive readership. Social network distribution will be an integral channel.

**Establish project reference group/community of practice (deliverable 35)** A Project Reference Group will be established with leading practitioners and policy/decision makers to support the implementation of the project. The reference group will contribute to the evaluation of the project, dissemination activities, and importantly to the valorisation activities. The target is to have a membership of at least 40 experts in this group. We already have several members of this group from our CTA and other activities. Members of this group have already provided invaluable feedback about the content and activities to be included in the game.
3. Project Outcomes & Results

The literature review confirmed that there are few papers describing game-based approaches to teaching research methods and statistics and even fewer which carried out rigorous evaluations of the success of such games. Since games-based learning is a new area, papers which were identified tended to be accounts of the development of the game or how it was used in learning with only limited accounts of the success in improving performance. The games described by Operation ARA (Halpern et al, 2012), Martian Boneyards (Asbell-Clarke et al, 2012) and Ramler and Chapman’s (2011) use of Guitar Hero to teach research methods were all games where players had to propose a hypothesis, look for evidence and evaluate whether the evidence supported the hypothesis. This research suggested that games provide a highly appropriate method of learning to use in searching for evidence to confirm a hypothesis as they provide activities which are congruent with the desired learning outcomes and they provide enjoyable challenges which players are motivated to solve.

The use of e-learning applications and animations to support teaching in research methods and statistics has been around for much longer and is more established than the use of games. There was empirical evidence about the success of these evaluations, with several evaluations finding that e-learning and animations lead to more successful learning than traditional methods.

Several papers provided in-depth analyses of the problems students have in learning about statistics and suggestions for supporting students in this. The first step in designing a game is to specify the desired learning outcomes. These papers were discussed in the review since they were extremely provided useful guidance about effective learning of statistics.

The literature review suggested that teaching the research and statistical skills of scientific methodology would seem to be highly amenable to a game-based approach and there are reasons to be optimistic that a game-based approach might be successful. It is interesting to note that the focus of most e-learning applications and games is on statistics rather than research methods. CHERMUG is different from these other approaches in that it does not just aim to teach statistical concepts. The proposed CHERMUG game goes beyond teaching statistical concepts to teach research methods and design and supporting students in tackling both qualitative and quantitative approaches to research.

User requirements analysis: All staff and students in the focus groups were generally supportive of games-based learning as a means of teaching research methods and statistics. The particular advantages that staff saw were primarily motivational: anything that might engage students was regarded as potentially useful for this difficult content area. Some staff were already using game-type activities, such as a board-game type layout for progressing through the different stages in the critical evaluation of a paper.

Game features mentioned by staff as being potentially useful included standard features such as progression to the next level; a navigation tool to allow students to know whereabouts in the game they are and a clock. More creative features included a post-it facility for highlighting difficult concepts and an “I’m stuck” facility for conversing with the tutor or a phone to phone for help. One respondent felt that games could be used as an assessment tool: the game could be used to monitor time spent playing as proxy for engagement with learning and effort in learning, although there was a danger that students might dislike the “big brother” element of this.

The students felt that games might be particularly useful for supporting quantitative research which they found difficult. They liked the idea that they could use the game to practice material covered in class. They also liked the idea of a nursing work station as a base where they could access information and where all the tools needed for solving problems are sitting in the booth. An important
requirement was that the game should be easy to navigate: if a mistake was made it should be easy to return to where they were. One student emphasised that the game needs to be interactive. Students also mentioned useful game features such as a clock to monitor time on task.

Cognitive Task Analysis

Many requirements for a game to support research methods were proposed. Respondents mentioned that the game should:

- immediately engage players and provoke research interest
- challenge students in their question definition and research design & show the dependencies of the full research cycle
- get students to make predictions about the next stage
- allow students to experience the difference between qualitative and quantitative research methods
- allow students to experience being part of the experiment
- allow students to visualise data
- provide structured support to students approaches
- include interactions between peers

Development of the game (see Deliverable 15: Requirements Specification document and Deliverable 16: Design specification document)

The evidence, suggestions and constraints identified in the literature review, the user requirements analysis and the cognitive task analysis provided useful information which guided the development of the game. Clearly designing a game is a complex operation and many different aspects and issues had to be considered including:

1. The content area and topics to be addressed
2. Specification of the required learning outcomes
3. Games to support the learning outcomes
4. Levels of the game
5. The game mechanics
6. The narrative
7. Pedagogy underlying the game
8. The audience for the game
9. Platform

The content area and topics to be addressed: One of the findings of the literature review was that teaching research methods and statistics seems to be more successful when it is taught with content and examples which are relevant to the student and are grounded in real-life examples. The game was targeted at nurses and social scientists in the first place and there are a number of topics and issues especially in the area of health and well-being which are relevant to both of these groups and which students find engaging.

Health and well-being is also broadly relevant to and of interest to most people at a personal level. The broad area of obesity was selected as a topic of general interest. There are many variables which are relevant to and impact on obesity and informal piloting in a class and with friends suggested that most lay people could quickly generate several factors which are related to obesity. The topics of food preferences and diet and exercise were selected as the topics which the game would address. These topics are also of personal interest to students across disciplines.
The game: At the same time as developing the game content, consideration was also given to the kind of game which might support that content. Entertainment games have traditionally been categorised in terms of genre which provides a high level categorisation of the nature of the activities which are typically found in that kind of game. From that perspective the CHERMUG game is a role playing game in that players adopt the role of the individual whose mission it is to develop a rigorous understanding of research methodology to try and avert the world from the disaster of obesity. The player adopts the role of trainee researcher in the game.

Specification of the required learning outcomes: It was important to develop a clear understanding of the required learning outcomes for the game and these were identified from textbooks but guided by partners’ knowledge and experiences and findings from the CTA. At the first project meeting the desired learning outcomes for the game were identified as: an understanding of the research methods cycle; contrasting qualitative and quantitative approaches to research; understanding study design; developing and testing hypotheses; identifying variables. These higher level outcomes were essentially unchanged throughout the development of the game although they became more detailed as the game progressed.

Games to support the learning outcomes: The next problem was to identify games which might be appropriate in supporting these learning outcomes.

UCM, Playgen and UWS were the main partners in developing the game. The structure of the game and the division of labour in terms of developing the game was agreed at the second partner meeting in Madrid. Essentially three games were selected corresponding to the different stages in the research methods cycle:

1. paper dissection game
2. qualitative data analysis game
3. quantitative data analysis game

The games were strongly built around the required learning outcomes and consequently involved a lot of content development. UCM agreed to develop the qualitative game, while Playgen and UWS developed the paper dissection and quantitative games. The further sub-division of labour was that UWS developed the content for the games while Playgen developed the game. In addition Playgen agreed to develop animations which introduced the game.

The research methods cycle: Initially in thinking about the research methods cycle it was not clear whether developing an understanding of the stages of the research methods cycle was a game in itself since the cyclic structure was reminiscent of a “board game” format around which students could progress. It was decided that the research cycle was more like a framework or platform from which the game would operate with activities/mini-games delivering appropriate activities located at the different stages of the research methods cycle. This would be important in helping students gain an understanding of the different stages in the cycle. The different stages in the research cycle were considered with a view to developing games which would support students with tasks which are appropriate to these different stages.
Number of stages and tasks at each stage While most CTA respondents agree with the research method cycle idea they did not always agree about the number of stages and the tasks which should be performed at each stage. The stages we proposed (Van Buuren, 2008) were (1) introduction/research question (2) data collection (3) data analysis (4) discussion/conclusion.

Pre-game brainstorming activity A number of respondents to the CTA as well as partners felt that there was also a pre-stage to the research methods cycle, where ideas about a topic were generated. The research cycle seemed to be more focused on the procedures which take place once a research area has been identified. In thinking about how this would fit into the game it was decided that this pre-stage would be ideally suited to a brainstorming activity where students would be given a topic, such as obesity, and they would have to try and think about as many factors as they could which impact on obesity. (While this activity was intended to be played outside the game, it could be included in the game for those who

Stage 1: formulation of Hypothesis, literature review, design Following the generation of ideas in the “pre-game” brainstorming activity, the first stage in the research methods cycle proper is the “research question” stage. While there was broad agreement about the tasks of stages 2, 3 and 4, there was less agreement about the tasks of the first stage. There seemed to be a number of issues to tackle at the first stage making it difficult to pinpoint which specific activity was the most important to address and there was more discussion and debate concerning exactly which activities are important at this stage (and consequently what the game should support) than with any other stage.

Tasks at this initial stage included formulating the research question (and the hypothesis) but specifying the design of the study and getting a good understanding of existing research in the area via literature review were also important. Another confusing factor was that since this was the first stage, it also seemed to be an appropriate stage at which we should introduce the students to research methods cycle generally. These tasks also seemed to be interlinked: for experts in methods the statement of the hypothesis is inextricably bound up with the study design and it is this kind of implicit knowledge which we are aiming for players to acquire.

Several respondents to the CTA, especially those whose students take evidence-based practice modules, argued that it would be useful for students to have support in critically evaluating papers. One respondent said that when he was supporting students in identifying a suitable research question for their Honours dissertation he would give the student 3 papers and get the student to read the three papers and identify similarities and differences between them. Recent thinking about effective teaching of research methods and statistics emphasises the need to ground teaching in real world research and referring students to real papers would help in this respect. An activity involving published papers would allow students to understand the structure of an academic paper and the first activity we considered for this stage was a “paper dissection” game.

The name given to this stage in the Van Buuren (2008) model is research question. Developing and formulating a research question or hypothesis is a key activity for this stage. This gave rise to another problem since the hypothesis is much more specific than the research question and there was discussion about the level of generality required at this stage. Many introductory modules do not require students to think about developing a hypothesis as they are usually presented with a specific hypothesis to test. However partners felt that it is a good idea to give students some experience of formulating a hypothesis since they typically find this very difficult. The introduction or background section of most papers ends with a statement of the hypothesis. After careful consideration, it was thought that rather than ending this stage with a hypothesis we should introduce the hypothesis at the data analysis stage. Consideration of this but this activity was delayed until the data analysis game where it provided the impetus for the data analysis.

The paper dissection game Since the literature review suggested that learning activities should be grounded in the existing literature, it was thought that activities based around analysing relevant
papers might provide a useful game. The game which was developed was called the “paper dissection game” since this was how the game was envisaged initially. A number of versions of the paper dissection game were considered.

There is a knack to reading papers and one of the tasks in the preliminary stages of carrying out research is to help students to realise that papers are written in a structured order with different topics covered in different places. The game at this stage was intended to support players in understanding that there is a structure which is common to all papers, both qualitative and quantitative: the abstract, the introduction, the research question or hypothesis, the methods, results and then discussion and conclusion.

The most recent version of the paper dissection game involves three main activities.

1. Jumbled papers
2. Answers to questions
3. Scenarios

**Jumbled papers:** In this game, players are presented with the different sections of structured abstracts from two academic papers: background, aims, measures and procedures, results and discussion. These are jumbled up and the players’ task is to “construct” the papers from the different component sections by fitting the different sections together to provide the correctly ordered abstract summaries of the two papers. Players have to actively manipulate the different sections of the papers. The first run through the jumbled papers would include a qualitative and a quantitative paper and the second would include papers with two different quantitative designs, one looking at differences between groups and one looking at an association between variables.

The intended learning outcomes for this game are to acquire an understanding that academic papers have a consistent structure with respect to the sections which appear and the kind of information which appears in the different sections. This structure applies whether the approach taken is qualitative or quantitative, although the focus might differ for the two approaches. The game highlights similarities between the two different kinds of paper with respect to their structure and the kinds of information which appears in different sections. The students might also pick up on differences between qualitative and quantitative approaches but this should be evident in the following task.

**Answers to questions:** The aim of the next task is to compare and contrast the qualitative or quantitative papers. Having “constructed” the papers, the next task is to answer questions about the papers. These are interpretation questions which require players to identify the relevant information in a specific paper, e.g. find which paper (for example) involved an independent samples t test. Was there a gender difference in liking for vegetables? These tasks help students to understand that specific kinds of information are typically found in specific sections of a structured abstract and that this is similar for both quantitative and qualitative papers.

**Scenarios:** In the next task, four short scenarios will be presented, either qualitative or quantitative, and players have to say whether each is qualitative or quantitative and provide reasons. Again this helps students to compare and contrast qualitative and quantitative approaches and allows students practice in deciding which kind of research approach, qualitative or quantitative, would be most appropriate for answering which kind of research question.

**Stage 2: Data collection** A number of papers in the literature review emphasised the value to students of collecting and analysing their own data since this helps students to feel more of a sense of control and belonging. Resource constraints led to the decision that this was not a stage that the CHERMUG project would gamify at this point, although in the data analysis game students will experience a short exercise where they will complete a questionnaire.
Stage 3 data analysis Since an important aspect of research methods concerns the difference between qualitative and quantitative methods two games were proposed at this stage – one for qualitative and one for quantitative methods. Both the quantitative and qualitative data analysis games are intended to simulate the experiences of students involved in carrying out that kind of research.

The qualitative data analysis game: The qualitative game would be introduced by returning to the talking heads scenes introduced at the start of the game which graphically showed the results of the obesity epidemic in terms of obese persons’ perceptions of how it feels to be fat etc. It would be pointed out that these snippets provide "data" for input to the qualitative analysis game.

There are four suggested activities in the qualitative analysis game and these were designed to reflect typical issues which emerge in carrying out qualitative research.

1. Contrasting qualitative and quantitative research
2. Qualitative or quantitative data?
3. Issues in Sampling
4. Qualitative coding exercise/game

Contrasting qualitative and quantitative research: Qualitative and quantitative approaches to research differ in terms of their philosophical underpinnings, methods, the kind of data collected and the kind of analysis used. In this activity players would be presented with characteristics which are typical of either qualitative or quantitative research (for example deals with numbers, deals with descriptions, data analysis is inductive, data analysis is deductive, data analysis involves coding, data analysis involves statistical testing) and they would have to match the characteristic with the research approach. A suggestion would be to have this as a kind of card sorting game where players have to sort the descriptions into qualitative or quantitative.

Qualitative or quantitative data? : This is a simple activity in which various data sets are flashed up on the screen and students are simply asked to decide whether the data is qualitative or quantitative data.

Issues in Sampling: Sampling is an important issue in qualitative analysis and the sampling activity was designed to reflect the idea that in selecting the sample careful consideration needs to be given to ensure that the sample is appropriate in terms of size, quality and representativeness.

Qualitative coding exercise/game: The qualitative coding exercise is a key activity with respect to qualitative analysis. In this activity players are provided with participants’ verbal statements about a specific topic and a number of pre-defined categories and the goal for the players is to classify the statements to the appropriate higher level categories. This could also be a card sorting activity.

The quantitative data analysis game: The aim of the quantitative data analysis game is to take students through the sequence of operations from identifying the research question, to clarifying and stating the hypothesis to selecting an appropriate statistical test. At the start of the game the player is presented with a research question and he is guided through the varied issues which need to be considered in developing a hypothesis and adopting a rigorous approach to quantitative data analysis. The research question provides the goals for the game and provides a reason for the players to need to consider each question. The sequence of operations will vary to some extent depending on what the hypothesis is. Currently the game includes hypotheses which require either an independent samples t-test or chi square test although the game could be extended to include paths through other statistical tests.
The data analysis game emphasises the links between the different stages from the formulation of a hypothesis, to operationalising the variables and determining which kind of data are collected and determining which kind of statistical test should be used. Understanding links between the different stages in the process was one of the ideas that respondents to the CTA said that students did not always appreciate.

The sub-skills in the quantitative data analysis game were derived from text books but guided by the CTA and views of partners. The game aimed to support players in:

- Stating the null hypothesis correctly and precisely
- Understanding directionality of hypotheses
- Identifying variables from hypotheses or descriptions of the study
- Identifying levels of variables
- Identifying types of measurement
- Understanding the operationalisation of and measurement of variables
- Inspecting and identifying problems with raw data sets, such as missing values and incomplete data
- Selecting appropriate graphical and tabular representations of the data and understanding skewed data sets and outliers
- Interpreting graphical and tabular representations of data
- Choosing appropriate statistical tests to test hypothesis
- Interpreting statistical tables

**Stage 4: The discussion/conclusion stage** It was decided early on in the game development that this stage would not involve a game but would be conducted back in the classroom in a debriefing session.

**Links between games** The games are designed to simulate the experiences of beginners in learning about research methods and statistics and provide support for the difficulties they face. The games are set up so that a student taking an introductory module on research would play all three games as they progress through their research methods module. The paper dissection game would come first but the qualitative and quantitative analysis games could be played in any order depending on the tutor’s focus.

**Levels of the game:** All three games will be played at two different levels which are related to the topics of food choices and preferences (level 1) and diet and exercise (level 2). It was thought that the use of the same topic for all games at the same level would help students to understand that the same topic can be studied in different ways.

**Game mechanics:** The student will interact with the game through the main interface, which displays their progress, research cards they have collected and their score. As a student completes a mission it turns green, the missions that haven’t been completed in that stage stay red. This provides students with a sense of their progress through the game.

The game includes traditional game mechanics such as reward structure, competition and levels. Rewards are included in the form of points and research cards. Earning points allows users to feel they aren’t wasting their time and they are being rewarded for their actions. Points give an indication of the user’s position within a game and enable them to compare and rate each other. Points are acquired by completing the tasks, answering the questions and solving the problems and puzzles which are presented throughout the game. The student with the most points wins. The prize can be determined by the facilitator.
As the user plays through the game they collect research cards. These cards act as flash cards which provide bite-size chunks of informative content as well as an indicator of how much progress the student has made and how much they have covered. The students will aim to collect them all. Bonus points can also be awarded.

Reward schedules determine when and how a reward is given. They are used to prevent static rewarding, making the game reward a user based on their actions and skill.

If the player is finding a task too difficult hints are provided in the form of clues given to the player to help them solve the problem/question. Hints cost points which the player earns by answering questions correctly. It is up to the user to decide whether to spend their hard earned points or guess the answer.

**Game mechanics to support learning:** There is some discussion about whether it is appropriate to categorise serious games in terms of genre. However there is a recognition that it is useful to link learning activities to game activities at a finer level of granularity. Habgood (2007) proposes that the secret of creating engaging educational games is in “integrating learning content with the game mechanics of a game”. The knowledge and skills required in developing an understanding of research methods and statistics were decomposed into medium level activities (activities typical of each stage, such as formulating and testing a hypothesis in the quantitative data analysis game) and lower level activities (the more specific detailed operations that underlie these activities, such as deciding what kind of variable this is). The game mechanics supported these skills.

**Narrative:** The narrative provides an important means of engaging players by establishing a context which provides reasons for the player to play the game. A number of versions of the narrative were considered. Given the subject area, most of the ideas involved a main character who had to acquire an understanding of research methods and statistics to provide him with an appropriate toolset to tackle difficult problems in systematic way. One idea was that the game character was a girl called Alice, who like Alice in Wonderland was curious and interested in acquiring a more rigorous approach to tackling problems. This idea was rejected as it was thought to be too similar to other games.

The idea that partners agreed on was that the main character was living in the year 2045 where there was an obesity epidemic and the character’s mission was to imagine that they could go back to 2012 and correct the mistakes made in the past by adopting a more rigorous approach to evidence based practice whether it would have been possible to prevent this epidemic.

**Pedagogy:** There is a range of pedagogical theories which are acknowledged to be relevant in designing games. Given the complex nature of the knowledge and skills required in acquiring competence in this area, the pedagogical model which seemed to have most relevance to CHERMUG was Van Merrienboer, & Kirschner’s (2012) 4C-ID instructional design model. This is a model of learning in complex tasks which proposes four core components, i.e. authentic learning tasks, part task-practice, supportive and procedural information which need to be considered. 4C-ID was used to underpin the game design of CHERMUG with a sound instructional basis.

**Audience for the game:** The game was originally conceived as a game for teaching research methods and statistics to nurses and social science students as these students frequently struggle to acquire a solid understanding of the higher level logical reasoning, critical thinking and computational skills that underlie research methodology and statistics.

There was discussion concerning which level of expertise and which kind of module the game should support since students on different kinds of research methods module emphasise different skill sets and students with varying levels of expertise will require different kinds of support. It was agreed that the game should be targeted initially at beginners since many students are required to acquire a basic
understanding of statistics and a game-based approach might be most relevant to initiating interest in methods and statistics.

Interestingly CTA respondents did not appear to view the level of expertise at which the game was targeted as a problem. It was felt that the game might act as a revision aid for more experienced students and possibly even some staff who want to revise specific methodological skills. Research methods and statistics is complex and the game supports a variety of skills. Even experts have areas where they might find it useful to revise their understanding.

The games could be played as three separate exercises: the first on hypothesis testing, literature review and design, the second on qualitative data analysis and the third on quantitative data analysis. Each of the three games should take about half an hour to play and has been designed to be incorporated into a lab class. However the games could also be used by students at home or even via mobile phone on the web as a support exercise.

**Platform** It was agreed at the kickoff meeting that the game should be a web based game. Focus group participants felt that it would be best to access the game by PC and laptop rather than via mobile technology where they felt there might be problems with legibility of material.
4. Partnerships

Added value of the multi-country partnership in executing the project

The added value of the project comes from the complementary blend of expertise, skills and interests of the CHERMUG partners including research methods and statistics, nursing, social science, educational game design, game pedagogy, measurement of playing experience, application of educational standards and user modeling, web-based learning, adaptive learning and educational games, assessment features and adaptation.

Partners on the CHERMUG project were recruited through networking opportunities provided by the European funded FP7 Network of Excellence GALA (Games and Learning Alliance), which aims to gather, integrate, harmonize and coordinate research on Serious Games, as well as contacts established through the European Conference on Games-Based Learning (ECGBL). Through GALA a number of academic and industrial partners with expertise in game development (UCM and PLAYGEN), educational theory (OUNL) and nursing (SAMK) were identified who were interested in joining the CHERMUG project. The Romanian partner was identified as an expert in nursing through an existing contact in UWS. The partners represent a range of European countries (UK, Spain, the Netherlands, Romania, Finland) which are all involved in teaching research methods and statistics to nurses and social scientists. The piloting of the project will take place with varying cohorts of students from partners’ institutions taking introductory research methods modules.

The European added value of this project is generated from benefits that would not have been possible from a national or regional approach. The project directly contributes to the key priorities of EU policy, while being consistent with the pursuit of scientific and technical quality. Moreover, because the problem being addressed requires activities on a large scale, the complementarity of the work being carried out by the individual project partners around different aspects of innovative educational technologies enables significant results to be obtained in the Community as a whole. Finally, through a unified approach the results of the project will be exploitable all over Europe, and at all levels of education, and it will enhance the transferability and multiplying effect through its outcomes. The project should be especially beneficial for transnational transfer of knowledge and experiences in the field in the use of innovative technologies for teaching and learning.
5. Plans for the Future

At the end of the reporting period (November 30th), the game is still being developed. We have a mock-up of the chi-square quantitative analysis game (http://playgen.com/chermug/story.html) and part of the qualitative analysis game. Partners, methods experts and students are being asked for feedback about these games as part of the ongoing formative piloting.

Task which are still to be completed The game development phase ends at the end of January 2013. The piloting of the game is due to take place from April – July 2013 but due to the semester structure in universities which runs from February to May and the availability of relevant student groups, some piloting with the Scottish groups will need to take place in February 2013. This means that the pedagogic guides and materials for the teacher training courses which are not planned to be available until the end of April 2013 will need to be ready earlier than that. The initial piloting will be with an English language version of the game, but the game and accompanying tutor and user guides will be translated into Spanish, Dutch, Romanian, Finnish, French and German. Pilots in non English languages can start a bit later.

Following the piloting with student groups across Europe, 6 best practice case studies from the pilots will be developed in which teachers and students will reflect upon their experiences. To complement the best practice case studies, a set of additional use case scenarios will be developed to provide additional examples of how the educational game and training guides can be used across the curriculum, as well as recommendations and advice aimed at decision-makers and other relevant stakeholders.

The best practice case studies and use case scenarios will be made available from the Chermug web site for registered members to view and download and will be sent out to decision-makers and key stakeholders across Europe which will further enhance Chermug’s dissemination activities.

Quality assurance for the project is ongoing. Dissemination of the project results will be take place as described in section 2 of this document.
6. Contribution to EU policies

EU education policies emphasise the importance of students acquiring generic core skills which will be of value in the workplace. For example the EU 2020 Strategy "New Skills for New Jobs" emphasises the need to help students acquire skills for the jobs which will be available in the year 2020. It seems likely that the ability to summarise and analyse data, evaluate the quality of evidence and present convincing arguments are higher level thinking skills which are required to tackle the ill-defined problems that we face in the 21st century. It is these skills which the CHERMUG game aims to support.

Research methods and statistics are complex and developing an understanding of these subjects involves for example understanding of probability, the ability to isolate and test variables, fair comparison, computational skills and argumentation. These are sub-skills of mathematical competence and basic competences in science and technology which are highlighted in the European framework for key competences (2007) as crucial skills for lifelong learning. The game also requires student to evaluate and reflect on their own performance. These are meta-cognitive skills which underlie the students’ abilities in learning to learn, a further requirement for effective lifelong learning.
7. References


