By hook or by crook: Designing physics video hooks with a modified ADDIE framework

By Hook or by Crook: Designing physics video hooks with a modified ADDIE framework.

McHugh, M. [1*], McCauley, V.[1]

[1]School of Education, College of Arts, Social Sciences, & Celtic Studies, National University of Ireland, Galway, Ireland.

corresponding author email address: m.mchugh2@nuigalway.ie

Abstract

This paper delineates the specific design strategy used in the creation of physics video hooks over the course of an eight week project. A hook, is an instructional technique which stimulates student attention (Hunter, 1994; Lemov, 2010), interest (Jewett Jr, 2013) and engagement (McCrory, 2011; Riendeau, 2013). The hook videos are aimed at 12 – 15 year olds with relevant topics being selected from the Irish junior science curriculum. The project employed a modified ADDIE (Analysis, Design, Development, Implementation and Evaluation) design framework that allowed videos to be developed in an efficient and practical manner. The videos are aligned with multimedia principles and cognitive load theory. Furthermore, specific design elements are embedded into the videos, which include relevance, questioning, discrepancy and novelty. Finally, the key findings and challenges encountered during the project are examined.

Keywords: Hook, Instructional Design, Video, Physics

Introduction

Coffman (2003, p. 2) asks "Wouldn't it be great if our students came to class prepared – not just having read the assignment, but mentally prepared as well – alert and ready to debate, challenge, interact, and contribute?". As such, the author advocates that students should anticipate a teaching strategy that provokes these attributes and enthuses them into an active state of learning from lesson introduction. Hooks are any form of pedagogy that catch attention and serve as an enticement for learning. They are different from other teaching resources in that they are specifically designed to augment interest and attention among learners. Hooks represent an instructional method used to garner attention(Hunter, 1994;

Lemov, 2010; McCauley, Davidson, & Byrne, 2015) foster interest (Jewett Jr, 2013; Marinchech, 2013) and create engagement (McCrory, 2011; Riendeau, 2013).

The purpose of the study reported here was to design and construct an instructional resource that would act as an effective hook when applied to science classrooms with second level students (11 – 15 years). This paper stems from a collaborative design project with pre-service science teachers and educators at the National University of Ireland, Galway. As part of this project, six pre-service science teachers were recruited to work with a science and technology educator. Working in separate pairs, the goal was to design a suite of physics, chemistry and biology video hooks. This paper will delineate the specific design strategy used in the creation of the physics video hooks over the course of the eight week project. The development employed a modified ADDIE instructional design framework. This involved the removal of the implementation phase and the instigation of an enhanced evaluation step to compensate. This paper delineates how the physics video hooks were created by examining each phase of the instructional model followed.

Instructional Design Framework

The creation of the physics video hooks employed an instructional design framework. Instructional design refers to the detailed design and evaluation of instructional materials to facilitate learning and performance (Martin, Hoskins, Brooks, & Bennett, 2013). It is a systematic and iterative approach to developing educational materials and programs (Smith & Ragan, 1999). The goal behind instructional design is to follow a process that can make instruction more effective (Gustafson & Branch, 2002). Merrill (2002) states how instructional design can be used for the generation of learning products and video hooks represent a learning product for the science classroom.

Modified ADDIE Framework

The instructional design framework initially utilised during this project was the ADDIE framework. ADDIE stands for Analysis, Design, Development, Implementation and Evaluation (Gustafson & Branch, 2002). The ADDIE model provides dynamic and flexible guidelines for the construction of teaching and learning tools (Moradmand, Datta, & Oakley, 2014). It is a common approach used in the development of instructional programs and training courses. The process is considered to be iterative and sequential (Molenda, 2003). The ADDIE design is a generic model in which any type of instructional material can be created (Martin et al., 2013).

The hooks project worked through every phase of the ADDIE model. However, it was not within the scope of the project to complete the implementation stage. Implementation of the videos would have involved school testing by science teachers with associated feedback (the implementation phase is currently being conducted as part of the primary author's doctoral research). The hooks were designed and created within the remit of an eight week project based in the summer months meaning this was unfeasible. Therefore, the exact instructional design model used was a four stage model instead of five (Figure 1) changing ADDIE to ADDE*. To compensate, the project used an enhanced evaluation stage.

It should be noted that the ADDE* model followed was not linear. For convenience, steps may be presented in an undeviating manner, however, designers transition in and out of phases as needed. This allows for a 'self-corrective' strategy in which mistakes can be identified and corrected at almost any stage of the design (Gustafson & Branch, 2002).

Analysis
- Analysis of teacher needs and requirements
- Analysis of student needs and requirements
- Identification of instructional techniques used to augment attention, interest and engagement
- Selection of digital video as hook medium

Design
- Establishment of specific goals and objectives to be completed
- Alignment of design with the principles of Cognitive Load Theory
- Alignment of design with Multimedia principles
- Selection of curriculum relevant topics to base video content
- Delineation of design elements to be tested during development phase

Development
- Refinement and testing of hook video content and specific design elements
- Collaboration with camera man through story boarding process
- Direction and recording physics video hooks

Evaluation *
- Formative weekly evaluation based upon group meetings with corrections/modifications
- Subjective expert evaluation by teachers/designers
- Edits and revisions conducted

Figure 1. Summary of phases during the ADDE* model of instructional design

Analysis

The motivation behind the study was a disconnection between multimedia resources, the science curriculum, coupled with decreasing student numbers in physics and the type of students that exists in classrooms today. To address such issues, a detailed analysis of the following areas took place a) instructional techniques used to augment attention, interest and engagement among students, b) student needs and characteristics, and c) teacher needs and characteristics. In analysing the various components, a comprehensive literature review was undertaken.

Instructional techniques used to augment attention, interest and engagement

The first instructional technique specifically designed to stimulate the affective and cognitive constructs of attention, interest and engagement was 'set induction' as developed by Schuck (1969, 1970, 1981). Its aim is to focus pupil attention on a common object by scaffolding the introduction to a lesson and linking to the prior lesson (Perrott, 1982). However, within the set induction literature, it is never specifically detailed, how student attention should be attained. Indeed, this is a reoccurring theme throughout the surrounding literature with publications giving little guidance to educators on what exact instructional techniques can be used as a set or hook. This was one of the largest quandaries during the analysis phase. The only example the authors could find for teachers is delineated by Keller (2000). The author discusses the Attention, Relevance, Confidence and Satisfaction (ARCS) model in which the first step is getting student attention. Keller (2000, p. 2) suggests that a teacher can gain attention by creating unexpected events using "… a loud whistle, an upside-down word in a visual." We posit that such a strategy has limitations and would only grab attention for a limited period of time. This is more akin to what Mitchell (1993) notes as 'gimmicks' in class. They may get attention, but serve no purpose with regard to interest and engagement.

Anderman et al. (2004, p. 1) postulates that "Students often are not motivated to engage in academic tasks that are boring". Implicit within any theories of academic achievement, learning and motivation is the assumption that the student will pay attention. Motivational, interest and engagement theories are redundant if the student were to ignore instruction. Attention is a necessary precursor to cognitive processing. Motivational theories such as the Expectancy value theory and Goal orientation theory are widely advocated, however, they do not explain how instruction and tasks initially grab a learner's attention

(Anderman, Noar, Zimmerman, & Donohew, 2004). Educators have long espoused the imperative role of attention, interest and engagement in stimulating student learning (Dewey, 1913; Johnston & Roberts, 2011; Schraw, Flowerday, & Lehman, 2001). Hence the analysis phase revealed a need from a theoretical and practical perspective for resources that specifically target student attention in class.

Digital Residents

Analysing student needs in the science classroom led the project to take into account the makeup of today's students. A strategy needed to be developed which was much more rigorous in achieving the goal of being a dependable hook than those mentioned previously. However, Duffy (2007, p. 119) asks "how can we as educators engage the YouTube, Google-eyed generation?"

Our target audience, are often referred to as 'digital residents'(Connaway, White, & Lanclos, 2011; White & Le Cornu, 2011) or millennials (Steffes & Duverger, 2012). Education today has to compete with contemporary and instantaneous technology in grabbing student attention and maintaining their interest (Clifton & Mann, 2011). Such students command a wide range of digital resources to manage their social lives, but suffer from lower attention spans as they are habituated with a wide range of activities (Prensky, 2012). According to Clifton and Mann (2011), it is imperative that science education finds new ways of engaging such students. Based on the previous information the decision was made that some form of educational technology should be employed as the hook delivery method. Taking into account both user needs of teachers and students, digital video was the medium selected.

Digital video

As noted previously, the main consideration during the analysis phase is the target audience. In our case this refers to teachers and students within science (Peterson, 2003). From a teacher perspective, digital video was chosen due to its ease of use and dissemination. According to Andrews (2012) video can be 'pulled' by learners and 'pushed' by teachers. This means that learners can access the video at any time and teacher can present the content in a suitable pedagogical manner. Learners have increased control over their learning pace (Andrews J, 2012) and teachers through stopping and starting the video can achieve a 'bite size' delivery suitable to their needs (Fill & Ottewill, 2006).

From a student user perspective, the demographic of YouTube users aligns with the current demographic of students. Therefore, students are more likely to identify with the content (Steffes & Duverger, 2012). According to Jones and Cuthrell (2011) students make positive gains in learning outcomes from the inclusion of video technology in the classroom. Furthermore, video can also display hard to capture phenomena that are common in physics. It has the ability to present both static and moving material with additional animation to further highlight points (Harwood & McMahon, 1997). Video provides an information rich and realistic context, referred to by Kumar (2010, p. 14) as “macro-contexts”. This allows educators to teach about the processes and nature of science (Vaughan, 2004). Gilbert (2005, p. 37) states that “Conveying process in static diagrams is not straightforward”. Processes normally involve fluid movement and changes in structure. Students who find mental visualisation difficult are at a disadvantage in a science curriculum based on static diagrams. Therefore, physics video hooks have the potential to bring to life a number of moving processes grounded in a realistic context to benefit learners and teachers alike.

Although, one of the notable criticisms of using video as the hook delivery method is that many science videos can be found online especially on YouTube. One of the negatives of YouTube, however, is finding and selecting appropriate videos. Often video quality is lacking, videos are not entirely fitting or correct for teaching and learning environments (Trier, 2007). Another problem is commercials within video and suggested videos on the website that may not be appropriate for the classroom (Trier, 2007). Additionally, the structure of a YouTube video may not be suitable for instructional use as many videos are lengthy, use inapt language or are confusing and distracting (Berk, 2009). The hook videos are specifically built for the science classroom while being underpinned by the Irish science syllabus. The content is wholly relevant to science teaching. Furthermore, teachers do not have to ‘search’ for the videos as the entire suite was made available through a downloadable iBook on the iTunes store. https://itunes.apple.com/ie/book/physics-resource-hooks/id549475578?mt=13

Design

The information developed during the analysis phase provided the relevant data to assist in creating a design for effective physics video hooks. The design phase includes the identification of objectives to be completed and elements to be built into the videos (Peterson, 2003). During the design phase, objectives were defined that would embed a theoretical framework into the videos based upon the principles of a) cognitive load theory and b) multimedia design. Such principles were integral to the design and creation of the physics hook videos as moving images present new pedagogical hurdles to be overcome (Gilbert, 2005). Moving images are a natural way of presenting processes and this is one of the reasons for student enthusiasm. However, they are often far too fast and complex to be adequately perceived (Kozma, 1986; Spanjers, Wouters, Van Gog, & Van Merrienboer, 2011). There are sometimes too many moving parts occurring at various times. The mind and the eye are working together to figure out the process, but often cannot keep up. Some students don't even know what to focus upon (Gilbert, 2005). Both of the ideologies behind cognitive load theory and multimedia design will be described in the following sections. In addition, the specific strategies to align the physics hook videos with the principles of the former theories is demarcated.

Cognitive load theory

Cognitive load is concerned with the difficulty of material that is learned. It is suggested that to reduce load that information needs to be structured in a manner that reduces difficulty (Sweller, 1994). Cognitive load theory suggest that the capacity of working memory is limited. Hence, if a learning activity requires too much of this capacity, learning will be hampered (De Jong, 2010). It is suggested the design of instruction should be optimised to avoid cognitive overload (De Jong, 2010, Smith and Ragan, 1999). One of the core design goals was for the physics video hooks design to be aligned with this philosophy. As explained by Mayer and Moreno (2003), cognitive overload is an issue when processing demands exceed the learner's cognitive capacity. This is described as a "central challenge for instructors (including instructional designers)…" (Mayer and Moreno, 2003, p. 45). The following strategies were set out in the design phase to reduce cognitive load on students.

The most efficient way an instructional designer can reduce cognitive load is via streamlining the video content. Videos should be streamlined with the removal of any extraneous material as student's attention may focus on the incorrect aspects of a video. Student attention should be directed toward essential information (Mayer and Moreno, 2003, Berk, 2009). The two main streamlining methods include signalling and weeding. Signalling limits words and narratives, however, it highlights certain sections of interest or application (Spanjers et al., 2011). Signalling involves the highlighting of objects to focus attention. Such cues orientate the student through a video and facilitate the extraction of essential information. This also reduces extra cognitive load as the learner does not have to try to locate the most vital aspects intended for comprehension (Mayer and Moreno, 2003). This was done by placing words on screen at pivotal times. The example in Figure 2 is asking the viewer to explain the phenomena being observed by placing the word 'Explain?' on the screen.

Figure 2. Screenshot from the Sink or float physics video hook exhibiting the signalling principle

The second process is weeding where irrelevant information is removed from a multimedia project. This principle applies to sounds, words and visuals. Irrelevant information diverts attention away from the intended focus (Mayer and Moreno, 2003). This physics video hooks were kept as simple as possible.

Multimedia design

The multimedia principle states that deeper learning occurs when words and images are used over words alone (Mayer, 2002, 2003; Paivio, 1969, 1990). The promise of multimedia is that students can learn more effectively from well-designed multimedia applications combining both visual and word based platforms rather than traditional forms of instruction. Words are a single medium presentation format and the dominant vehicle for instruction (Mayer & Moreno, 2003). However, humans are adapted to interact with moving visual images, the same we encounter on a daily basis. Winkler (2005, p. 5) states that “80 – 90% of all neurons in the human brain are estimated to be involved in visual perception.” Humans naturally gravitate toward visual stimulation and this is potentially why Vaughan (2004) posits that multimedia can ‘electrify’ the action centres of peoples brains. Pertaining to multimedia design, there are two principles that were inserted into the physics video hooks.

The first is the multiple representation principle that suggests that it is better to present information in word and pictures rather than one alone. Two modes of representation are better than one. An example of which is highlighted in Figure 3. This is known as the multimedia effect (Mayer & Moreno, 1998). This principle suggests that multiple formats provide multiple platforms on which retrieving information is possible (Kalyuga, Chandler, & Sweller, 1999).

The second is the split attention principle of multimedia, which states that words should be delivered in an auditory manner rather than visually. Narration and visual information are processed in different systems of the brain (Mayer and Moreno, 1998). It is argued that narration is beneficial as the human eyes cannot be subject to concurrent information (Mayer and Moreno, 2003). That is, within our video design context, too much on screen text. Hence, narration was used when one or two words on screen would not explain the phenomena being demonstrated and the multiple representation principle was not appropriate. As recommended by Berk (2009) and Mayer (2008) the narrative was written in everyday and non-scientific language. Thus, narration formed and integral part of the video hook design.

Figure 3. Screenshot of the energy conversions physics hook video displaying the use of the multimedia principle with words and corresponding image

Finally, during the design phase, specific topics within the physics syllabus on which to base the videos were selected. However, this was a back and forth process between the design and development phases. A process of experimentation had to be instigated to refine a list of topics that could be adequately represented in a visual capacity. In addition, the design phase was used to figure out specific design elements that could be positioned in the videos to augment attention, interest and engagement among learners. The specific list of instructional design elements included a) Relevance, b) Questioning, c) Discrepancy and d) Novelty. Again, is must be noted that this was a flexible process between the design and development phases.

Development

The development phase was based upon the results of the former phases and involves the construction of a product (Peterson, 2003). The physics hook videos display numerous scientific phenomena which needed to be verified in the laboratory to establish their ease of use and visual suitability before filming. Once testing was finished, a list of ten physics based topics with ten storyboards were developed. These included: atmospheric pressure, centre of gravity, conservation of energy, convection, density, energy conversions, friction, pressure, sink or float and sound. A storyboarding process was used to set out exact shots and transitions. Storyboarding provides a particular type of diagram for efficient communication between design members (Jantke & Knauf, 2005). The diagram attempts to convey in static pictures the flow and shots of a finished video or film (Goldman, Curless, Salesin, & Seitz, 2006). The videos were then filmed by a professional camera man and directed by the pre-service teachers over two days in a laboratory setting. The model of camera used was a Canon 7D. The videos were edited using Adobe Premier Pro CC.4.

Specific design elements

As mentioned previously, there are very few examples of actual hooks in the literature. Therefore, the design phase, involved the examination of instructional techniques used to stimulate attention, interest and engagement. This produced a list of specific elements used in instruction to generate the aforementioned constructs with the overall aim of embedding such techniques into the hook videos. This list had to be broken down into design elements that would translate effectively onto the digital video medium. The design elements embedded into the videos are a) Relevance, b) Questioning, c) Discrepancy and c) Novelty. These strategies were tested in the development phase and built into the videos where possible.

Relevance

Numerous authors note the importance of relevance in education for creating interest in a topic (Osborne, Simon, & Collins, 2003; Pikaar, 2013; Roe, 2011; Rotgans & Schmidt, 2011). The relevance strategy was a twofold approach. Firstly, relevance was constructed throughout the videos by using items students would find and see in everyday life. This ranged from foodstuffs such as maple syrup and honey to hardware such as hammers and weights to simple aluminium cans (Figure 4). This approach enables the viewer to observe how interesting and engaging scientific experiments and phenomena can be constructed with objects students would encounter on a daily basis.

The second relevance strategy is derived from basing the videos on the Junior Irish Science syllabus. All video content can be linked back to sections of the syllabus or textbooks. This makes the videos more useful than other videos that may contain extraneous content. The hook videos are totally relevant to science curricula giving the video value from a teacher and learner perspective.

The final relevance strategy was the use of cross curricular links within the videos. Links to art, music and in particular mathematics were made to broaden the scope and appeal of the videos and to show the various connections between science and other subjects.

Figure 4. Displaying every day and relevant materials used in the density physics video hooks.

Questioning

The basic premise of the questioning strategy is that questioning facilitates attention (Bergin, 1999). This aligns perfectly with the primary aim of the physics hook videos. The physics hook videos utilized two types of questions, lower order and higher order. This was heavily dependent on the content of the video and when opportunities for questions within footage presented themselves. The following are examples of generic questions either presented on screen or asked by the narrator of the videos.

a) “Can you explain this?”
b) “What is happening here?”

The questions are very simple and direct student thinking toward the crux behind the phenomena within the video. They are employed to keep attention focussed and make the video easier to follow.

The second type of question was a higher order more complex question. For example, during the pressure video in which a balloon is pressed against a bed of nails and then against one nail, the narrator asks –

a) "Why was the balloon safe on this bed of nails, but popped on this one nail?"

The second strategy was employed at the end of the videos so that students are left pondering about the exact science behind what they observed. After these questions are asked, the video ends so it's does not compromise the aims of the design phase to align the videos with the cognitive load theory and multimedia design.

Discrepancy

Discrepancy is a pedagogical methodology mentioned by a number of authors to stimulate interest and attention among learners (Bergin, 1999; Cakir, 2008; Edelson, 2002; Thornton & Sokoloff, 1998). Discrepancy is a method in which in which an educator presents a phenomena that does not make sense or has associated misconceptions (Broughton, Sinatra, & Reynolds, 2010). When designing the physics video hooks, we tried to create effects or visuals that look impossible or implausible similar to magic tricks. Such a technique presents a student with a gap in their knowledge that has the potential to spark interest (Bergin, 1999, Edelson and Joseph, 2004, Rotgans and Schmidt, 2011). An example of which is Figure 5. This displays a screenshot from the centre of gravity video hook in which a meter stick, and sledgehammer are balanced off a table with a string. It isn't intuitive to explain why the items are balanced and therefore attempts to create a discrepancy within the video for students to notice.

Figure 5. An example of a discrepant event in the centre of gravity physics video hook

Novelty

Finally, during the development phase, the design team tried to make the videos novel. We posit that the aforementioned discrepancy strategy works on the basis of novelty. The two are heavily interlinked. According to Silvia (2008), novelty may result in greater attention, interest, recall and behavioural intentions. Novel events act as a form of surprise (Itti & Baldi, 2005) which relies on the uncertainty of prior beliefs. This unpredictability impacts on all stages of neural processing indicating that novelty within a hook may augment attention, interest and engagement.

Evaluation*

The enhanced evaluation step in this project took on a twofold approach. The first involved weekly meetings throughout the eight weeks to critique and assess the work that had been conducted by the three pairs of teacher designers. This was a collaborative effort along with the project leader in which ideas were compared and contrasted. Changes were identified and modifications made to improve the end product. The goal of this evaluative step was to provide formative feedback that would interlace between every step of the ADDE* model. A similar formative evaluation process was conducted by Moradmand (2014) in which evaluation is present during every phase of instructional design.

Enhanced Evaluation

An enhanced evaluation step was built into the project to compensate for not being able to conduct a full scale implementation phase. This was conducted near the end of the project where changes to the video hooks could still be made. Briggs et al., (1991) states that products be tried out on members of the targeted population. Our target population is both teachers and students. Hence, for the enhanced evaluation, it was decided to get members of the other design teams to critique the videos from a science teacher perspective to develop critical subjective expert opinions (Briggs, Gustafson, & Tillman, 1991). We posit that this is appropriate strategy as teachers are the gatekeepers to their own classrooms. If a resource does not fit their teaching criteria, then it will not be implemented within the classroom and will not reach the second user group of students. Thus, the enhanced evaluation allows the videos to be revised upon the user needs.

Two separate pairs of teachers worked as designers on biology and chemistry hooks. Within the enhanced evaluation stage they were asked to critique the physics hook videos highlighting their user needs as teachers. They were also asked to evaluate the instructional products based upon the following criteria:

a) The characteristics of target teachers
b) The characteristics of target learners
c) The characteristics of intended learning environments

This provided two sets of user feedback based upon a needs assessment from four teachers in total. This is what Briggs et al. (1991) denotes as subjective expert opinion in which as expert is asked to render an opinion in relation to a product, procedure or program. The opinions generated are generally personal, limiting them to a degree. However, "experts can usually provide insights for decision makers that are absent from more objective methodologies" which is our case is full scale implementation (Briggs et al., 1991, p.228). Edits and revisions were conducted based upon the user generated feedback.

Discussion

Before the initiation of the project, one of challenges faced was to find an instructional design framework that 'fit' the project. The ADDIE framework was employed, however, other frameworks examined including the 'Pebble in the Pond" design (Merrill, 2002) and the 'Spiral Model' as described by Goodyear (2013) were considered, but their emphasis was too focussed on in-classroom teaching strategies. This project required something less specific that could be adapted to our needs. Neither of the aforementioned models suited the hooks project and the ADDIE framework was not a perfect fit either. Hence, it had to be adapted to an ADDE* framework with the removal of the implementation phase. Originally, the ADDIE model was used because of its simple layout and approach to design. We found this particularly useful for novice designers. An implementation phase would have been desirable, however, it would have been wholly unpractical within the remit and time restrictions of the project. When discussing the process of instructional design, Jonassen (2008, p. 21) notes, "Decisions are driven less by accepting principles than they are by constraint satisfaction and beliefs, some of which are culturally accepted and others are context specific". In our design, decisions were made based upon content specific constraints to enable the completion of the project. Additionally, Jonassen (2008) brings up the problem of adhering too closely to instructional design models, when they can be a limiting factor to some projects. This was the case within this project. Design is a problem solving process and ADDE* was the most efficient route to follow to create a solution to our context specific problem. Jonassen (2008, p. 26) continues and characterises successful design as one that "must address the constraints imposed by the context". As such, constraints have to be addressed by decisions. Our decision was to modify the design process to accommodate our constraints and goals. An implementation phase would have provided practical feedback and changes to the video from an instructional environment. However, re-editing and reshooting digital video is expensive and timely when contracted to an outside source as it was in this project. The implementation phase is currently being conducted as a PhD study.

Design elements

One of the biggest quandaries was during the design and development phases of the project in which the specific design elements of relevance, questioning, discrepancy and novelty were built into the videos. All the videos cover various aspects of physics that are highly varied in nature. This makes it difficult to develop every video in a way that employs all of design elements. Not every design element can be utilised. An example of which is using a tuning fork in the sound video which does not abide by the relevance strategy as this may not be an everyday object for a lot of students. However, some students may find it novel.

Indeed, the design element of novelty proved to be the most difficult to build into the videos. How can you judge novelty? What is novel to one student may be mundane to another. Videos were aimed at what we term digital residents, however, are the videos novel enough to stimulate the attention, interest and engagement of a potential cohort of students who are competent with YouTube and Web 2.0 applications. Our novelty strategy is to use everyday items in unusual ways and testing this in a student users would have demonstrated if this worked. This is where the ADDE* instructional design framework is lacking most and an implementation phase would have been beneficial.

Collaborative development

Gilbert (2005) postulates that visualisations in science require excellent design input from both an educational and scientific perspective. In achieving this, discourse is advised between scientists, teachers and technologists. Collaboration will lead to more effective interventions. However, we would argue based on this project that it would have been beneficial if teachers could perform every part of the development phase so that a clear and concise vision can be achieved. None of the designers had any experience with cameras or filming. The cameraman had limited knowledge of science. Therefore, this created a knowledge gap that could not be bridged fully. Making the link between teacher and cameraman meant that certain aspects of the videos do not capture phenomena in the way originally intended due to camera and angle restrictions. This is a problem if there is limited filming time for every video. The storyboarding process noted earlier did not ameliorate this negative effect. In future, we would suggest combatting this by the teachers/designers filming the phenomena using tablets or phones to acquire a rough idea of what will look good on camera and give the camera operator an opportunity to see what is planned. Other options include teachers and designers gaining camera experience to film the videos themselves or the cameraman forming part of the design team throughout every phase of the project.

Conclusion

This article describes the design process involved in the creation of physics video hooks. It is argued that the adapted instructional model in the form of ADDE* is highly suitable for the creation of video content for the science classroom. The videos were aligned with the multimedia principle and cognitive load theory. This was effective in aiding the creation of the videos. Some specific design elements worked better than others. The main difficulty was assessing what would work for students. This is where the implementation phase of the ADDIE framework would have been beneficial. However, a formalised intervention process is currently being undertaken in schools.

References

Anderman, E. M., Noar, S. M., Zimmerman, R. S., & Donohew, L. (2004). The need for sensation as a prerequisite for motivation to engage in academic tasks. *In M. L. Maehr and P. R. Pintrich (Eds.), Advances in motivation and achievement, Volume 13: Motivating students, improving schools: The legacy of Carol Midgley. Elsevier, San Diego, CA.*

Andrews J. (2012). Onine videos: A new tool for Medical Education. *UBCMJ*.

Bergin, D. A. (1999). Influences on classroom interest. *Educational psychologist, 34*(2), 87-98.

Berk, R. A. (2009). Multimedia teaching with video clips: TV, movies, YouTube, and mtvU in the college classroom. *International Journal of Technology in Teaching and Learning, 5*(1), 1-21.

Briggs, L. J., Gustafson, K. L., & Tillman, M. (1991). *Instructional design: Principles and applications*: Educational Technology.

Broughton, S. H., Sinatra, G. M., & Reynolds, R. E. (2010). The nature of the refutation text effect: An investigation of attention allocation. *The Journal of Educational Research, 103*(6), 407-423.

Cakir, M. (2008). Constructivist Approaches to Learning in Science and Their Implications for Science Pedagogy: A Literature Review. *International Journal of Environmental & Science Education, 3*(3).

Clifton, A., & Mann, C. (2011). Can YouTube enhance student nurse learning? *Nurse education today, 31*(4), 311-313.

Coffman, S. J. (2003). Ten strategies for getting students to take responsibility for their learning. *College Teaching, 51*(1), 2-4.

Connaway, L. S., White, D., & Lanclos, D. (2011). Visitors and residents: What motivates engagement with the digital information environment? *Proceedings of the American Society for Information Science and Technology, 48*(1), 1-7.

De Jong, T. (2010). Cognitive load theory, educational research, and instructional design: some food for thought. *Instructional science, 38*(2), 105-134.

Dewey. (1913). *Interest and Effort in Education*: Riverside Press Boston MA.

Duffy, P. (2007). *Engaging the YouTube Google-Eyed Generation: Strategies for Using Web 2.0 in Teaching and Learning*.

Edelson, D. C. (2002). Design research: What we learn when we engage in design. *The Journal of the Learning Sciences, 11*(1), 105-121.

Edelson, D. C., & Joseph, D. M. (2004). *The interest-driven learning design framework: motivating learning through usefulness.* Paper presented at the Proceedings of the 6th international conference on Learning sciences.

Fill, K., & Ottewill, R. (2006). Sink or swim: taking advantage of developments in video streaming. *Innovations in Education and Teaching International, 43*(4), 397-408.

Gilbert, J. K. (2005). *Visualization in science education* (Vol. 1): Springer.

Goldman, D. B., Curless, B., Salesin, D., & Seitz, S. M. (2006). *Schematic storyboarding for video visualization and editing.* Paper presented at the ACM Transactions on Graphics (TOG).

Goodyear, P. (2013). Instructional design environments: Methods and tools for the design of complex instructional systems. *Instructional design: International perspective, 2*, 83-111.

Gustafson, K. L., & Branch, R. M. (2002). What is instructional design. *Trends and issues in instructional design and technology*, 16-25.

Harwood, W. S., & McMahon, M. M. (1997). Effects of integrated video media on student achievement and attitudes in high school chemistry. *Journal of research in science teaching, 34*(6), 617-631.

Hunter, M. (1994). *Mastery Teaching*: ERIC.

Itti, L., & Baldi, P. F. (2005). *Bayesian surprise attracts human attention.* Paper presented at the Advances in neural information processing systems.

Jantke, K. P., & Knauf, R. (2005). *Didactic design through storyboarding: Standard concepts for standard tools.* Paper presented at the Proceedings of the 4th international symposium on Information and communication technologies.

Jewett Jr, J. W. (2013). Hook your students! *The Physics Teacher, 51*, 442.

Johnston, T. L., & Roberts, T. G. (2011). The Effect of an Interest Approach on Knowledge, Attitudes, and Engagement of High School Agricultural Science Students. *Journal of Agricultural Education, 52*(1), 143-154.

Jonassen, D. H. (2008). Instructional design as design problem solving: An iterative process. *Educational Technology, 48*(3), 21.

Jones, T., & Cuthrell, K. (2011). YouTube: Educational potentials and pitfalls. *Computers in the Schools, 28*(1), 75-85.

Kalyuga, S., Chandler, P., & Sweller, J. (1999). Managing split-attention and redundancy in multimedia instruction. *Applied Cognitive Psychology, 13*(4), 351-371.

Keller, J. M. (2000). How to integrate learner motivation planning into lesson planning: The ARCS model approach. *VII Semanario, Santiago, Cuba*, 1-13.

Kozma, R., B. (1986). Implications of instructional psychology for the design of educational television. *Educational Communications and Technology Journal, 34(Spring), 1-19.*

Kumar, D. D. (2010). Approaches to interactive video anchors in problem-based science learning. *Journal of Science Education and Technology, 19*(1), 13-19.

Lee, G., Kwon, J., Park, S. S., Kim, J. W., Kwon, H. G., & Park, H. K. (2003). Development of an instrument for measuring cognitive conflict in secondary-level science classes. *Journal of research in science teaching, 40*(6), 585-603.

Lemov, D. (2010). *Teach like a champion*: Gildan Media.

Marinchech, J. (2013). A great teacher begins with a hook. Retrieved from https://suite101.com/a/a-great-teacher-begins-lessons-with-the-hook-method-a255945

Martin, F., Hoskins, O. J., Brooks, R., & Bennett, T. (2013). Development of an Interactive Multimedia Instructional Module. *Development of an Interactive Multimedia Instructional Module*, 5.

Mayer, R. E. (2002). Cognitive Theory and the Design of Multimedia Instruction: An Example of the Two-Way Street Between Cognition and Instruction. *New directions for teaching and learning, 2002*(89), 55-71.

Mayer, R. E. (2003). The promise of multimedia learning: using the same instructional design methods across different media. *Learning and Instruction, 13*(2), 125-139.

Mayer, R. E., & Moreno, R. (1998). A cognitive theory of multimedia learning: Implications for design principles. *Journal of educational psychology, 91*(2), 358-368.

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational psychologist, 38*(1), 43-52.

McCauley, V., Davidson, K., & Byrne, C. M. P. (2015). Advancing science teacher education and professional practice: A collaborative lesson hooks approach. *Irish Educational Studies*.

McCrory, P. (2011). Developing interest in science through emotional engagement. *ASE Guide to Primary Science Education. Hatfield: ASE ed. W.Harlen, 94-101, UK: ASE. Draft Chapter also available from: Learn-differently.com*.

Merrill, M. D. (2002). A pebble-in-the-pond model for instructional design. *Performance improvement, 41*(7), 41-46.

Mitchell, M. (1993). Situational interest: Its multifaceted structure in the secondary school mathematics classroom. *Journal of educational psychology, 85*(3), 424.
Molenda, M. (2003). In search of the elusive ADDIE model. *Performance improvement, 42*(5), 34-37.
Moradmand, N., Datta, A., & Oakley, G. (2014). The Design and Implementation of an Educational Multimedia Mathematics Software: Using ADDIE to Guide Instructional System Design. *We are celebrating 4 years of service!*, 37.
Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: a review of the literature and its implications. *International Journal of Science Education, 25*(9), 1049-1079.
Paivio, A. (1969). Mental imagery in associative learning and memory. *Psychological review, 76*(3), 241.
Paivio, A. (1990). *Mental representations: A dual coding approach*: Oxford University Press.
Perrott, E. (1982). Effective teaching: A practical guide to improving your teaching.
Peterson, C. (2003). Bringing ADDIE to life: Instructional design at its best. *Journal of Educational Multimedia and Hypermedia, 12*(3), 227-241.
Pikaar, Y. (2013). *Implementing a new instructional design framework in an animated pedagogical agent: Does and animated pedagogical agent enhance student moivation and learning gains.* . (Masters Thesis), Twente University
Prensky, M. (2012). Digital natives, digital immigrants. *On the Horizon. MCB University Press, 1*.
Riendeau, D. (2013). Delightful Beginnings. *The Physics Teacher, 51*, 380.
Roe, S. (2011). Young People's Views on Reform of the Junior Cycle. *Youth Studies Ireland, 6*(1).
Rotgans, J. I., & Schmidt, H. G. (2011). Situational interest and academic achievement in the active-learning classroom. *Learning and Instruction, 21*(1), 58-67.
Schraw, G., Flowerday, T., & Lehman, S. (2001). Increasing situational interest in the classroom. *Educational Psychology Review, 13*(3), 211-224.
Schuck, R. F. (1969). The Effects of Set Induction Upon Pupil Achievement, Retention, and Assessment of Effective Teaching in a Unit on Respiration in the BSCS Curricula. *Educ Leadership*.
Schuck, R. F. (1970). Set Induction as an Instructional Tool. *Amer Biol Teacher*.
Schuck, R. F. (1981). The impact of set induction on student achievement and retention. *The Journal of Educational Research*.
Silvia, P. J. (2008). Interest—The curious emotion. *Current Directions in Psychological Science, 17*(1), 57-60.
Smith, P. L., & Ragan, T. J. (1999). *Instructional design*: Wiley New York, NY.
Spanjers, I. A., Wouters, P., Van Gog, T., & Van Merrienboer, J. J. (2011). An expertise reversal effect of segmentation in learning from animated worked-out examples. *Computers in Human Behavior, 27*(1), 46-52.
Steffes, E. M., & Duverger, P. (2012). Edutainment with Videos and its Positive Effect on Long Term Memory. *Jurnal for Advancement of Marketing Education, 1*(20), 1.
Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction, 4*(4), 295-312.
Thornton, R. K., & Sokoloff, D. R. (1998). Assessing student learning of Newton's laws: The force and motion conceptual evaluation and the evaluation of active learning laboratory and lecture curricula. *American journal of physics, 66*, 338.
Trier, J. (2007). "Cool" Engagements With YouTube: Part 1. *Journal of Adolescent & Adult Literacy, 50*(5), 408-412.
Vaughan, T. (2004). Multimedia: Making It Work 6th Edition. 1333 Burr Ridge Parkway, Burr Ridge, IL 60527: McGraw-Hill Companies, Inc.
White, D. S., & Le Cornu, A. (2011). Visitors and Residents: A new typology for online engagement. *First Monday, 16*(9).
Winkler, S. (2005). *Digital video quality: vision models and metrics*: John Wiley & Sons.