Consuming Security: Evaluating Podcasts to Promote Online Learning Integrated with Everyday Life

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Abstract—**Traditional (online) teaching approaches put the student into a video-based, classroom-like situation. When asked to reproduce the content, the student can consciously remember what he learned and answer accordingly. Contrasting, knowledge of IT-security aspects requires sensitization for the topic throughout the daily life of a learner.**

We learned from interactions with former learners that they sometimes found themselves in situations where they — despite knowing better — still behaved in an undesired way. We thereby conclude that the classroom-based presentation of knowledge in Massive Open Online Courses (MOOCs) is not sufficient for the field of IT-Security Education. Therefore, this work presents an approach to a study to assess and analyze different audio-based methods of conveying knowledge, which can integrate into a learner's everyday life. In the spirit of Open Research, we therefore publish our research questions and chosen methods in order to discuss these within the community. Following, we will study the perception of the proposed education methods by learners and suggest possible improvements for subsequent research.

Keywords—**IT security education, MOOC, podcast, learning analytics, multimedia, learner engagement, engineering education**

I. INTRODUCTION

The COVID-19 pandemic of the past year(s) has led to a massive surge in online education offers and consumers of the same. Particularly in a situation where many spare time activities were limited, potential learners have started investing time into their education [1]. Thereby, many initiatives have been created and started to enable providing more and more topics in the form of Massive Open Online Courses (MOOCs), e.g., as training for course instructors as described in [2], [3]. Traditional learning contexts such as higher education classrooms or formal training apply varying forms of teaching to catch the learner's interest [4]. While that is a practice that is easily applicable when learning face-to-face, online learning offers such as MOOCs are not implementing many different e-learning design principles according to a recent study [5]. Online courses often lack instructional methods for transferring knowledge to real-world applications or different instructional methods [5].

Traditional online courses started initially by providing video-based learning snippets connected by, e.g., multiple-choice quizzes to engage the learners and ensure that knowledge is appropriately understood. In the last years, the usage of interactive learning content such as those created with H5P [1] or the integration of auto-graders for the assessment of, e.g., programming exercises has increased largely [6].

Still, new knowledge is provided to the learner primarily by video-like elements or additional literature. While that is appropriate and useful in many cases, e.g., when important visual material is needed, such a form of education always requires the learners to be actively consuming it on an electronic device in the form of their computer or smartphone.

In our traditional education approaches for Information Technology (IT) security education, we identified that it is crucial to sensitize today's society for the dangers in omnipresent cyberspace. During talks with students enrolled in our free online courses, we discovered that many of them have perfect knowledge of specific IT-Security principles but struggle to behave *properly* in their personal lives.

The overarching goal of our research, therefore, is to *identify education methods that enable a learner to gain knowledge in the IT-security area in a sustainable way*, i.e., in a way in which it will benefit him in his everyday life for the upcoming years.

To undertake the outlined research, it deems essential to assess how to achieve sustainable sensitization for a topic through online education. We hence aim to investigate how integrating studies into the daily life of a student can influence said sustainable sensitization. Yet, several challenges have to be overcome to allow students to integrate online education into their daily lives. Most prominently, a student needs to physically interact with the learning content (watch the video). Therefore, we evaluate other possible teaching methods by presenting the following contributions in this work:

- Assessment of various possibilities for conveying different bits of knowledge and the opportunity to integrate

[1]Website: https://h5p.org/

them into a learner's everyday life.

- Designing and structuring an evaluation of feasible methodologies to obtain knowledge in an everyday-integrated way.
- Outlining our desired use of Learning Analytics to understand (and further improve on) the use of these methodologies for learners

As the paper at hand outlines our current Work-In-Progress, we want to use this possibility to present our study approaches and design before conducting the study. In a follow-up publication, we plan to present the results and the retrieved knowledge of a course using the described methodologies. Our goal is to address the following research questions:

RQ1. Which education methods can a teacher use to effectively allow learners to integrate online learning into their daily lives?

RQ2. How are the various offers (podcasts, interviews, videos) perceived by learners, and how do they interact with the learning materials provided (leveraging Learning Analytics)?

II. BACKGROUND AND RELATED WORK

This section provides a general overview of other research efforts in a similar area, such as Engineering Education. Mainly, we highlight the current state of research in the fields of *Podcasts, Videos, and Mobile Learning*, primarily focus on *Podcasts as Sole Medium for Conveying Knowledge*, and *Challenges in IT-Security Education*.

A. Podcasts, Videos and Mobile Learning

Before assessing the different kinds of content in the upcoming paragraphs and the remainder of this work, we shortly introduce some general concepts and differentiate between the methods.

Traditionally, video-based online education features learning videos provided by a teacher. Those videos are – particularly in the context of MOOCs – open to everyone to consume. Similarly, podcasts convey knowledge in a solely audio-based format. In addition to podcasts, so-called *vodcasts* extend the audio-based format with visual information. In traditional podcasts, one or multiple podcasters talk about a certain topic of interest, often enhanced by interviews with experts.

Concerning mobile learning, which we interpret as any form of education which does not happen at a fixed place [7], both formats – podcasts and videos – are considered. As mobile learning describes the ability to learn *on-the-go*, e.g., during one's daily commute, to enable mobile learning, teaching videos or podcasts should be available offline.

Learning Analytics can assess interactions of learners with the learning content (regardless of being online or using a native mobile app). These may provide insights for learners themselves (e.g., presented on a personal dashboard or for individual recommendations) or for instructors (e.g., to gain knowledge about complex content or the acceptance of different teaching methodologies). Specifically for videos in online courses, learning analytic engines exist that enrich user

interactions (play, pause, seek) with the learner's performance and behaviours [8]. For the study outlined in this paper, we aim to leverage similar tools for analyzing the interactions with the multimedia content offered.

Previous research has shown that mixing various multimedia formats in a course is beneficial for learners in terms of engagement and content delivery [9]. Whether a learning video, (interactive) animation or a demonstration, those formats typically require the learner to interact with the learning content visually. One exception is audio podcasts without visual information, which experience rising popularity within online courses and as dedicated offers [10]. Educators creating an audio-only format instead of video-based content are facing lower efforts in the creation [11]. Many other pieces of research explicitly excluded a comparison of the impacts of delivery methods for learners (for example [12]). With the evaluation outlined in this paper, we want to close this gap and compare the learning outcome gains for various content presentations using podcasts.

B. Podcasts as Sole Medium for Conveying Knowledge

In the past years, the amount of podcasts available on the internet has boomed [13]. There are barely any topics which are lacking a corresponding podcast. However, research has shown that most prominent podcasts which do not solely aim at entertaining their listeners but rather have a more sophisticated goal of presenting and teaching complex topics usually rely on further resources than the podcast alone [14]. Be it the availability of lecture notes or Hyperlinks to further documentation or information on the internet, podcasts often make good use of the benefits known in online learning methods.

Those benefits are, e.g., quizzes or exams which test the learners' knowledge and therefore maintain their interest in further occupation with the specific topic. Online education additionally also allows learners to engage in, e.g., online forums, sharing their learning experiences with other learners of the same or similar topics.

C. Challenges in IT-Security Education

As highlighted in other research, the field of education in contexts of Security in Information Technology (IT) faces several problems. One of the major problems is that specialists for IT-Security concepts may build the most secure system. Still, whenever a layperson uses that system without specific knowledge or sensitization for the topic, even a secure system is at risk [15].

According to Rowe et al., although researchers and academic institutions acknowledge that awareness of possible threat models in IT security is essential, even existing IT programs do not cover security topics adequately [16]. At the same time, it is emphasized to embed security topics in engineering education: For example, one of the challenges faced with the introduction of Industry 4.0 is the need for IT security awareness while interconnecting various traditional engineering topics [17]. In engineering education, the literature

identifies both the acquisition of deep technical knowledge in a specific area as well as a broad professional engineering skillset as key skills [18]. We argue that fundamental IT security awareness should be part of the more comprehensive engineering education as it is essential for many other professionals and everyday life.

As shown by many other current researchers, educating laypersons for sensitization in IT-Security demands is a daunting task. Achieving a permanent behavior change by laypersons in the digital world requires educators to address one of the higher levels of Bloom's Taxonomy (which describes the human cognitive learning processes with six levels) rather than the lowest *remember* level [19]. Furthermore, Ebbinghaus has shown in several experiments that learners might remember as little as 25% after 48 hours have passed [20]. According to his studies, one possible way to increase the retention rate of learning content is repetition, which has shown positive effects in the MOOC context with spaced repetitions [21]. Daniel and Woody further studied the use of audio podcasts for delivering new content; however, "the use of audio podcasts remains untested for delivering secondary content that reinforces, extends, and contextualizes the primary concepts of a course or concept" [22].

Performing education in a specific situation / framed training has shown to be very ineffective due to a multitude of reasons [23], [24]. While such challenges are faced using various techniques for learner engagement in face-to-face learning situations, this is hardly possible for online learning situations. The work at hand shall therefore present a step into the direction of online multimedia learning in the area of IT-Security.

III. COURSE CONTEXT

The following section introduces the general topic the course is dealing with to better understand the content to be taught.

As previously described, security in information technology (IT) is becoming more and more prominent in today's world. With the increased factor of digitization in the world, it becomes increasingly important for each individual to experience sensitization for the threats of the internet. Starting from the dangers of bad password usage up to the knowledge about how to use online banking securely, everybody is responsible for keeping care of their own digital identity.

Therefore, teaching particularly laypersons fundamentals in the security of information technology and the internet is a challenging but essential task for professionals of that specific area. In the past years, many MOOCs for laypersons have been held to teach the underlying issues. In our previous IT security courses, learners achieved a mean score of more than 85% across all multiple-choice quizzes and graded exams. According to our learning analytic insights, offered videos were often watched completely (or even repeated) by enrolled learners. However, interaction with learners in the forum shows that it is not uncommon that even knowledgeable learners still experience problems with their online identities.

Therefore, we conclude that a sensitization for the topic is far more important than teaching expert knowledge itself for laypersons. To sensitize the learners, we would like to disconnect the learning process from the time they spend in front of the electronic devices they are using to consume the offers. Instead, we aim to produce content that is consumable during the chores of the learner's daily life, such as when cooking food or cleaning dishes. If feasible, we aim to evaluate whether integrating learning new content into daily lives can improve the learner's long-term sensitization for a particular topic. However, to achieve this goal, we focus on exploring methods for conveying knowledge that the learner can integrate into his daily life.

A. Contents to be Taught

Assessing the requirements for the learning situation, we quickly determined that the aimed learning experience requires that the user can do tasks parallel to consuming the learning content. Therefore, teaching components that require user interaction, such as quizzes or even video material of a particular topic, could be hard to follow as those need the user to either interact or actively watch the screen of his device. This results in the fact that only audio content can be properly used for the described learning scenario.

However, teaching plenty of new content in a solely audio-based way will quickly hit certain limits. On one side, providing additional graphical helps to explain complex contexts. Therefore, we have to choose carefully which content to teach in an audio-only form.

After close consideration of our syllabus, we decided that we would add a section to each module of content: **Analysis**. This section will revisit the contents taught before and evaluate questions that interconnect the different bits of knowledge that should have been gained. As the learners should – at that point – be familiar with many of the underlying principles, the fact that graphical material is not provided should not hinder their learning process. Instead, they should be able to listen to the review of the knowledge and understand it without additional visual input. Using the randomized control trial outlined in Section V, we will validate that assumption.

B. Exemplary Overview of Content in the Analysis Section

Figure 1 shows a an exemplary extract from the course's syllabus. As presented, the appropriate section in the course concerns topics on *User Authentication* and highlights functionality, advantages, and disadvantages of the specific methods.

In that case, the **Analysis** section aims at answering questions that a learner might have and that are interconnecting all the different pieces of knowledge gained in the various sections of that module or the more extensive scope of the course so far. Therefore, the questions that the instructors will answer help to extend the gained knowledge. We do not plan a simple revision of the module's contents for our syllabus but rather an enhancement of the provided knowledge as relationships between different elements are highlighted.
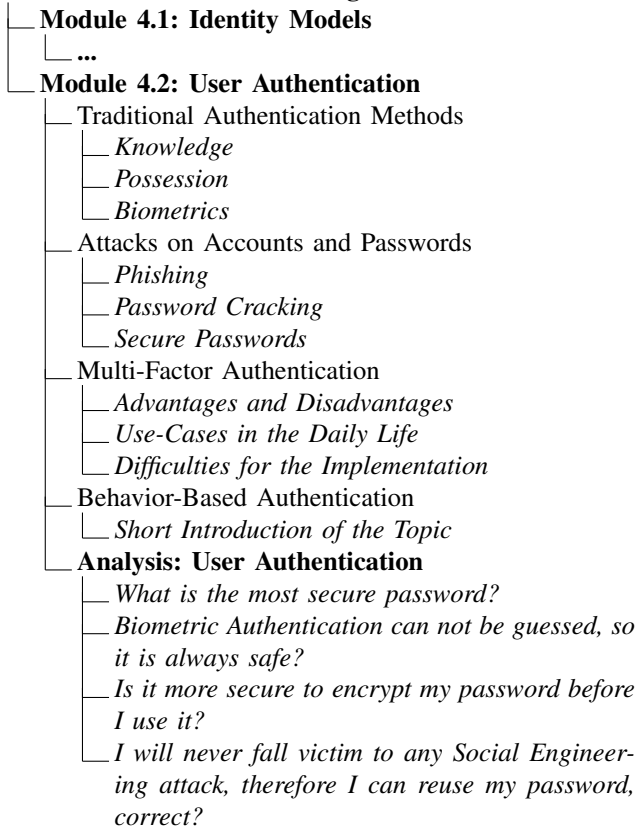
Module 4: Identities in the Digital World
└ **Module 4.1: Identity Models**
   └ **...**
└ **Module 4.2: User Authentication**
   └ Traditional Authentication Methods
      └ *Knowledge*
      └ *Possession*
      └ *Biometrics*
   └ Attacks on Accounts and Passwords
      └ *Phishing*
      └ *Password Cracking*
      └ *Secure Passwords*
   └ Multi-Factor Authentication
      └ *Advantages and Disadvantages*
      └ *Use-Cases in the Daily Life*
      └ *Difficulties for the Implementation*
   └ Behavior-Based Authentication
      └ *Short Introduction of the Topic*
   └ **Analysis: User Authentication**
      └ *What is the most secure password?*
      └ *Biometric Authentication can not be guessed, so it is always safe?*
      └ *Is it more secure to encrypt my password before I use it?*
      └ *I will never fall victim to any Social Engineering attack, therefore I can reuse my password, correct?*

Fig. 1. Exemplary extract from the course's syllabus highlighting one **Analysis** section planned as a foundation for the study.

IV. COURSE CONTENT DESIGN

As previously described, the core element of the proposed study consists of learning elements used to review essential parts of the previously presented module. The underlying question, whether combining learning into daily life activities supports the subconscious reminiscence of the knowledge, will be investigated in future research. To properly assess that, we have to identify which teaching methods can be involved in daily life to please the learners.

With this goal at hand, we decided to assess three different methods for the identical content.

A. Podcast

Very common and known by a majority of people are traditional podcasts. Podcasts are usually used to transmit knowledge in a purely audio-based format and have found massive success over the past years. Therefore, we decided that a traditional podcast approach should be one of the teaching methods to be evaluated in our study. We plan to introduce the podcast with a small informational text that the following content can be consumed while following other activities. This introduction shall engage the learner to enter the daily-life situations that we aim to evaluate for their subconscious teaching effectiveness later.

B. Interview Podcast

Many podcasts known from our daily lives do not rely on a single speaker alone. Instead, they often interact with two or more people to create an engaging atmosphere and synthesize ideas. Therefore, we aim to study whether learners prefer podcasts with more than one speaker or a single speaker only. In the *Podcast* method presented before, the knowledge is provided by a single teacher alone, while for this method, two teachers are going to interact with one another, asking questions and reviewing the achieved knowledge.

C. Espresso-Podcast

Like the traditional podcast approach, we plan to have one teacher alone present the contents for this method. However, rather than reviewing all material at once and creating a podcast episode that might be 30 minutes long, we plan to split the podcast into multiple short podcasts, each not taking longer than 5 minutes. This aims to evaluate whether a learner would appreciate being offered the possibility only to consume a specific, time-limited set of information at once because they, e.g., might not be interested in listening for a more extended period.

D. Traditional Video

To reference traditional online teaching methods, we aim to have one method being a traditional video. However, essential to note is that while a conventional lecture in video form would rely on the help of, e.g., PowerPoint slides, for this method, we want to emphasize that we will not provide additional information on a visual basis. I.e., we plan to record the video while recording the podcast. The teacher will be visible, as will be his gestures and general body composure. Still, he will not show additional graphics or slides, solely the information that he explains shall be relevant.

V. STUDY METHODOLOGY

As the context of the study has been laid out, this section presents the methodology of the study that is to be performed later this year.

A. Target Audience

To enable various people with different backgrounds to take part in the study, we aim to perform the survey during a MOOC. In the past, similar MOOCs offered by us often had 2000 to 4000 learners enrolled.

B. Assessment of Methods

As we aim to have the same content taught with different methods, each learner will only experience one method of presentation by default. Therefore, we plan to *randomly* assign learners to one form of presentation of the content. The random assignment allows us to have equally distributed groups of learners for each of the different methods in the study.

C. Evaluation

Using methods of qualitative and quantitative research and evaluation, we plan to evaluate the *performance*, *success*, and whether the learner *liked the presented method*. The performance of a learner is rated by his performance in corresponding quizzes and graded exercises. This data is evaluated using learning analytics and combined with further personal information, e.g., typical learning scenarios or previous knowledge. We aim to collect such general information using questionnaires based on 5-Point Likert-Scales [25] with additional free-text questions. Where suitable, we also intend to ask learners *how likely it is that they would recommend the learning materials to a fried* and calculate the net promoter score (NPS) based on their responses [26]. Using both described feedback mechanisms should allow us to understand the learner's experience and success with the specific content. Asking these questions might show similarities across different methods as the knowledge presented remains the same nevertheless.

We can further rate the success of a method by comparing learning analytic information on the corresponding learning elements (e.g., videos, podcasts, ...) to other elements in the same course. Specifically for the podcasts, we aim to capture similar learning events to those generated by the learning analytic engine available for videos in the MOOC platform. At the same time, we will ensure that the podcasts offered can be accessed seamlessly through a smartphone. Creating an easy way of interaction ensures that learners can listen to the podcasts during their daily life chores.

Further, we aim to ask specific questions regarding the *method of knowledge transfer* used for the content that the learner just consumed. Interesting questions could contain Multiple-Choice questionnaires in which the learner can choose how he would rather have liked to consume the content. Subsequent free-text answers allow them to provide more context for their answers. For example, the first questions of a questionnaire might be:

1) After having listened to the content, are there possibilities for improvement? (*multiple-choice question*)
   - ⃝ Yes, I would have preferred to **see** the speaker while listening (Video)
   - ⃝ Yes, I would have preferred to listen to **multiple speakers**
   - ⃝ Yes, I would have liked to listen to **shorter snippets** of information, e.g., "Espresso Podcasts" with a maximum length of five minutes.
   - ⃝ No, I liked the way that the content was presented.
   - ⃝ Other (Please specify)
2) Please let us know any additional feedback that you might have! (*free-text question*)
3) **...**

One major advantage we see in those specialized questionnaires is that the learner can explicitly be shown what the differences in terms of the methodology would have been. Similarly, e.g. for a learner having consumed the *Interview Podcast*, one question could be whether he would prefer the content to be only presented by one speaker.

Finally, we want to perform short qualitative interviews or interview-like evaluations with learners from the different methods to ask them open questions and derive ideas for future improvement.

VI. Outlook

The *Work-in-Progress* paper at hand aims at presenting a study design and the corresponding study methodology as well as the research questions connected to the study. We thereby aim at transparency in current research topics and open up opportunities for discussion, ideas, and further input to the planned research.

We envision the presented research to provide new insights on differences in content delivery to learners by leveraging learning analytic data, quantitative and qualitative surveys. As described in Section II we could not find sufficient research on the question of content delivery using podcasts and vodcasts for IT security topics. We, therefore, aim to provide a first springboard – particularly for our research area – into that field of knowledge delivery.

With the knowledge gained from the proposed study, we aim to broaden the multi-media and cross-media possibilities for online education contexts in the field of IT education. Enabling multi-media and cross-media potential can further help to allow personalized learning experiences that a learner can adjust directly to his preferences. Similarly, the presented potential can help to develop further the use of explorative content in online learning scenarios.

Given the identification of a *suitable* method for everyday-life-integrated learning experiences, we aim to investigate the broader research question, whether the subconscious of a learner is better prepared for everyday challenges when trained by everyday-integrated learning material.

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