A Case Study of Learning Personalization in Class Based on Blended Learning with Multimedia Content

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Abstract

The Online courses based on multimedia content mixed with other formats like HTML facilitate personalization in regular classes. Tailor-made applications also help to increase personalization, resulting in a methodology that improves and accelerates learning. Syllabus expansion and a growing volume of exercises support that idea year after year, as learning becomes more and more personalized. Recent research shines a light on the concept of personalization and helps to explain six years of teaching experience in class, where personalization brought benefits, difficulties, and challenges.

1. Introduction

This case study reports a teaching experience implementing personalization with blended learning. This experience uses two tailor-made applications and online courses with multimedia content -mainly videos recorded in class- combined with other content formats. The context is a Vocational Training program at a charter school in Seville, Spain.

One group of students are over 16 years old, and in a second group they are over 18. However, precedence varies, and so does age. Some students are over 20 in both groups, and depending on the academic year, some of them may even be over 30.

The first group is an intermediate vocational training course ISCED-2011 level 354. When applying, students are required to have finished secondary school or equivalent. The second group is an advanced vocational training course ISCED-2011 level 554. When applying, students must have finished the former intermediate course or upper secondary school, equivalent to high school [1]. Both courses are about applied computer sciences.

All classes are in-person, never online, and any online resource is prepared to be used during classes. That has come to be called blended or hybrid learning [2].

2. Initial learning theory review

At first, two main approaches and their theoretical corpus support this teaching experience. They are multimedia learning and blended learning.

2.1. The Cognitive Theory of Multimedia Learning

Based on the Cognitive Load Theory [3], Mayer and his colleagues at the University of California, Santa Barbara, developed the Cognitive Theory of Multimedia Learning [4]. They consider multimedia content as the combination of voice explanation synchronized with images in motion [5].

With a firm foundation in experimental research, Mayer demonstrates several principles related to learning effectiveness using multimedia content. We may mention, among others, the split-attention effect [6], the signaling principle [7], or the coherence effect and the redundancy principle [8]. Together, these results and principles form a set of design heuristics that leads Mayer to advocate for the multimedia learning principle -formerly called hypothesis: "People can learn more deeply from words and pictures than from words alone" [5].

Video content has been successfully used in different formal educational contexts. It impacts the way students learn, and multimedia content has proven advantageous to traditional teaching in different educational levels, such as elementary school and college [9]. A case worth mentioning is the Khan Academy and the Khan Lab School in California. Sal Khan founded both institutions following his insight on learning, which he elaborates on during two TED Talk conferences in 2011 and 2016.

According to Sal Khan, students like having control over the content in videos, something that they do not have during a lecture. Thus, videos help students learn at a personalized pace, "removing the one-fits-all lecture to 30 students" [10].

2.2. Blended learning

According to several authors, blended learning is the combination of online and face-to-face instruction [2]. One of the reasons for blending learning is that in-person classes may benefit from e-learning platforms. In particular, these platforms are valuable tools for the students that facilitate taking control of one's own learning.

Well-equipped online courses include several tools for students that help them keep track of their progress, review previously accessed content, selfassess their learning, and so on. In short, those tools leverage students' autonomy. As it happens with multimedia content, using an e-learning course in a 30 students face-to-face class makes it possible that every student learns at their own pace. Therefore, we can affirm that blended learning lets personalize learning in class. This idea is supported by a report of Public Impact and Clayton Christensen Institute in 2018. It focuses on the experience of eight schools in the USA that implemented learning personalization in class thanks to blended learning solutions and new teaching roles [11]. We will give more attention to those new teaching roles later in this paper.

3. Personalization of learning through blended learning with multimedia content

In our case, videos may show software demonstrations, software issues solving, concept explanations, or design problems. Different visual materials are often combined in the same recording, mixing, for example, slides with screencasts, websites, and a document camera. With all that content, students learn Database Design -which involves unstructured and open problem solving with conceptual diagrams-, SQL (database language), and deployment of networkoriented servers and services, like Web services and intranets. This last subject entails understanding how software and networks work and procedural knowledge.

The multimedia content consists of more than 200 videos. Most of them are between two and five minutes long. Each video contains an explanation made during an in-person class, recorded while students watched it on a projector screen. All the videos and playlists are accessible on a YouTube channel: http://youtube.com/ldts1.

The experience behind this case study supports the idea that students learn with a deeper understanding and faster. Consequently, extending the syllabus is possible when classes take advantage of the multimedia format. An example of this is an intermediate level course about Linux-based Web Servers, as shown in Figure 1.
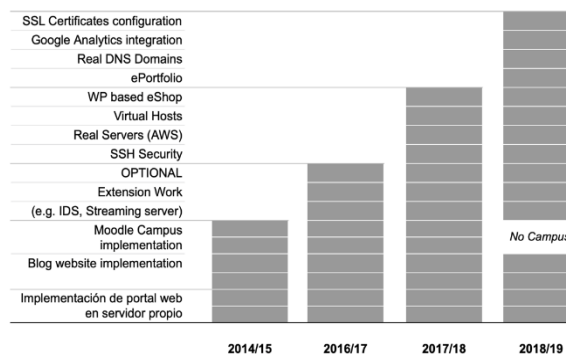

Figure 1. Syllabus growth as personalization increases in a 21-week course, 3 hours per week, part of an intermediate vocational training program

In addition, multimedia content made it possible to individualize learning. This case study entirely agrees with Sal Khan regarding educational video content and the benefits of learning each student at their own pace without being forced to move along with their peers.

Paradoxically, that also helps students to move faster, as more skilled students do not stop, resulting in generalized faster learning. Table 1 shows the workload growth in a Database's 32-week course, part of an advanced vocational training program, where students are over 18.

Table 1. Workload evolution in an advanced Database course

Part	2016/17	2017/18
I. DB Design	10 designs	14 designs
II. SQL - DDL DML	2 cases	3 cases
III. SQL Queries	18 collections	23 collections

Note: A SQL collection usually has 6 to 7 exercises.

The main difference between 2016/17 and 2017/18 was that, during the second year, assignments were handed out individually every time a student finished the previous task and requested a new one. In addition, corrections were recorded and delivered in video format, and the online courses were published on a website and incorporated into regular classes. That course included all the assignments from the year before plus a few more with an advanced level.

As far as we leverage individual learning, we become capable of building a learning community in our classroom. This statement aligns with the idea that individual learning processes precede collective ones [12]. Besides, learners become prepared to participate in that learning community, produce meaningful contributions, and become active members.

3.1. Issues derived from video content as the primary source

Using multimedia content for the students to learn from also has inconveniences. This case study makes us think that students have similar struggles, both with multimedia content and textbooks.

In particular, after several months, students revealed some weariness because of the videos. Furthermore, some of them, sometimes, showed

excessive difficulty getting the gist of the explanations. Adhered to the cognitive load theory and the cognitive theory of multimedia learning, some solutions to avoid the inconveniences mentioned above were implemented. Following the coherence principle [8] and keeping in mind the limits of the working memory [3][4], videos were limited to a three-minute length, when possible. According to the signaling principle [7], embedded headings and transitions resulted in helpful signals to emphasize the rationale and the scheme behind explanations. Video editions increased to remove pauses and interruptions in the recording [8]; thus, videos kept a certain rhythm. These measures helped students keep focused and connect ideas between new videos and previously acquired knowledge. Additionally, short questions introduced into some videos with H5P software helped students avoid passivity and check their understanding through formative assessment. The elaboration of online courses proved helpful by complementing videos with other content formats, such as HTML pages with images. They also helped to establish the syllabus that students should complete at their own pace. Despite all the effort, some students were reluctant to personalized learning in class. Indeed, things were challenging for them, and they demanded replacing the online platform and video content with traditional lectures. Those students, though a minority, represented another challenge for this approach.

4. A different insight on personalization

After several years of developing personalized learning, it looked as if the methodology was not entirely correct nor complete. An ongoing systematic review about personalization in schools reveals some key points that lead to a more comprehensive insight into personalization.

Personalization is a controversial concept [13][14], especially when viewed from a behaviorist perspective. From this viewpoint, maximum learning effectiveness is the goal, pure individualization is the way, and technological resources are the key. Some opinions even say that in the future, teachers may be expendable. Entirely on the contrary, as personalization evolved, some teacher roles became crucial, like a facilitator, a mentor, and a central member of the learning community that a classroom

like this entails. These roles are especially relevant when it involves students who are not a good fit with this methodology. Part of the solution was improving their reasoning capacity, thus becoming more autonomous learners and less teacher-dependent. When students demand assistance or assessment, student-teacher dialogue is essential to get that improvement. A well conducted conversation has the virtue of leading the student to formulate the right questions and infer the answers instead of being told. Thus, they reach a deep understanding. Many theories support this way of teaching, including scaffolding and Vygotsky's zone of proximal development [15], among others. It also leads to a more comprehensive personalization concept where the teacher ensures that learning makes sense for every student according to their previous knowledge and mindset.

4.1. The need for mentoring students

Furthermore, the teacher support that students receive must not end with academic aid. There is a need for individually guiding the students in their process of becoming autonomous learners. That kind of help goes beyond theoretical explanations and problem-solving assistance.

As mentioned before, the Public Impact and Clayton Christensen Institute report underscores the importance of blended learning and new teaching roles for personalizing learning. In particular, they propose "mentoring students—forming closer relationships and helping students develop habits of success and social-emotional skills."

In that line, Rutledge et al. give another valuable insight, pointing out that the student-teacher relationship is critical at effective schools, even when instruction quality is outstanding [16]. After several years of teaching with helpful technology, this experience aligns with Rutledge, who advocates for "Personalization for Academic and Social Emotional Learning." Their findings emphasize the importance and benefits of the relationships between adults working at schools and each student. That importance is especially evident when it is about those learners who have developed little autonomy. Consequently, one-to-one teacher-student interaction makes a difference. However, how can it be possible for one teacher with 20-30 students in a class?

5. The role of education technology in personalization

We can agree on the fact that technology is neither sufficient nor central, we may admit it is necessary. Many research work from the past decade draw on the point, suggesting that teachers cannot carry on that huge classroom workload [17]. At first, it looks like they should multiply themselves by ten or twenty to assist each student. Here is where education

technology may have a say. The aforementioned tailor-made applications and online courses have proven to be immensely practical and transparent. By transparent, we mean that education technology should never be the primary focus. Instead, it helps to learn and see more, like a pair of glasses do. Figure 2 shows the application made for personalized coursework delivery with the student's names blurred. This tool made it possible to hand out assignments both individually and instantly. It manages more than 50 assignments given to more than 20 students -above a thousand worksheets- at the right time. It works on Google Drive, and we programmed it using Google Script. Clicking on any of the students' names makes the application send the exercise to the student. They receive a Google document containing the individual worksheet and the previous answer key with a video explanation.
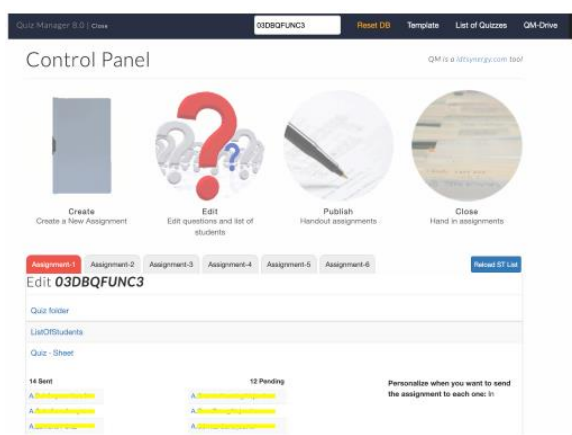

Figure 2: The tailor-made application for individualized exercise delivery

As the theory behind this case study claimed, these years of experience sustain that blended learning - understood as e-learning in face-to-face classes- helps personalize teaching, making it easier to students to become more autonomous learners. That autonomy makes them less dependent on the teacher, and consequently, the teacher can assist whoever needs it whenever needed or check in on students one by one. However, it is not easy at the beginning of the course since students are not naturally autonomous. They usually need to acquire the skills to become self-regulated learners [18], which is one of their teacher's primary goals. To that purpose, new teacher roles are capital for mentoring students, motivating them, and scaffolding their learning process.

6. Benefits

With the class adaptations of this methodology, some benefits that have been previously reported by other researchers our noted. Learner's exercise and develop autonomy and self-regulation strategies with

the guidance of their teacher. As students' independence increases, teachers have time to help more diverse learners one by one. Not in vain, personalization is widely present in academic articles regarding inclusive classes [19]. We have provided adequate personalized help to students diagnosed with Asperges' syndrome or ADHD. Moreover, this methodology facilitates adapting instruction to each learner, considering their needs and differences [20].

The COVID 19 pandemic has proved this teaching approach more valuable. The lockdown we lived through during 2020 encouraged students to become more autonomous than ever. Of course, they counted on the teacher's assistance, and distanced classes were held with video conferencing, but never had the learning process been so independent as then.

7. Conclusion

A proper design of the education technology may lead to a substantial benefit in classrooms. Well understood, personalization, leveraged by transparent technology and multimedia content in a blended learning setting, helps students become more self-regulated and autonomous. Consequently, the teacher can reach the individual student needs, checking in on them one by one. Though necessary, technology is not enough. Beyond technology, teacher-student relationships and new teacher's roles -like facilitator and mentor make a significant difference in helping the student develop autonomy and self-regulated strategies. That way, most students will be very likely to be successful in a personalized learning classroom.

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