Enhancing Programming Lectures Using Interactive Web-Based Lecture Slides

Paul Albinson
Faculty of Science and Technology
Bournemouth University
palbinson@bournemouth.ac.uk

Abstract

Programming is often seen as a difficult subject to teach and keep students engaged and motivated about. Also programming results are frequently found to be lower than for other subjects (Bennedsen & Caspersen, 2007; Jenkins, 2002; Robins, Rountree, & Rountree, 2003). Therefore, the challenge is to find a way of improving programming education to address these problems. This paper considers the use of innovative pedagogy approaches to do this due to their ability to enhance learning experiences. An innovative pedagogy case study is presented that was designed to test whether interactive web-based lecture slides can enhance programming lectures to make them more engaging and enjoyable and make programming easier to understand. The lecture was an introduction to the jQuery JavaScript library/framework for first year undergraduates. Results were overall positive and show value for approaches like this and that they can enhance lectures to make them more engaging and enjoyable and can be used to make programming easier to understand.

Keywords: Web Technologies, Interactive Web-Based Lecture Slides, Innovative Pedagogy, Programming, Tackling High Failure Rates, Technology Enhanced Learning, TEL, Reveal.js

1. Introduction

Diligent academics frequently look for ways to improve their teaching practices and potential to introduce curricula changes that can enhance teaching, student motivation and engagement, student outcomes, etc. (Albinson, 2016; Vieluf, Kaplan, Klieme, & Bayer, 2012). One way of doing this is by using innovative pedagogy approaches which, as many studies that have tried such approaches (such as Morley (2012), Vieluf et al. (2012), and Higher Education Academy (ca. 2015)) have found, can enhance learning experiences which can lead to better student outcomes due to more engaged and motivated students. Considering these findings, the author wished to see if an innovative pedagogy approach can help improve programming teaching to tackle difficulties with teaching the subject.

Having reviewed a number of contemporary pedagogic innovations, for example Technology Enhanced Learning (Gordon, 2014; Kirkwood & Price, 2014), Blended Learning (Blended Learning Toolkit, ca. 2015; Friesen, 2012), Flipped Classrooms (Brame, ca. 2015; Herreid & Schiller, 2013) and use of web technologies (Anderson, 2007; Gosper et al., 2008), the author chose to explore using web technologies. The rationale being it offers opportunities for: flexible learning (flexibility for where, when and how students wish to learn), the use of technology to enhance learning, and the ability to create a more active student-centred andragogical learning experience; also other researchers (Gosper et al., 2008; Morley, 2012) have found web technologies are useful for enhancing learning experiences and outcomes, student engagement, motivation etc. This andragogical approach is advised for adult learning and will appeal to the way adults prefer to learn, and research has found it can increase engagement and enhance learning and the student experience (Albinson, 2016; Knowles, Holton, & Swanson, 2011). It should also help enhance lectures and make the format more effective which should help tackle the difficulties with teaching programming.

Programming (both web programming and traditional software programming) is often seen as a difficult subject to teach and keep students engaged and motivated about (Bennedsen & Caspersen, 2007; Jenkins, 2002; Wray, 2007). Empirical evidence and research (Bennedsen & Caspersen, 2007; Robins et al., 2003) has found results for programming are frequently lower than for other subjects and engaging students in the subject is difficult.

One reason for the problems with teaching programming could be due to the way it is taught with the traditional lecture format perhaps being inappropriate for the subject. Traditionally lectures for programming have consisted of explanations of concepts and syntax with blocks of related sample code displayed to show how they are used. As this approach is purely theoretical and doesn't show the output of code students may struggle to understand the concepts being explained as they don't see what the code does. However, if code output could be shown on the screen then programming should become more understandable. Research by Lahtinen et al. (2005) suggests this would aid learning as they found via a student survey that learning by doing, where students tried code themselves thus seeing how it works, was seen as more useful than traditional lectures. Therefore, if seeing what code does aids understanding then enhancing lectures with examples of how code works should be beneficial.

However, the problem with traditional presentation software is it is designed to display text, images and videos from a central screen in a passive way (Matheson, 2008; Young, Robinson, & Alberts, 2009). There is no option to embed code to show how it works and no way for the audience to interact with the content. However, with modern web technologies we can create web-based presentations that can include more advanced features such as demonstrations of code and tests within the presentation which students can interact with to aid their understanding. This can make lectures a more active (and less passive) student-centred andragogy focused experience which is beneficial for adult learning and aiding engagement (Albinson, 2016; Knowles et al., 2011). This is not only useful for teaching programming, it can assist understanding of any subject via active involvement in the learning process and interactive features (for example tests) to aid memory recall and help students construct their own understanding of a concept following the constructivist and cognitivist learning theories (Blondy, 2007; Petty, 2014).

This paper presents a case study designed to test whether interactive web-based lecture slides can enhance programming lectures to make them more engaging and enjoyable and make programming easier to understand. The lecture was an introduction to the jQuery JavaScript library/framework for first year undergraduates. The session was evaluated via an anonymous voluntary student feedback survey; unfortunately, attendance of the lecture was poor and only 36 students completed the survey. Therefore, results simply provide an initial small sample to evaluate the value of this innovation with a larger sample required to validate the findings. It did however present interesting positive results that show value for approaches like this and that they can enhance lectures to make them more engaging and enjoyable and can be used to make programming easier to understand.

2. Case Study - Interactive Web-Based Lecture Slides

In response to the problems discussed about difficulties teaching programming a case study of a potential solution was created using an innovative pedagogy strategy.

This case study introduces a web-based presentation solution using Reveal.js (El Hattab, ca. 2015) which is a web-based slideshow system similar to traditional presentation software such as Microsoft PowerPoint; it uses HTML5, CSS and JavaScript for the basic presentation and Node.js and Socket.IO for more advanced features. This web-based approach with the option of utilising server technology for adding advanced features allows for presentations which are more flexible and can include a wider variety of content and interactive elements enabling a more active learning experience rather than the passive experience of traditional presentations/lectures.

As web-based slides are created using web technologies each slide is a web page allowing programming to be demonstrated directly within the presentation; instead of saying this code does X requiring the audience to imagine the code in action (the traditional presentation approach) the presenter/lecturer can actually demonstrate what the code does. Not only could this demonstrate actual web programming code in action (for example when teaching HTML or JavaScript) it can also be used to demonstrate code examples from traditional software programming languages too. However, when the code isn't from a native web programming language/technology (e.g. it is from a traditional software programming language like C#) you can't run the code directly within the presentation but you can show the code and use other web technologies (e.g. JavaScript) to

demonstrate/simulate how it is meant to work; i.e. show C# code but use JavaScript to create the output of what the C# code does (you wouldn't even see the JavaScript code that is being used).

Reveal.js (El Hattab, ca. 2015) also has the option of having master and client presentations (reveal.js refer to this as multiplexing) to allow the audience to see and interact with the presentation on their own devices. This means there are two versions of the presentation, the master presentation which the presenter uses and shows in the lecture theatre (usually via a projector), and a client presentation which the audience can access on their own devices (such as a tablet computer, laptop, or mobile phone). The master presentation controls the client presentation allowing the presenter to control what the audience sees on their own devices; whatever slide is shown on the master presentation is what appears on the client presentation. When the audience use the client presentation option on their own devices it offers a variety of advantages such as:

- A better viewing experience as the presentation is in front of them rather than on a screen at the side of the room which may not be easy for them to see. Reading text is also easier.
- Improved accessibility: should the audience member need the text size increasing or colours adjusting they can do this on their own device.
- The ability for the audience to interact with the slides, so for example if there is a demonstration of some code which is interactive (e.g. click a button to make something happen) they can try it on their own device.
- When tests are added to the presentation (made possible due to the use of web technologies) it allows the audience to answer questions using their own device for self-testing their understanding to highlight areas they need to study further or seek advice on (hopefully increasing questions asked in the session and audience participation). This is useful formative feedback and student-centred learning.

Therefore, not only does a web-based system allow for more features than a traditional presentation it can also allow the audience to access the presentation on their own device and interact with it. Additionally, as it is web-based it can be hosted online for students to access it anytime anywhere with an internet connection to refresh and self-test their knowledge of the topics covered, try code demonstrations etc. Also research (Gosper et al., 2008) has found online content helps students take control of their learning and become less reliant on the teacher. Reveal.js also has many other useful features such as exporting the presentation to PDF, speaker notes, and many plugins to add extra features.

To investigate the potential of using such a system a lecture was created that used interactive web-based lecture slides. The slides used multiplexing (master and client presentations) and included interactive content for the students to use on their own devices, tests for students to check their own knowledge, and demonstrations of code. It was an introduction to the jQuery JavaScript library/framework for first year undergraduates[1]. It was loosely based on content from a similar lecture from previous years but instead of traditional slides using Microsoft PowerPoint it used interactive web-based lecture slides. You can see the presentation at http://presentations.paulalbinson.info/jquery-introduction; this is the version the audience would use (the client version) to see it on their own devices, interact with code demonstrations and tests, use it anytime afterwards, and so forth[2].

The session was evaluated via an anonymous voluntary student feedback survey[3]. It asked for opinions on statements regarding learning and understanding, session organisation and clarity, teaching, interactive web-based lecture slides, general opinions, and views on the lecture compared to regular lectures; possible answers/responses were Strongly Disagree, Disagree, Agree and Strongly Agree. A middle neutral answer/opinion "Neither Agree or Disagree" was excluded for the majority

1 The lesson plan can be requested from the paper's author via email.

2 The master version is accessed via a separate link but this link has not been included because using it would change the slides of anyone using the client version therefore it should only be used in a lecture.

3 The survey form can be requested from the paper's author via email.

of questions to force students to think more carefully about their answers and to avoid indecision and the temptation of answering with the middle/neutral option. Research (Albinson, 2013; Garland, 1991; Johns, 2010) has found that when surveys have middle/neutral options people are tempted to choose them to avoid making decisions or to avoid questions they don't like or don't understand, or they feel this response would help or please the interviewer/researcher (e.g. they may not wish to give a harsh or negative response), causing undesirable results. It was however allowed for the questions about comparing the case study lecture to regular lectures as it is feasible for students to be indifferent over lecture styles; although of course it increases the chance of undesirable results. There was also a free text box for any comments students wished to make about the session such as things they liked or disliked, areas that could be improved etc. Results are discussed later in this paper.

3. Reflection on Related Literature and Learning Theories

3.1 Is it Blended Learning?

The case study's hybrid approach of using technology and traditional class-based teaching is a type of Technology Enhanced Learning (TEL). It shares some characteristics of blended learning as it uses technology to improve the learning experience and for students to use technology to enhance their learning both inside and outside the classroom. However, while sharing the ideals of blended learning of using technology to assist in the delivery of course content it is not replacing any part of the learning with online delivery, it compliments rather than replaces lecture content delivery, and so in that respect it isn't blended learning. It meets older definitions of blended learning as discussed by Oliver and Trigwell (2005) which described adding some aspect of online learning to the learning experience but it does not meet the more modern understanding and standard definition of blended learning like discussed by later literature (Blended Learning Toolkit, ca. 2015; Christensen, Horn, & Staker, 2013; Friesen, 2012); the modern definition also specifies that some aspect of the learning must be replaced by an online component like for example using the flipped classroom approach where some taught content is delivered online releasing the lesson time for other activities.

When the web-based lecture slides are presented in a lecture at an educational institution it probably isn't blended learning but when the students use the slides outside the classroom to aid their learning, thus taught content is delivered online, it is blended learning. Also as the lecturer can control the slides the audience sees and everyone's slides are in sync it would be possible to run the presentation remotely with the audience offsite (and perhaps even the lecturer too) if audio (and ideally video) of the lecturer is added; a method for communicating with the students would also be a useful addition. This delivery would be blended learning as long as it was only part of the course; if the whole course is online it would be online learning.

Therefore, whether a session like the case study is considered blended learning or simply just a use of Technology Enhanced Learning depends on your opinion of what defines blended learning and/or whether the lecture is delivered remotely.

3.2 Student-Centred Learning

Use of web-based lecture slides including additions of interactive elements helps to make lectures more student-centred by helping learners construct their own understanding of content and also makes lectures a more active rather than passive experience. As research has found (Albinson, 2016; Knowles et al., 2011) adults prefer an andragogical student-centred approach as it appeals to their learning preferences and desire for independence, self-direction and self-learning. While the case study is not fully student-centred as it is still a pedagogical teacher-led lecture to allow the teacher to impart the knowledge students need to know this is not necessarily a problem. While in general an andragogical student-centred approach to teaching tends to be preferred by students, especially as learners mature, it is sensible and necessary to use a pedagogical teacher-led approach to introduce new content due to students' lack of prior knowledge or experience of the content (Albinson, 2016; Knowles et al., 2011). Also as the content is designed to be suitable for self-study and revision outside the classroom with aids to assist self-learning, such as code demonstrations and tests, it supports andragogy in this respect.

3.3 Learning Theories

The case study lecture, like traditional lectures, primarily takes a didactic passive pedagogical teacher-led approach which mostly follows the behaviourist learning theory as it treats learners as dependents with no free will and dictates how they will learn (Petty, 2014). In this case it is due to the learners' inexperience and lack of knowledge of the content meaning students need to be introduced to the content before they can actively participate in lessons. However, with the web-based interactive lecture slides allowing students to be more actively involved in the lecture the teacher can reduce the behaviourist style and use other more andragogical student-centred learning theories. As discussed, this will appeal to the way adults prefer to learn and research has found it can increase student engagement (Albinson, 2016; Knowles et al., 2011).

By showing students how code works and providing demonstrations they can interact with along with the self-testing elements helps students construct their own understanding of the content. This aligns with constructivism which is based on the belief that learning is most effective when learners construct their own meanings for subjects based on existing knowledge and experiences. It also aligns with cognitivism's approach of building understanding/cognition based on previous knowledge to assist learning and aid memory recall (Blondy, 2007; Petty, 2014). Cognitivism also advocates learning by doing/practical learning and providing challenging questions to analyse concepts and develop a deeper understanding (Petty, 2014) which this approach facilitates. Students' knowledge at the beginning of the lecture may be minimal but as they see how code works and can test their knowledge via the tests they can build up knowledge by linking past knowledge, for example how something works in a previous basic example, to later more complex concepts and examples. In addition, it aids self-learning, especially if students make use of the lecture slides outside of taught sessions to aid their learning which links with humanism's belief of allowing students freedom to learn independently and develop in any way they prefer (Petty, 2014). Social learning theory (Petty, 2014) isn't used as it relies on students learning via social interaction and there isn't time to allow such activities to occur in the limited time available in a lecture. However, students could make use of the self-study opportunities that this approach supports for social learning via, for example, group study and discussions amongst themselves.

4. Survey Results

The results were overall positive with the majority of responses being agree or strongly agree. Additional comments (omitted to save space) were also overall positive but some students cited minor concerns and made suggestions for improvements, these and full survey responses can be requested from the author via email. Unfortunately, attendance of the lecture was poor and only 36 students completed the survey making this just an initial small sample to evaluate the value of this innovation with a larger sample required to validate the findings.

4.1 Learning and Understanding

The results of questions relating to learning and understanding were overall positive. These questions related to the aims/learning outcomes of the session so the results give some indication as to whether the lecture can deliver the required learning for the aims to be met. All students felt they gained a better understanding of jQuery as a result of the lecture with 75% agreeing (27 students) and 25% strongly agreeing (9 students). As jQuery uses JavaScript (it is a JavaScript library) students' opinions on if the session had improved their understanding of JavaScript was also questioned. Results were overall positive with 75% agreeing (27 students) and 8.33% strongly agreeing (3 students). The remaining results were 13.89% disagree (5 students) and 2.78% strongly disagree (1 student). These results are encouraging but there was some negativity which could perhaps be because students don't see the relationship between jQuery and JavaScript and that code used for jQuery is actually JavaScript code; improving clarity of this point would be worthwhile for future uses of the lecture.

Students were also asked about whether they had a better understanding of JavaScript libraries and frameworks as a result of the lecture and if they see the usefulness of them for supporting project development and reducing development time; for example, such libraries simplify complex operations by having functions that deal with the complexity. Overall students felt they understood JavaScript libraries and frameworks better after attending the lecture with 80.56% agreeing (29 students) and

2.78% strongly agreeing (1 student) but 16.67% disagreed (6 students), note nobody strongly disagreed. Overall opinions on the usefulness of JavaScript libraries and frameworks for supporting development were positive with 61.11% agreeing (22 students) and 30.56% strongly agreeing (11 students) they are useful, while the rest disagreed (8.33% - 3 students), note nobody strongly disagreed. The presence of disagreement in the responses for both of these statements indicates some students don't understand the point of JavaScript libraries and frameworks so perhaps more time should be spent explaining this if the lecture were repeated.

4.2 Session Organisation and Clarity

Students were asked for their opinions on session organisation and clarity of its content. The majority (94% - 34 students) felt the session was well organised, with 69.44% agreeing (25 students) and 25% strongly agreeing (9 students), with the only negativity being 5.56% disagreeing (2 students). Results are similar on slides being clear and informative[4] with 94% positive responses (34 students) but with a larger proportion strongly agreeing (36.11% - 13 students). Opinions on information being concise were almost identical, with 55.56% agreeing (20 students) and 36.11% strongly agreeing (13 students), although with a slightly larger amount disagreeing (8.33% - 3 students). With such low levels of disagreement for all 3 questions these results are very encouraging for continuing lectures in this style, however investigating reasons for the negativity (albeit small) would be useful.

4.3 Teaching

Opinions were collected on how well the session was taught to allow the teacher to reflect on their teaching practice. Students overall were happy with the teaching with most responses being positive. The majority of students felt the lecture was clearly presented with 52.78% agreeing (19 students) and 33.33% strongly agreeing (12 students), however 13.89% disagreed (5 students). Almost identical to this were the opinions on whether the teacher made content easy to understand which is no surprise as they are similar (clarity aids understanding). The majority of responses were positive with 58.33% agreeing (21 students) and 30.56% strongly agreeing (11 students) with only 11.11% disagreeing (4 students) and nobody strongly disagreeing. Opinions on whether students liked the teacher's lecturing/presenting style were a little more mixed but still overall positive, 47.22% agreed (17 students) and 30.56% strongly agreed (11 students) but 19.44% disagreed (7 students) and 2.78% strongly disagreed (1 student). The teacher was reasonably inexperienced at presenting lectures at the time so these opinions are understandable and surprisingly very positive for a novice.

4.4 Interactive Web-Based Lecture Slides

Opinions were gathered about interactive web-based lecture slides to assess whether students feel using them is worthwhile. Results were overall very positive and encouraging. Most students found the code displayed on the slides was clear and easy to read with 97% positive responses (35 students), 69.44% agreed (25 students) and 27.78% strongly agreed (10 students), with the only negativity being 2.78% disagreeing (1 student). All students felt the demonstrations of what code does was useful for aiding their understanding with 63.89% agreeing (23 students) and 36.11% strongly agreeing (13 students).

The interactive elements were also well received with only small amounts of negativity. 94% (34 students) felt having test questions is useful to identify areas they need to study further (61.11 agreed (22 students) and 33.33% strongly agreed (12 students)), with the only negativity being 2.78% disagreeing (1 student)[5]. Most students felt being able to interact with the presentation was useful with 89% positive responses, 50% agreed (18 students) and 38.89% strongly agreed (14 students), with the only negativity being 8.33% disagreeing (3 students)[6]. The majority found the interactive elements made the lecture more enjoyable and engaging with 94% positive responses (34 students), 58.33% agreed (21 students) and 36.11% strongly agreed (13 students), with the only negativity being 5.56% (2 students) disagreeing. Most students agreed that web-based lecture slides should be used in future

[4] 58.33% agreed (21 students), 36.11% strongly agreed (13 students) and 5.56% disagreed (2 students), note nobody strongly disagreed.

[5] Note 1 student (2.78%) didn't add an answer/opinion

[6] Note 1 student (2.78%) didn't add an answer/opinion

with 86% positive responses (31 students), 55.56% agreed (20 students) and 30.56 strongly agreed (11 students), with only 8.33% disagreeing (3 students) and 2.78% strongly disagreeing (1 student)[7].

These responses are very supportive of using interactive web-based lecture slides, and the reasons they were used for (features and benefits) were positively received.

4.5 General Opinions

When asked more general questions about the lecture students' opinions were diverse. When asked if they thought the lecture would make them better web developers or designers 92% of responses were positive (33 students), 77.78% agreeing (28 students) and 13.89% strongly agreeing (5 students), with the only negativity being 8.33% disagreeing (3 students). The results for whether students felt the lecture would enhance their future work and grades achieved were a little more mixed but still overall positive with 78% positive responses (28 students), 63.89% agreeing (23 students) and 13.89% strongly agreeing (5 students); there were however 11.11% of respondents who disagreed (4 students) and 8.33% who strongly disagreed (3 students)[8]. This negativity is confusing as it conflicts with opinions on other questions relating to the value of the lecture which have much lower negativity.

When asked whether they would recommend the session is repeated in future years there were 97% positive responses (35 students), 69.44% agreed (25 students) and 27.78% strongly agreed (10 students), with unfortunately the remaining 3% strongly disagreeing (1 student). When asked if the session was valuable and they were glad they attended it the results were a little less positive with 89% of responses being positive (32 students), 69.44% agreed (25 students) and 19.44% strongly agreed (7 students), with the rest being 8.33% disagree (3 students) and 2.78% strongly disagree (1 student). The additional negativity between these two questions is confusing because if students say the session is worth repeating but they saw no value in it then why are they making the recommendation? Also overall responses to all statements were positive thus saying the session is worthwhile further conflicting with these findings.

4.6 Comparison to Traditional Lectures

Finally, students were asked for their opinions on whether the lecture was better in comparison to traditional (PowerPoint based) lectures. These questions allowed a response of "Neither Agree or Disagree" as it is perfectly feasible to be indifferent over lecture styles. When asked if they felt they learned more in the lecture compared to regular lectures the majority of responses were positive (58% - 21 students), with 38.89% agreeing (14 students) and 19.44% strongly agreeing (7 students), and there were only 2.78% negative responses (1 student) which were disagree responses. 38.89% (14 students) however chose "Neither Agree or Disagree" perhaps meaning they felt they learned the same amount compared to regular lectures or it could mean they wanted to avoid answering the question or they didn't understand the question. When asked about if they enjoyed the lecture more in comparison to regular lecturers there was less neutrality with only 16.67% saying "Neither Agree or Disagree" (6 students). A much larger proportion of the responses were positive (81% - 29 students) with 58.33% agreeing (21 students) and 22.22% strongly agreeing (8 students); also, just like the previous question, 2.78% disagreed (1 student). Indecision aside this is very encouraging as those with an opinion were mostly positive about the style of lecture and there was only 2.78% negativity (1 student) on both questions.

[7] Note 1 student (2.78%) didn't add an answer/opinion

[8] Note 1 student (2.78%) didn't add an answer/opinion

5. Discussion

Feedback was overall very positive and showed the aims of the session have been met; however, investigating reasons for the negativity (albeit small) would be useful.

Overall students thought the lecture was useful for aiding their understanding of the lecture content and that the interactive elements helped enhance their learning. They saw value in the session and enjoyed it and recommend it is repeated in future. Responses also show interactive web-based lecture slides are useful for maintaining engagement and motivation and students thought they should be used more in future.

Students consider the use of clearly displayed code, interactive demonstrations of code outputs and self-testing opportunities useful for making programming easier to understand which satisfies one of the main aims of the case study.

Additionally the case study lecture showed how interactive web-based lecture slides can make lectures a more active andragogical student-centred learning experience helping address the passive nature of lectures which, as discussed, is beneficial for adult learning and aiding engagement (Albinson, 2016; Knowles et al., 2011).

Some students ignored some questions perhaps suggesting they didn't understand the questions or simply didn't want to answer them. Similarly, for questions where a neutral/middle answer/option was available many chose it which could be due to no preference or indecision, or given the other unanswered questions it may be due to misunderstanding of questions or unwillingness to answer. This overuse of the neutral/middle answer/option corresponds with findings from other research (Albinson, 2013; Garland, 1991; Johns, 2010) which found including such an option can result in undesirable results; it is for this reason that the author was reluctant to include such a response and only added it where it was absolutely necessary.

Unfortunately, attendance of the lecture was poor and only 36 students completed the survey making this just an initial small sample to evaluate the value of this innovation with a larger sample required to validate the findings. Also, assessing this approach over multiple sessions would be advantageous to produce more results to allow deeper analysis to take place. Additionally, with the experiment running over a longer period it would allow for more detailed assessment methods to be used giving more evidence of improved learning and one could also assess success rates compared against previous years where this approach wasn't used.

6. Conclusion and Future Improvements

As discussed, programming can be a challenging subject to teach and keep students engaged and motivated about and programming results are typically lower than for other subjects (Bennedsen & Caspersen, 2007; Jenkins, 2002; Robins et al., 2003). Therefore, the challenge is to find a way of improving programming education to address these problems. This paper considered the use of innovative pedagogy approaches to do this due to their ability to enhance learning experiences. An innovative pedagogy case study was presented that was designed to test whether interactive web-based lecture slides can enhance programming lectures to make them more engaging and enjoyable and make programming easier to understand.

The way programming is taught was queried and whether the use of lectures could be to blame for the problems with teaching programming. Traditional programming lectures are a passive experience delivered in a didactic pedagogical way containing explanations of concepts and syntax with blocks of related sample code displayed to show how they are used. As this approach is purely theoretical and doesn't show the output of code students may struggle to understand the concepts being explained as they don't see what the code does. However, if code output could be shown on the screen then programming should become more understandable.

However, the problem with traditional presentation software is it is designed to display text, images and videos from a central screen in a passive way (Matheson, 2008; Young et al., 2009). There is no option to embed code to show how it works and no way for the audience to interact with the content. However, with modern web technologies we can create web-based presentations that can include more advanced features such as demonstrations of code and tests within the presentation which students can interact with to aid their understanding. This can make lectures a more active andragogical student-centred learning experience helping address the passive nature of lectures which, as discussed, is beneficial for adult learning, helping learners construct their own understanding of content, and encouraging engagement (Albinson, 2016; Knowles et al., 2011).

The interactive web-based lecture slides case study presented here used this approach and results were overall positive and show value in approaches like this and that they can enhance programming lectures to make them more engaging and enjoyable and make programming easier to understand. However, it was only one session with a small amount of students completing the survey, therefore to properly assess this approach a wider sample over multiple sessions would be advantageous to produce more results to allow deeper analysis to take place. Additionally, with the experiment running over a longer period it would allow for more detailed assessment methods to be used giving more evidence of improved learning and one could also assess success rates compared against previous years where this approach wasn't used. Also wherever there is significant negativity, especially relating to content students don't fully understand, the lecture will be revised accordingly to address the problems.

7. References

Albinson, P. (2013). Computing in Education: A study of computing in education and ways to enhance students' perceptions and understanding of computing. (MSc Thesis), Bournemouth University, Bournemouth University.

Albinson, P. (2016). Exploring Student Engagement and Disengagement in University Education, Can Vocational Activities/Practice-Based Learning Help? Paper presented at the The 21st Annual INSPIRE (International conference for Process Improvement, Research and Education) Conference, Bournemouth. online retrieved from http://eprints.bournemouth.ac.uk/23376

Anderson, P. (2007). What is Web 2.0? Ideas, technologies and implications for education. JISC Technology and Standards Watch, Feb. 2007. Retrieved from Bristol: http://www.jisc.ac.uk/media/documents/techwatch/tsw0701b.pdf

Bennedsen, J., & Caspersen, M. E. (2007). Failure rates in introductory programming. ACM SIGCSE Bulletin, 39(2), 32-36. doi:10.1145/1272848.1272879

Blended Learning Toolkit. (ca. 2015). What is Blended Learning? Retrieved from https://blended.online.ucf.edu/about/what-is-blended-learning

Blondy, L. C. (2007). Evaluation and Application of Andragogical Assumptions to the Adult Online Learning Environment. Journal of Interactive Online Learning, 6(2), 116-130.

Brame, C. J. (ca. 2015). Flipping the Classroom. Retrieved from http://cft.vanderbilt.edu/guides-sub-pages/flipping-the-classroom

Christensen, C. M., Horn, M. B., & Staker, H. (2013). Is K-12 Blended Learning Disruptive? Retrieved from San Mateo, California: http://www.christenseninstitute.org/wp-content/uploads/2014/06/Is-K-12-blended-learning-disruptive.pdf

El Hattab, H. (ca. 2015). Reveal.js. Retrieved from https://github.com/hakimel/reveal.js

Friesen, N. (2012). Report: Defining Blended Learning. Retrieved from http://learningspaces.org/papers/Defining_Blended_Learning_NF.pdf

Garland, R. (1991). The Mid-Point on a Rating Scale: Is it Desirable? Marketing Bulletin, 2.

Gordon, N. (2014). Flexible Pedagogies: technology-enhanced learning. Retrieved from York: https://www.heacademy.ac.uk/sites/default/files/resources/tel_report_0.pdf

Gosper, M., Green, D., McNeill, M., Phillips, R., Preston, G., & Woo, K. (2008). The Impact of Web-Based Lecture Technologies on Current and Future Practices in Learning and Teaching. Retrieved from Sydney: http://mq.edu.au/ltc/altc/wblt/research/report.html

Herreid, C. F., & Schiller, N. A. (2013). Case Studies and the Flipped Classroom. Journal of College Science Teaching, 42(5), 62-66.

Higher Education Academy. (ca. 2015). Innovative pedagogies. Retrieved from https://www.heacademy.ac.uk/workstreams-research/workstreams/innovative-pedagogies

Jenkins, T. (2002). On the Difficulty of Learning to Program. Paper presented at the 3rd Annual Conference of the LTSN Centre for Information and Computer Science. online retrieved from http://www.psy.gla.ac.uk/~steve/localed/jenkins.html

Johns, R. (2010). Likert Items and Scales. Retrieved from Glasgow: http://www.becomeanengagedemployee.com/wp-content/uploads/2012/06/likertfactsheet.pdf

Kirkwood, A., & Price, L. (2014). Technology-enhanced learning and teaching in higher education: what is 'enhanced' and how do we know? A critical literature review. Learning, Media and Technology, 39(1), 6-36.

Knowles, M. S., Holton, E. F., & Swanson, R. A. (2011). The Adult Learner: The Definitive Classic in Adult Education and Human Resource Development (7th ed.). Oxford: Elsevier.

Lahtinen, E., Ala-Mutka, K., & Jarvinen, H.-M. (2005). A Study of the Difficulties of Novice Programmers. Paper presented at the ITiCSE'05, Monte de Caparica, Portugal. online retrieved from http://dl.acm.org/citation.cfm?id=1067453

Matheson, C. (2008). The educational value and effectiveness of lectures. The Clinical Teacher, 5(4), 218-221. doi:10.1111/j.1743-498X.2008.00238.x

Morley, D. A. (2012). Enhancing networking and proactive learning skills in the first year university experience through the use of wikis. Nurse Education Today, 32(3), 261-266. doi:10.1016/j.nedt.2011.03.007

Oliver, M., & Trigwell, K. (2005). Can blended learning be redeemed? E-Learning, 2(1), 17–26.

Petty, G. (2014). Teaching Today: A Practical Guide (5th ed.). Oxford: Oxford University Press.

Robins, A., Rountree, J., & Rountree, N. (2003). Learning and Teaching Programming: A Review and Discussion. Computer Science Education, 13(2), 137-172. doi:10.1076/csed.13.2.137.14200

Vieluf, S., Kaplan, D., Klieme, E., & Bayer, S. (2012). Teaching Practices and Pedagogical Innovation: Evidence from TALIS. Retrieved from Paris: http://www.oecd.org/education/school/TalisCeri%202012%20%28tppi%29--Ebook.pdf

Wray, S. (2007). SQ Minus EQ can Predict Programming Aptitude. Paper presented at the Proceedings of the 19th Annual Workshop on Psychology of Programming, PPIG 2007, Joensuu, Finland. online retrieved from http://www.ppig.org/papers/19th-Wray.pdf

Young, M. S., Robinson, S., & Alberts, P. (2009). Students pay attention!: Combating the vigilance decrement to improve learning during lectures. Active Learning in Higher Education, 10(1), 41-55. doi:10.1177/1469787408100194