

iBook learning experience: the challenge of teaching computer architecture to first year university students

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Abstract - Tablets, mobiles and handheld computers such as the iPad / iPhone and similar platform technologies are transforming the ways in which we interact with technology. It is becoming easier for people from all backgrounds and age groups to assimilate information quickly, efficiently and to have a fun, entertaining and even educational experience. One such current and popular interactive learning experience is through the use of what is commonly known as an iBook. This research aims to explore how and if the iBooks Author application with its new and stimulating interaction and multimedia capabilities can be used to encourage and motivate first year university students into becoming active learners. The outcomes of this research will be evaluated on four key elements: motivation, experience, knowledge and reflection. This paper will document the early developmental stages of an iBook learning experience as well as present some of the initial research findings.

Keywords: learning, experience, iBook, interactive, iPad

1 Introduction

Computer systems are everywhere and as end users the majority of our students in computer science are familiar and comfortable working with and using computers. However going beyond the keyboard and monitor, many students struggle to fully comprehend the mechanisms and the relationships that make a computer system function. As research highlights [1] [2] [3] the difficulties encountered by students studying computer architecture have been well recorded. [4] believes that without a solid understanding of computer architecture most computer science students will have a fragmentary knowledge of how a computer operates. In her paper 'A Case for Teaching Computer Architecture' she has identified a need for better pedagogical methods and tools to provide students with a balanced, well-informed view of the subject, and following from that, the ability to apply this understanding to problems that they might face in their professional life [4].

At the University of Glamorgan, the basic principles of computer architecture play a role in the core of most of computing modules. However, it has been a subject that has proved difficult for students to fully understand as is evident

from their poor student performance, engagement and grades. Therefore, the aim of this research is to tackle/address some of the conceptual challenges surrounding the student's understanding of computer architecture. The work aims to explore new ways of interacting with a computer, to instigate new ways of thinking about how a computer works and in doing so to introduce new approaches for learning and teaching the core concepts of computer architecture. The key will lie in triggering the student's inner motivation for learning by offering engaging learning experiences. This paper aims to show the early elaboration stages of harnessing the innovative potential of mobile and handheld devices (and in particular, the new interactions they afford) to intrinsically motivate students to become active learners who seek to understand and learn. In detail, the paper will show initial investigations into what we mean by an iBook learning experience and then how we propose to use a Learning, Research and Development Framework [5] to create an iBook learning application. The overall focus is on the elaboration phase particularly the thoughts, feeling and impressions behind the planning of the iBook learning experience. This paper will present some of the initial research findings.

2 iBook and the learning experience

Understanding what constitutes a learning experience is the first step in designing and developing for an intended iBook learning experience. In this paper we would like to build up an understanding of what is meant by the term 'iBook learning experience' and how we might go about actually designing and developing for a holistic iBook learning experience.

The term 'experience' has been making a noise in the e-learning sphere for quite a while now. In fact, the last decade and a half has been about trying to make sense of the concept of experience: what is it? What does it mean for learning? It is generally now agreed that it is no longer considered sufficient to produce 'a computer system that is effective, flexible, learnable and satisfying to use ... [but] it must now also be useful in the lives of those using it' [6]. When we look at the iBook, these applications are already transforming the way in which we assimilate and absorb information providing a greater level of accessibility to people on a global scale [7]. It

is true, we have moved on from using technology for just instrumental needs to now it being more about the subjective, situated, complex and dynamic encounter [8]. Computers have become something larger than usability or one of its components, such as satisfaction or attitude [6], it now touches into all spatial dimensions and senses [9]. Indeed, the Apple product (including the iBook) epitomizes this new ideology of experience driven technology so much so that over the last few years it has played a leading role in securing this truly revolutionary and innovative vein within computing. However, in terms of learning, it has only been in the last two years, that the iBook has started to take shape and to move slowly into the educational sphere. For example, some of the more successful iBooks are Alice in Wonderland which has been used to educate young children in classic storytelling [10] as well as the interactive iBook from Al Gore which aims to educate people on the damaging effects of Climate Change [11] illustrated in Figure 1. These books are described as inspiring creativity and hands-on learning with features that let students engage with content in interactive ways, find information in an instant, and access an entire library wherever they go [12]. These books have the potential to take learning to a whole new level, but it is only now that designers/developers are realizing this and are in a position to start to take the iBook serious as a means to enhancing and building our student's learning experiences.



Figure 1 Our Choice by Al Gore iBook

In fact, iBooks /Mobile devices are promoted as excellent interpersonal communication tools bringing the opportunity for students to interact with each other in order to resolve problems and to develop deeper understandings of complex concepts. One of the main advantages of the iBook would be its capacity to engage and stimulate students; it seems to afford a learning at-the-time-and-place that it is needed format, which could bring greater context and relevance to the learning. For designers and developers, it is important to

understand the bigger picture (i.e. the relationship between the iBooks properties, the experiences that they provide and how these can be harnessed to create a contextualized learning experience). To understand this, a Learning, Research and Development Framework [5] will be used as guidance in the development of the iBook learning experience. This framework (see Figure 2 on next page) adopts a spiral model supporting a process that passes through a number of iterations. This is divided into four main phases: inception – determining scope and purpose of the project; elaboration – capture requirements and determining structure of the project, construction – building the experience and transition – dealing with production, installation and rollout of the project. These extensively cover the dimensions of experience design, educational research, instructional design, innovation development and methodology. As seen from the diagram, the framework places an equal importance on issues concerning the design of the experience (i.e. the learner and educator experiences) and how these could be represented by the designers, as on other forms of design.

For this paper, we will document some of the requirements in the elaboration phase for the development of the iBook. The paper will highlight some research undertaken with the target learners and in particular, their thoughts on an existing iBook technology and the potential for it to enhance the learning of a computing subject such as computer architecture. The main objective was to probe the learner's thoughts on the creation of multi-sensory experiences, different levels of interaction that might be used to create a iBook learning experience. In doing so, it attempted to identify some of the learner's requirements in terms of the curriculum area and how they perceive the iPad technology and its many interactions may be best utilised to achieve the expected learning outcomes. The framework is used to achieve a deep understanding of different dimensions of the possible iBook learning experiences through observing how target learners consider and might use the iPad technologies and its interactions.

2.1 Research methods

This study investigated first year computing student's main perceptions of the iBook technology and their reflections on its potential to enhance their own learning (i.e. the strengths and weaknesses of the technology and ultimately their opinion of its prospects for learning success). A total of 27 participants (20 male and 7 female) took part in the study. They were of different ages (18 - 47 years) and from computing backgrounds. They were shown a video clip of Al Gore's Our Choice, the first full-length interactive book for the iPad by Mike Matas [13]. The video demonstrated some new multi-touch interface features, in particular the 'pick up', 'explore', 'zoom out' and 'quickly browse' features. After watching the video clip the participants were asked to answer a short questionnaire to provide insight in their perceptions on such technology on the learning experience.

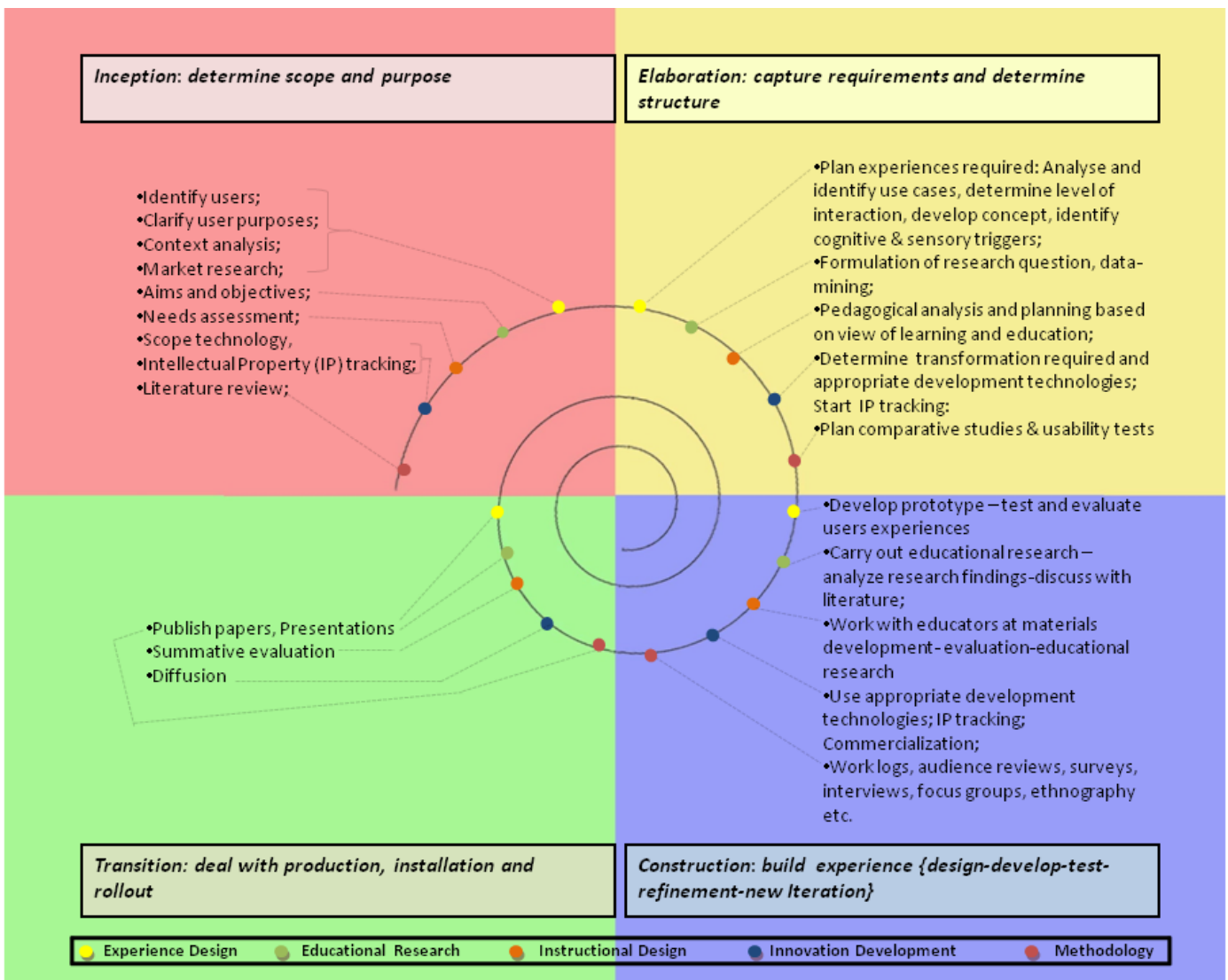


Figure 2 Learning, Research and Development Framework [5]

3 Results

From the data collected, it became apparent that the majority of participants (92%) had a positive view on the use of iBook technology – if used correctly, and accessible to all students –in a lab/ lecture. Moreover, that it has the potential to effectively teach a computing topic. One student (Participant 17) described it as the next level of interaction with several students’ feeling that especially it’s facility for interaction would enhance their learning. As we can see from Figure 3, the overall participant’s response/attitude to the technology and its use in education was very positive.

Students used words like ‘interactive’, ‘interesting’, ‘brilliant’, ‘helpful’, ‘useful’, ‘exciting’ and ‘fun’ to describe the iBook technology. With only three students feeling it was ‘expensive’, ‘waste of time’ and ‘redundant’.

Some of the responses from the questionnaire:

- ‘...useful way to interact with a book’ (Participant 3)
- ‘...could be very useful – interactivity useful’ (Participant 5)

- ‘...an interesting development that could lend to even easier access to information’ (Participant 6)

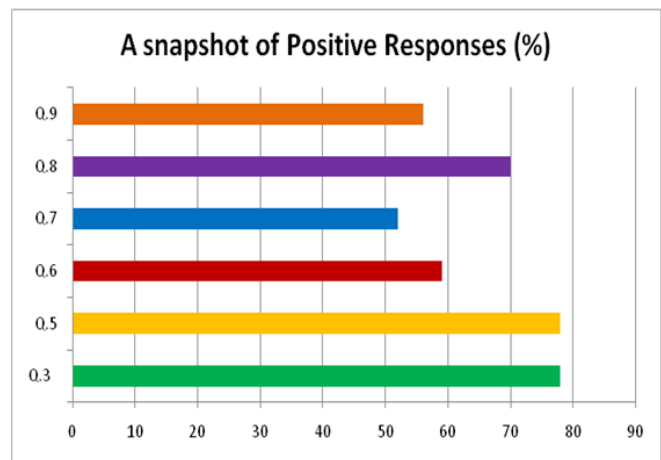


Figure 3 Snapshot of positive responses

- ‘...it’s very interesting as it has a vast range of interaction and has unlimited capabilities’ (Participant 13)
- ‘...very exciting and impressive’ (Participant 14)
- ‘...looks fun and interactive’ (Participant 15)

When asked how they perceived the technology could be used effectively to teach a computing topic, the majority of participants had positive views and shared some ideas, including:

- ‘I think it would be good for guides such as code and web’ (Participant 1)
- ‘...showing the construction of computers’ (Participant 3)
- ‘...have animations of computer points or examples of code’ (Participant 4)
- ‘You could have inside of computer, interactive sites/code’ (Participant 5)
- ‘...can lead to clearer understanding of complex computing concepts’ (6)
- ‘... some computing elements could be simulated’ (Participant 10)
- ‘... by having examples within the text that could be picked up so the student can see the creative process’ (Participant 11)

Computing requires more visualisation and live demos to understand how things work and the iBook could enhance this’ (Participant 20)

- ‘... lecture slides can be downloaded onto it and it is easy to flick through’ (Participant 27)

However, when asked would using a range of interactions (i.e. shake, touch, gestures, camera, geo-location etc) help them to further understand complex concepts/ topics? Some students felt:

- ‘Yes, it is easier to learn when interacting with elements of the topic’ (Participant 16)
- ‘Yes, more fun and imagination capturing, keeping interest, lots of computing subjects need more visualisation’ (Participant 20)

Whilst others felt it might be a distraction from the learning and also annoying:

- ‘I’m not sure as some people could find it annoying’ (Participant 13)
- ‘No it would distract me’ (Participant 26)

Finally, when asked if they had any views on the potential of the interactions seen in the video to stimulate their curiosity and interest in learning about a new topic, several students (78%) felt that it would help them to learn about a new topic.

Responses included:

- ‘...keep attention. Explain specific parts, better show example’ (Participant 5)
- ‘...by granting greater access to more information’ (Participant 6)
- ‘Help us with understanding’ (Participant 9)
- ‘Makes you enthusiastic about the topic’ (Participant 16)
- ‘...helpful, it can explain more, give you more understanding of the topic’ (Participant 23)
- ‘...you can view the images in different sizes such as small and large which is good’ (Participant 27)

4 Conclusion

This study has allowed us to identify some of the main perceptions of first year students on the iBook technology. More importantly, it has also given us an insight into why (and if) they think it might be an effective tool to teach a computing topic. In detail, it has highlighted the participant’s thoughts on the important role of ‘interaction’ in their learning experience. Through interaction, several participants felt that the iBook technology has the potential to help them with the understanding of complex topics. In fact, interaction, motivation, engagement, enthusiasm, helpful for access to information, interesting and fun were all terms used when participants were discussing learning in conjunction with the iBook technology; with more detailed requirements – in relation to the teaching of computing – taking the form of animation, simulation, interactive guides, interactive text/code, scaling, visualization and demonstrations. In summary, these results have given us insight into how the participants perceive the use of the iBook and how it might enhance their own learning. These important insights (and particularly the detailed requirements identified) will feed into the construction phase and then the overall planning of the iBook learning experience.

4.1 Future work

The work documented in this paper is part of the Novel Learning project which is funded by the Centre for Excellence in Learning and Teaching (CELT) at the University of Glamorgan, South Wales, UK where the authors have won this year’s Innovation in Learning and Teaching Grant award. The main aim of the project is to explore how emerging options for interaction with technology can be used to integrate an innovative learning application on handheld devices to stimulate students’ curiosity and interest. In addition to inspire learning, particularly within the field of computer architecture - an important subject area in any computing discipline, one which has often been quite difficult for new computing students to understand. Future research will include investigations into how we might organize and present high quality multimedia content in real-time responses to students’ interactions to enhance their understanding of

complex concepts. In detail, it will explore a wide range of interactions such as shake, touch, gestures, camera, geo-location etc in an attempt to cater for a range of senses such as sight, touch, hearing, etc. An iBook learning application will be developed and tested on first year university students. Evaluation will focus on four key elements: motivation, experience, knowledge and reflection.

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