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# Media Literacy as a By-Product of Collaborative Video Production by CS Students

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## ABSTRACT

Understanding, promoting, and teaching media literacy is an important societal challenge. STEM educators are increasingly looking to incorporate 21<sup>st</sup> century skills such as media literacy into core subject education. In this paper we investigate how undergraduate Computer Science (CS) students can learn media literacy as a by-product of collaborative video tutorial production. The paper presents a study of 34 third-year CS undergraduates who, as part of their learning, were each asked to produce three video tutorials on Raspberry Pi programming, using a collaborative video production tool for mobile phones (Bootlegger). We provide results of both quantitative and qualitative analysis of the production process and resulting video tutorials, and conclude that the student cohort demonstrated a clear development of media literacy skills. The paper's contribution is twofold. First, we add to the understanding of how the use of mobile collaborative video production technology by non-professionals can help them learn to create meaningful media messages with little scaffolding. Second, we present an alternative pedagogical approach that can help CS students acquire 21<sup>st</sup> century skills such as media literacy.

## Keywords

media literacy; mobile video; co-production; user-generated content

## 1. INTRODUCTION

Computer Science educators, and STEM educators in general, are increasingly concerned about teaching “soft skills” to their students. Today, a successful graduate has to demonstrate not only solid core subject knowledge, but also a set of additional 21<sup>st</sup> century skills. These include, among others, communication and critical thinking, as well as information and media literacies [28]. It has been argued that 21<sup>st</sup> century skills should be taught across the curriculum in both secondary [4] and higher education [7]. Besides, “it can be integrated into nearly any subject area” [4].

There is a growing demand for the ability to understand and create multimedia messages. We encounter media on-the-go, in our workplaces and at home; via TV, public display screens, phones, tablets, and computers. Elections and referendums are fought, won,

and lost on media battlegrounds, and our social lives are increasingly entwined within media-rich social platforms. Public discourses play out in the ‘comments’ of publications by powerful media organizations and many of us are now habitually representing our own lives in media forms [2].

It is widely accepted that media is a kind of *language* [11]. Like English or Mandarin, the language of media allows people to ‘encode’ and ‘decode’ meanings in various ways, from the highly *poetic* to the relatively *prosaic*. Like spoken or written languages, the language of the media requires certain *literacies* in order to encode and decode the meaning it represents, enabling people to both understand and engage critically with media [1, 14].

Furthermore, in the Web 2.0 era, where all of us gradually become *prosumers* (i.e. both producers and consumers) [20], educators need to prepare their students to be capable producers. Production of multimedia messages is no longer a prerogative of artists and journalists. Modern technical professions require the ability to produce creative solutions, powerful portfolios, and video presentations, and graduates must be equipped with these skills.

The SIGCSE community is driving the innovation in teaching soft skills as part of CS education, with substantial efforts dedicated to improving student communication skills [5], fostering team building and collaboration [26], as well as empowering students with entrepreneurial skills [19]. However, there is little research on developing media literacy of CS students, and we address this gap.

In this paper we present an empirical study of a pedagogical approach that facilitates the emergence of *media literacy skills as a by-product of collaborative video production* by third year undergraduate CS students during their coursework on a core subject module. We recorded student behaviour through the use of a collaborative video production tool and analysed it with respect to three key components of media literacy, namely: *access*, *analysis* and *production* of meaningful information. The study contributes to learning design and classroom practice for CS courses that aim to teach media literacy as a by-product of innovative pedagogy.

## 2. RELATED WORK

In this section, we: 1) critique the fragmented conceptualisation of “media literacy” within existing discourses and call for an applied model that is more suitable for use in empirical contexts; 2) introduce “student-generated content”, the central empirical dataset from our study; and 3) outline why student-generated content can be considered a key indicator of student media literacy.

### 2.1 Definition of Media Literacy

Media literacy has been discussed and approached by educators in Europe, North America, and Australasia for nearly three decades. Many studies, including white papers (e.g., [14]) and national reports (e.g., [27]), have been dedicated to this important

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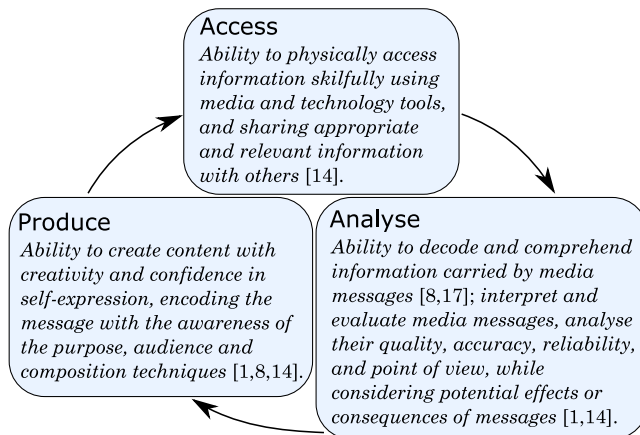
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component of 21<sup>st</sup> century life. It is also a component of an effective pedagogical approach, which attracts increasing attention from STEM educators. Yet there are gaps in understanding media literacy as both a research area and as an educational concept [17].

Hobbs [15] suggests that defining media literacy is not an easy task due to the variety of global education systems and fast changing nature of the media itself. For the purpose of this study, we adopted one of the most accepted general definitions: media literacy is “*the ability of a citizen to access, analyse, and produce information for specific outcomes*” [1]. Aufderheide [1] suggested that each component of this definition could be articulated in a number of ways. Among others, Hobbs [14] and Churchill [8] have developed models of media literacy. These models share the components of *analysis*, *evaluation*, and *creation*, but differ with respect to other factors (e.g. access, question, reflect, act, etc.) as well as in their structure (linear or circular). The relatively abstract nature of these models limits their utility for theoretical application. Thus, building on the flexibility of Aufderheide’s definition and drawing on other media literacy research, we have derived our own cyclical model of media literacy, including definitions of the key components of media literacy as following:



**Figure 1: Media literacy model**

Our model largely echoes Hobbs’s scheme and inevitably preserves the *creation* component, which is almost always present in such models. As Gilmor reasons, “being literate in today’s world means more than just smarter consumption, however actively you do that. Being literate is also about creating, contributing, and collaborating” [10]. This perspective resonates with pedagogical theory, and particularly *Constructionism*, which theorises that the best learning happens through application of the knowledge in the form of learning artefact creation [13, 21].

## 2.2 Student-generated content

Let us discuss the ‘produce’ component of media literacy in detail from the educational perspective. It has been argued that today’s students use technology more creatively and efficiently outside of the education system than they do within classrooms [24]. Multiple studies proposed that schools should take into consideration learners’ passion for technology and their naturally developed media literacy to enhance their learning experience. The development of Web 2.0 technologies emphasises user-generated content along with user interaction and collaboration [20] and powers another growing trend: yesterday’s *audience members* increasingly become content *creators* and *communicators* [30]. “Producing, commenting, and classifying are just as important as

the more passive tasks of searching, reading, watching, and listening” [16].

Asking students to create class content is not new. Indeed, instructors asked students to create multiple-choice questions to build interaction and support excitement in the classroom in the 1980’s [6], long before Web 2.0. However, with an abundance of technological tools available today, we see more studies demonstrating learning improvements for students who engage in content creation. For example, Hamer *et al.* [12] studied the concept of Contributing Student Pedagogy, which is grounded on student-generated content, and evaluated its benefits with regards to CS education. On reviewing numerous studies, the authors concluded that Contributing Student Pedagogy fosters learning of course content and promotes the development of a wide range of skills such as research, communication, interdependence, individual accountability, and interpersonal skills [12]. In addition to multiple-choice questions, other examples of student-generated content introduced into the curriculum include: editable wiki-pages [30], narrated animations [13], video vignettes [23], and tutorials [12].

In addition to linking the creation of digital products with deeper learning of subject knowledge and improved academic performance, evidence suggests further benefits: i) multi-media production helps students to better engage with the subject and to look at it under a different angle [13]; ii) it stimulates the development of creativity and critical thinking skills [20]; and iii) produced materials become tangible objects for student learning portfolios [20]. Furthermore, when tasked with creating digital products for the purpose of teaching, students are encouraged to reflect on how to communicate their learning to others, which further embeds their own learning [9].

In summary, the current settings of CS education are favourable for innovating with digital media and collaborative content production. Today’s students are “digital natives” [22]; they are born and raised in the Internet era and expect (or at least positively accept) a curriculum that involves working with digital multimedia and content creation. Similarly, educators report numerous benefits of student-generated content and incorporation of multimedia materials into teaching and learning activities. This paper contributes a study of digital content creation as part of an undergraduate CS curriculum. Through studying the process by which students created these products, as well as their experiences doing so, we show how a model of media literacy needs to evolve to take into account the complexity of the content creation process.

## 3. STUDY METHODOLOGY

We ground our stance for the overall study on Constructionism theory, which advocates *learning through making* [21]. Although this paper does not evaluate the improvement in student core subject learning, it does focus on the investigation of the *making* process and evaluates the *learning* of additional skills facilitated by this process. In other words, we look at how media literacy skills were learnt by students through the process of making digital artefacts.

A mixed methods approach was chosen for the study as media message creation is a complex concept, which is better analysed from multiple angles. We investigated it a) quantitatively through analysis of video creation data; and b) qualitatively through inquiring about student experience and examining the artefacts they produced. Data were collected and analysed with the following research questions in mind:

**RQ1:** What is the process by which students collaboratively create meaningful multimedia message about their own learning?

**RQ2:** What is the student acceptability and experience of creating media as a form of assessment within an undergraduate CS module?

### 3.1 Study Context

The study took place within a semester-long 3<sup>rd</sup> year undergraduate module on Ubiquitous computing (Ubicomp) at the School of Computing Science, Newcastle University, UK (module website: <https://openlab.ncl.ac.uk/ubicomp>). The learning objectives of the module were to introduce students to the field of Ubicomp and develop practical skills in building interactions with a prototyping toolkit (Raspberry Pi). The module was delivered in a flipped classroom format. The class comprised 34 students (85% male). All of them agreed for their final products and records of the creation process of these products to be included into the study.

As part of module assignments (30% of the total mark) students created three short video tutorials of their practical, or lab, sessions, which explained how to program Raspberry Pi and the Grove Pi kit in different scenarios, such as how to detect light or proximity. The activity was designed so that it would not require any more time or effort from students than usual report writing. Besides, tutorial making was incorporated into the existing practical sessions within the course and it did not considerably interfere with the normal running of the sessions. The teaching team used Bootlegger [3], a collaborative video production tool, to facilitate video production as described below.

The production of video tutorials comprised two phases. In the first phase, all students created short video *clips* during practical sessions to document their work, and uploaded these clips to the Bootlegger.tv platform. The uploaded clips would then become available for all other students to use in their own video; students could use clips produced by all their peers. In the second phase, students combined clips into *edits*, to individually create their tutorials. (See: [https://openlab.ncl.ac.uk/ubicomp/?page\\_id=502](https://openlab.ncl.ac.uk/ubicomp/?page_id=502))

### 3.2 Bootlegger and Class Integration

Bootlegger is an open source platform consisting of a web and mobile component for commissioning the creation of videos. It supports non-professionals in generating high production value content in situated locations such as concerts, marathons, and ethnography fieldwork. Participants use their mobile phones to capture short video clips, the framing and description of which are defined and requested by the producer, which can be later used to make video for the event. Bootlegger has previously been used for a variety of scenarios, including education [3, 25].

The following aspects influenced the choice of Bootlegger:

- i. *A collaborative environment:* Bootlegger is designed to allow users to share video footage, providing different points of views on the same step at a practical session. The students can therefore work together to make a comprehensive coverage of different steps of their work. Video clips can be used by all students in making the final edits to submit for assessment. This approach provides students an opportunity to examine how other students convey technical details and create learning materials.
- ii. *Ease of use:* the Bootlegger mobile app and the web platform are designed to be used by non-professionals, thus they are easy to use and require no prior skills in video capturing and editing.
- iii. *It is a mobile application:* this allowed the students to use their own familiar devices rather than to worry about acquiring video cameras and learning how to use them.
- iv. *The shoot templates:* Bootlegger provides a “shoot template”, a set of suggested shots that the teacher (producer) can choose from to help guide students on what to shoot, and aid framing it

better. The students are free to ignore the template and make their own choices.

### 3.3 Data Collection and Processing

Our dataset comprised both qualitative and quantitative data. Our quantitative data included system logs from the Bootlegger platform, which detailed the clip production and edit ‘lifecycle’ for all six practical sessions. The data comprised: i) for each created clip: id, author, time of creation, length, practical session id, file path; ii) for each created edit: id, name, author, description, path, time of creation, practical session id, number of clips used, clips ids. This provided us with a large dataset that we analysed with R, a programming language and environment for data analysis.

The qualitative set of the data included the following:

- i. Semi-structured face to face interviews (about 30 minutes long) conducted at the end of the module focusing on student general experience of the module and including questions about digital media creation as a form of assessment. The participation was voluntary, 8 out of 34 students were recruited. The transcripts were analysed using inductive thematic analysis.
- ii. Student artefacts: a sample of the 10% most popular clips used in student edits (50 clips, with 6 to 18 uses each); and all student final tutorials submitted for assessment along with their marking criteria – all analysed using inductive thematic analysis.
- iii. Our preliminary analysis of quantitative data and the student artefacts revealed a number of further questions we wished to investigate. A questionnaire with 6 closed- and 2 open-ended questions was created, tested, and distributed to the students electronically, with two £10 vouchers as an incentive; 10 students responded. The questionnaire covered: the impact of access to clips created by other students; most important factors for clip choice for edits; and perception of overall activity outcome. The answers to open-ended questions were analysed using a deductive approach.

## 4. FINDINGS

The module comprised eight practical sessions. In six of these sessions students were asked to document their work with the Raspberry Pi to generate footage for the tutorials. Students could choose any three practical sessions for their final submissions. The first three sessions, however, were significantly more popular with 88%, 82%, and 71% of students choosing them for their final submissions. The fact that the majority of students chose the same sessions contributed to a high degree of video clip sharing and facilitated student collaboration (e.g. 50% of students had their clips reused by other students 10 times and more). 102 tutorials were submitted in total (see Table 1).

**Table 1: Summary of student contribution for each tutorial**

Week	Tutorial	# of clips made	# of clip uses	# of submitted tutorials	% of total class
1	Pi is alive	177	745	30	88%
2	Proximity detector	221	699	28	82%
3	Context awareness	165	397	24	71%
4	Interactive surface	90	295	13	38%
5	Natural user interface	87	224	6	18%
6	Responsive LCD	66	62	1	3%
	<b>Total:</b>	<b>806</b>	<b>2422</b>	<b>102</b>	

By the end of the module the students captured 806 clips; 657 were successfully uploaded to the system (some were lost due to connectivity issues). The total number of clips used for edits by



unique users was 500. Many clips were used multiple times by the same and different students, and the overall number of clip uses for all edits was 2,422.

All students enrolled to the module had successfully completed the video creation assignment. The average mark for the class was 19.9 out of 30 (66.3%, equivalent to 2.1 classification), and 13 out of 34 students earned the first class mark (70% or above). The marking criteria for the assignment emphasised the clarity of video tutorials and their fitting to the purpose – showing all necessary steps to complete a task with enough details for another student to follow the tutorial and produce the same output. Therefore, we consider that the student artefacts were *meaningful multimedia messages*.

## 4.1 Media Literacy Model vs Student Behaviour

To answer **RQ1** we use Aufderheide's definition [1] of media literacy and our description of its three key components (see Section 2.1) as a framework for classifying our findings into categories of student behaviour. Below we describe how students *access*, *analyse* and *produce* a media message and demonstrate the necessary literacies using examples from the collected data.

### 4.1.1 Ability to Access

**Access** is the ability to physically access the information by skilfully using media and technology tools, and sharing appropriate and relevant information with others [14]. In terms of interactions with Bootlegger this is the ability to use mobile phones and PCs with the Bootlegger application; and to access the clips stored in the cloud that were created with Bootlegger.

#### Student behaviour:

Students used the Bootlegger mobile and online applications with shot planning and templates for shooting the clips, documenting the process of their work with Pis. They were also able to access and see all the clips uploaded into the Bootlegger system and participate in sharing the clips with others.

#### Activity outcome:

5 interview and 7 survey respondents said they liked the idea of using video for assessments, and 4 students said they preferred video tutorials to written reports. By possessing the required technology (mobile phones and PC), being able to download and install the tool (Bootlegger), and agreeing to do so, the students demonstrated their "ability to physically access information".

### 4.1.2 Ability to Analyse

**Analyse/Decode** is the ability to decode and comprehend information carried by media messages [8, 18]; interpret and evaluate media messages, analyse their quality, accuracy, reliability, and point of view, while considering potential effects or consequences of messages [1, 14]. In terms of interactions with Bootlegger this translates to 1) decoding the clips from the cloud to interpret their meaning and decide what they are good for; 2) evaluating the quality of the clips to select the best ones for the final video.

#### Student behaviour:

Students decoded the information carried by clips in Bootlegger to determine which clips they could use in their own tutorials.

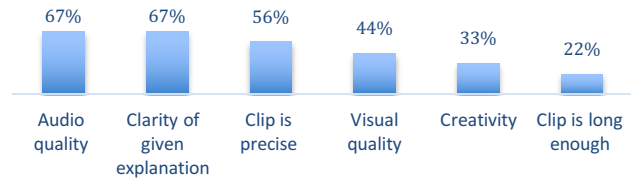
#### Activity outcome:

The Bootlegger platform allows the user to sort clips connected with a shot by the time of creation, author, and other preselected characteristics, such as association of the clip with a particular step, shot overlay, or subject focus; it also has a thumbnail preview with metadata. The Bootlegger log data demonstrates that all students (even those whose final videos contained only their own clips) tried

to create edits using clips made by others. This is also confirmed by student answers in the interviews and survey.

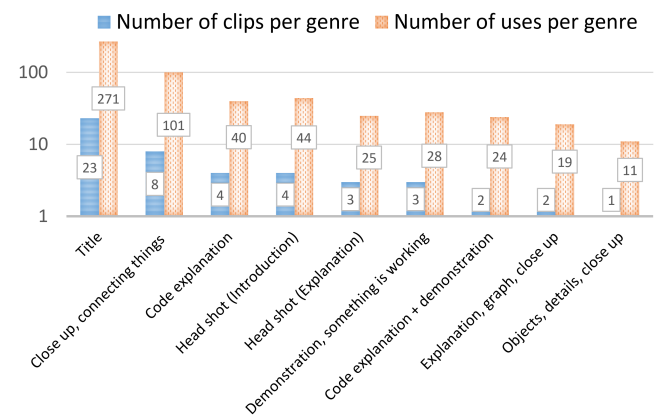
*"I first looked at my own clips, as I just wanted to use my own resources. Only when I didn't find something in my clips I went looking for others' clips. I also did use Lea's 'title' clips because they're good, she just nailed it."*

Qualitative analysis of 10% of most popular clips used in student edits gave us a list of most common features preferred by the students, including genre and cinematic qualities apparent in clips. We took this further and asked survey participants to rate these features with regards to their importance for student choice of the required clip, see Fig. 2.



**Figure 2: Most important factors for selecting clips for final edits (percentage of survey responses)**

Further analysis of most used clips also revealed the following clip genres were most popular: 1) Title; 2) Close up, connecting things; 3) Code explanation; 4) Head shot (introduction); 5) Head shot (explanation); 6) Demonstrating how something is working; 7) Code and output demonstration; 8) Graph explanation, close up; 9) Objects, details, close up. See Fig. 3 for a correlation between the number of popular clips per genre and the number of their total uses among the 10% most used clips. 64% of most popular clips were short and concise, focusing on only one thing (e.g. titles for tutorial steps; connecting something to the Pi), which suggests that elementary clips were more reusable.



**Figure 3: Clip genres (X-axis); number of clips and number of total uses (Y-axis) as seen from analysis of 50 most popular clips**

### 4.1.3 Ability to Produce

**Produce/Encode** is the ability to create content with creativity and confidence in self-expression, encoding the message with the awareness of the purpose, audience and composition techniques [1, 8, 14]. In terms of interactions with Bootlegger this translates to: 1) at clip level: generation of clips documenting each step of student work; 2) at edit level: editing the clips into the film (tutorial) in order to create a meaningful narrative for a specific purpose.

#### Student behaviour:

Video production through Bootlegger consisted of two steps:

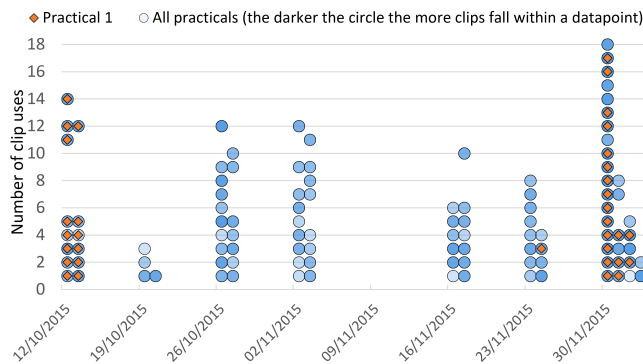
**Clip level:** students recorded clips showing the steps of their work. They were given some tips via the assignment brief, Bootlegger templates (suggested steps of the tutorial, clip lengths, a collection of possible shot overlays), and an example tutorial prepared by the instructor, but were free to experiment and demonstrate creativity.

**Edit level:** recorded clips needed to be composed into a tutorial, creating a meaningful narrative for i) demonstration of learning outcomes of the course; ii) instruction of other students.

#### Activity outcome:

Although students were tasked to produce clips during the class time, nearly half of the interview and survey respondents admitted that they were unhappy with the quality level of recorded clips and spent additional time to reshoot and improve most of the clips. By analysing time stamps of the clips uploaded to the cloud we can see that, for example, many clips related to Practical 1 were shot substantially later in the semester (see Fig. 4). In the interview and survey responses students also admitted that attempts to create an edit made them reconsider which clips had to be recorded:

*“When we actually did that first video, like maybe a couple of weeks before the deadline, we kind of realised that there is all this content that we needed that we haven’t actually been recording for all of the weeks, so in the end we had to go back and basically just record everything from scratch again.”*



**Figure 4: Number of clip uses (Y-axis) and production timeline (X-axis) during the module**

Students acknowledged that access to clips shot by their peers had a positive impact on their video creation (8 survey respondents), inspired them, and made them rethink their clips (6 respondents).

*“It got me thinking about things I never considered before and also on ways to improve it.”*

*“On seeing other’s clips I realized mine featured only code and the Pi, however some students had introduced the project and gave explanations with the camera focused on themselves. I thought this was a much more personal and friendly approach so I incorporated this into my own videos.”*

9 survey participants said they used clips shot by others because they did not capture those clips themselves. Also, 4 respondents admitted that clips made by others were of better quality.

On the other hand, 6 respondents preferred to use their own clips for the final edits as they thought they were of better quality. 3 respondents said they wanted to use only their own clips as they were shot in the same style so the edits would look homogeneous.

## 4.2 Student experience

Half of the students who took part in the interviews and survey reported that they had previous experience of creating video

tutorials. As mentioned above, 12 out of 18 respondents said that they liked the idea of alternative way of assessment for a CS module. Moreover, students reported that this assignment did not take them any longer to do than a regular written report.

When students were asked if they thought they had learned anything extra from creating the tutorials, 3 answered that they had improved their instructional videos creation skills. While 2 respondents reported that the task also improved their subject learning.

*“It did force me to gain an understanding of the task thoroughly so that I knew I had the knowledge to explain precisely what to do.”*

Although the students mostly liked the idea of using videos instead of written reports, there were a lot of complaints due to some technical issues with Bootlegger. Until asked, the students did not realise the benefits the tool provided them.

*“Bootlegger coursework - I didn’t think it really test the knowledge of the actual course content. I like the idea of making videos through the practicals but I thought having 30% of the coursework on just ordering other people’s videos was worth a bit too much...whereas you could’ve had another coursework kind of more programming based or an essay, which would’ve tested the knowledge a bit more... Also I just didn’t like the software we had to use.”*

Yet, some respondents still reflected positively on Bootlegger.

*“I thought that was really great, since everyone had different videos particularly because not everyone knew exactly what to shoot, and so some people would have like a really great clip of what the outcome was, someone would do a really good like speech on how to set up the code, and so it all just pieced together really nicely.”*

To summarise, student experience with video creation in general was mainly positive. However, their attitude to the used tool was mixed due to its instability and bugs.

## 5. DISCUSSION

We have explored the process of media message creation in student-generated content through a novel framework of media literacy. In doing so, we observed each of the three main components of media literacy (*access, analyse and create*), in the process of student learning to engage in the practice of producing a video. Like Weilenmann *et al* [29], we assume that the demonstration of these skills is a candidate step for the manifestation of an emerging media literacy trajectory.

In addition, there are further takeaways about student behaviour:

i. The students realised certain problems with their video footage (e.g. the lack of different perspectives or poor audio quality) only when they encountered them as part of the final video editing. Thus, student media literacy emerged and developed through the process, prompting them to redo the clips or to search for alternatives among clips produced by their peers.

In its essence, the production at clip and edit levels is very different: the former is to record what is happening here and now; the latter is to construct a storyline where each component/clip is in the right place and appropriate for the whole story. While in everyday life many of us create clip-level videos (recording events that are happening around us and catch our attention or interest), not everyone is familiar with video editing techniques, when the author has to bear in mind the ultimate purpose and hence the content and shape of the final product [29]. So the fact that our students had to

redo most of their recordings after trying to construct the final edits suggests that their media literacy emerged on the go.

ii. The fact that students moved back and forth between the media literacy components when they decided to redo the video to improve it, implies that the process of media message creation is neither linear nor cyclic (as suggested in Section 2.1). We believe that the three main components are interdependent and may occur in different sequences, which is an important consideration in updated media literacy models.

iii. Students took advantage of the possibility to see contributions uploaded by others. They *learned from each other*, as evidenced by their clip reshooting after watching clips by others (seen from Bootlegger log data, confirmed by interviews and survey). Students also developed an understanding of *reusability of media components* with such factors as the clip authorship, its visual and audio quality, as well as clip genre, and time of creation.

iv. The collaborative environment of Bootlegger in its nature is similar to crowdsourcing (something familiar to many CS practitioners). Thus, students looking at and selecting clips from the cloud have demonstrated the pattern of *deconstruction*, where the more elementary component is, the easier it is to reuse it. Such clips as 'title' and 'connecting things' are less personal, more elementary, and have limited capacity for misconception or presentation of a wrong point of view. Hence, they were popular for reuse among students. On the other hand, 'intro' and 'demo' clips display more individuality and present deeper levels of information, so there was a greater risk of being misinterpreted or provide incorrect details, thus most students preferred to shoot these clips themselves.

v. Returning to **RQ2** we can say that modern CS students are ready and mainly willing to deal with media creation as a form of learning and assessment, however they can easily become demotivated when they encounter technical issues with the tools used.

## 5.2 Limitations and Future Work

At the time of the study Bootlegger was still under development and it has been used in this specific context for the first time. Hence, the students and the teaching team faced several difficulties during the process, such as mobile application bugs, connectivity issues and scalability problems due to the rapid uptake of editing. These problems led to a mixed attitude of students to the tool.

The sample of this study is not suitable for generalisation due to its size. However, we hope that our results provide insights on innovative classroom practice. In our future work we plan to repeat the study with a larger student cohort to further validate our current findings and to focus on evaluation of the *learning through making* multimedia artefacts for CS subjects. We also intend to examine the student artefacts in more detail, from different perspectives, e.g. a professional videographer and other learners.

## 7. CONCLUSION

The purpose of this study was to report on innovative learning design and classroom practice for a CS course that aimed at teaching media literacy as a by-product of video tutorial production. We also presented how the use of mobile collaborative video production technology by non-professionals can help them learn to create meaningful media messages with little scaffolding.

## 8. REFERENCES

- [1] Aufderheide, P. 1993. *Media Literacy: A Report of the National Leadership Conference on Media Literacy*. Aspen Institute.
- [2] Aylett, M.P. et al. 2016. My Life On Film. *CHI EA'16*, 3379-3386
- [3] Bartindale, T. et al. 2016. Scaffolding Community Documentary Film Making using Commissioning Templates. *CHI'16*, 2705-2716.
- [4] Bergsma, L. et al. 2007. *The Core Principles of Media Literacy Education*. Denver, CO: Alliance for a Media Literate America
- [5] Blume, L. et al. 2009. A "Communication Skills for Computer Scientists" Course. *ACM SIGCSE Bulletin*. 41, 3 (Aug. 2009), 65.
- [6] Bonwell, C.C. and Eison, J.A. 1991. *Active Learning: Creating Excitement in the Classroom*. The George Washington University.
- [7] Christ, W.G. 2004. Assessment, Media Literacy Standards, and Higher Education. *American Behavioral Scientist*. 48, 1, 92-96.
- [8] Churchill, D. 2010. New Literacy in the Digital World: Implications for Higher Education. *ALSR 2010: Conference towards Future Possibilities*.
- [9] Dale, E. 1946. *Audio-Visual Methods in Teaching*. Dryden Press.
- [10] Gillmor, D. 2010. *Mediactive*. Creative Commons.
- [11] Hall, S. 1980. Encoding/decoding. *Culture, media, language*, 128-138.
- [12] Hamer, J. et al. 2008. Contributing Student Pedagogy. *inroads - SIGCSE Bulletin'08*, 194-212.
- [13] Hoban, G. et al. 2010. Articulating constructionism: Learning science through designing and making "slowmations" (student-generated animations). *ASCILITE'10*, 433-443.
- [14] Hobbs, R. 2010. *Digital and Media Literacy: A Plan of Action*. Aspen Institute.
- [15] Hobbs, R. 2016. Literacy: Understanding media and how they work. *What Society Needs from Media in the Age of Digital Communication*. R.G. Picard, ed. Media XXI. 131-160.
- [16] Horizon Report 2007. [http://www.nmc.org/pdf/2007\\_Horizon\\_Report.pdf](http://www.nmc.org/pdf/2007_Horizon_Report.pdf). Accessed: 2016-06-23.
- [17] Jolls, T. and Wilson, C. 2014. The Core Concepts: Fundamental to Media Literacy Yesterday, Today and Tomorrow. *Journal of Media Literacy Education*. 6, 62, 68-78.
- [18] Livingstone, S. and Thumim, N. 2003. Assessing the media literacy of UK adults: a review of the academic literature. *Seminar on Media Literacy*. March (2003), 54.
- [19] McGee, O. et al. 2016. Out of the Comfort Zone: Embedding Entrepreneurship in a Cohort of Computer Science Doctoral Students. *ITI'16*, 83-88.
- [20] McLoughlin, C. and Lee, M.J.W. 2008. The Three P's of Pedagogy for the Networked Society. *International Journal of Teaching and Learning in Higher Education*. 20, 1, 10-27.
- [21] Papert, S. and Harel, I. 1991. *Situating Constructionism*. Ablex Publishing Corporation.
- [22] Prensky, M. 2001. Digital Natives, Digital Immigrants Part 1. *On the Horizon*. 9, 5, 1-6.
- [23] Read, D. and Lancaster, S. 2012. Unlocking video: 24/7 learning for the iPod generation. *EDUCATION IN CHEMISTRY*. July 2012
- [24] Rodriguez, P.M. et al. 2012. Examining Student Digital Artifacts During a Year-Long Technology Integration Initiative. *Computers in the Schools*. 29, 4, 355-374.
- [25] Sarangapani, V. et al. 2016. Virtual.Cultural.Collaboration. *MobileHCT'16*, 341-352.
- [26] Soundarajan, N. et al. 2015. Collaborative and Cooperative-Learning in Software Engineering Courses. *ICSE'15*, 319-322.
- [27] Thoman, E. 2004. Media Literacy - A National Priority for a Changing World. *American Behavioral Scientist*. 48, 1, 18-29.
- [28] Trilling, B. and Fadel, C. 2012. *21st Century Skills. Learning for Life in Our Times*. Jossey-Bass.
- [29] Weilenmann, A. et al. 2014. Mobile video literacy: Negotiating the use of a new visual technology. *Personal and Ubiquitous Computing*. 18, 3, 737-752.
- [30] Wheeler, S. et al. 2008. The good, the bad and the wiki: Evaluating student-generated content for collaborative learning. *British Journal of Educational Technology*. 39, 6, 987-995.