Using H5P Services to Enhance the Student Evaluation Process in Programming Courses at the Universidad Politécnica Salesiana (Guayaquil, Ecuador)

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Abstract. This study analyzes the effectiveness of H5P services used to create interactive student evaluations on a Moodle platform. The content evaluated in this study comes from the Universidad Politécnica Salesiana (Guayaquil, Ecuador) Programming Course syllabus. Study participants are first year university students (18–20 years old). The students participate in a learning validation experience through Python Experiential Educational Platform (PEEP), designed for this purpose. A 75% improvement in retention of acquired knowledge is achieved by using active learning strategies during assessment. With H5P technology professors can reuse audio and video material previously recorded, together with the material they generate in each new class, allowing them to reuse resources not only for informative or didactic explanation, but also as an interactive evaluation resource made possible by interactive technologies designed for this purpose.

Keywords: Interactive assessments · Active learning · Technology enhanced learning · H5P

1 Introduction

1.1 Evaluation Strategies for an Active Learning Processes

The current generation of youth studying at the postsecondary level are known as the generation of “digital natives”, as their daily activities involve the continuous use of technological instruments [1]. To ensure an effective teaching – learning processes their teachers must constantly incorporate new technologies and develop new methodologies to effectively achieve specific learning goals while also participating in networks of educational professionals to share knowledge through the exploration of didactic resources that facilitate an effective educational process [2, 3].

Since March, 2020 due to restrictions in place to combat the COVID 19 pandemic [4], Ecuador requires social isolation measures. Technology and technological services have become an increasingly necessary support for teachers that use them for online, virtual and distance education [5]. Professors must define instructional strategies that
guarantee learning in virtual environments [6]. The pressing question for educational researchers in the coming years is how to create an active, effective, sustainable learning process that combines online learning with autonomous student work [7, 8].

An active learning process implies that a student is involved in teacher planned activities in an autonomous learning scenario [9, 10], such as study groups or work exchanges between students as well experiential stimulation processes such as the use of simulators [11, 12] or activities based on projects or challenges. The student learns at his or her own pace on his or her own terms and the role of the professor is that of a learning guide [13]. For professors the question arises “how can learning evaluations be optimized in this day and age?” The question opens the door to the exploration of interactive dynamic evaluation methods through known technological platforms [14, 15]. The use of new technologies or technological services within platforms that facilitate the continuous development of an active teaching-learning process poses an interesting challenge for professors as they must learn to use the new technology to potentiate student learning.

1.2 Technology Supported Learning and Interactive Evaluations

With the arrival of new technologies that offer educational services [16], learning experts worldwide agree that to ensure active and flexible learning, validation strategies must not only evaluate knowledge but must also motivate attention, assimilation and retention of knowledge through experiential approaches [17].

The application of immersive technologies [18–20] during a learning process requires that students have devices capable of producing an active experience whereas internet based technological services [21, 22] allow an experience with similar characteristics while hosting infrastructure in a virtual environment [23, 24].

H5P [25] services offer open source technologies for interactive content generation. Its philosophy of creating, sharing and reusing teaching resources with HyperText Markup Language and version 5 (HTML5), compatible with integration through platforms such as Blackboard, Brightspace, Canvas, Moodle among other learning management systems (LMS) and virtual learning environments (VLE), allow public and private institutions, educational institutions in particular, to create interactive learning strategies\(^1\) while optimizing reusable evaluations [26, 27].

2 Materials and Methods

This study uses an empirical methodology with a quantitative approach in a quasi-experimental model. It applies the survey technique to four groups of first-year university students. Sixty-eight students out of a total of one hundred and seven participated in the experience of measuring their knowledge through two types of evaluations: the first a questionnaire tool through the VLE platform (in Moodle) [28] and the second through the interactive H5P tool (integrated in the Moodle platform). This study has a confidence level of 89% and a margin of error of 5.9%.

\(^1\) Available at [https://h5p.org/].
The student participants are enrolled at the Universidad Politécnica Salesiana in Ecuador. The University has three campuses located in the cities of Guayaquil, Quito and Cuenca (main campus). This study is conducted on the Guayaquil campus. The syllabus of the Programming course is modified to incorporate H5P technology, introducing interactive course videos, which can then be used during the evaluation process. A Moodle based learning platform hosted at https://academiadevcode.com/moodle30/ is used for the experiment. In this setup, the administrator configures the H5P integration, a professor prepares appropriate instructional content and students are assigned a username and password to participate (see Fig. 1).

![H5P implementation diagram to prepare an activity within a virtual course](image)

Today’s society increasingly demands study methods that use communication technologies with adequate instructional design and technological tools, where a teacher can rapidly manage and development interactive activities for learning and evaluation [25]. Traditional teaching methods used in face-to-face classroom education have proven ineffective with the arrival of COVID-19 restrictions which have pushed schools to virtual environments. Teachers are now looking for new, creative, easy to use methods to promote the teaching-learning process in a virtual environment. H5P technology improves a variety of didactic resources by creating interactive experiences from traditional learning resources through its inter-active HTML5 package (see Fig. 2) [29].

Although many different digital learning tools are currently available, they are often expensive and difficult for teachers and students to manage [30]. H5P allows an appropriate and adaptable integration into learning systems with which teachers and students are already familiar (see Table 1).

H5P is a software as a service (SaaS) solution that, through technological resources, uses a standard integrated communication protocol to provide internet-based support. It distributes a software resource with technology available on its servers, known as Learning Tool Interoperability (LTI) that can be used in a transparent way by a variety of clients. Table 1 shows the different integrations available for H5P applications².

² Obtained from https://h5p.org/node/287135.
Fig. 2. H5P applications available at H5P.org

Table 1. Types of H5P integrations

| Systems               | Embed | Integrations via LTI | Plugins |
|-----------------------|-------|----------------------|---------|
| Canvas                | X     | X                    |         |
| Brightspace           | X     | X                    |         |
| Blackboard            | X     | X                    |         |
| Moodle                | X     | X                    |         |
| WordPress             | X     | X                    |         |
| Drupal                | X     |                      |         |
| Sakai and others      | X     | * (systems that supports LTI) | |

2.1 Python Experimental Educational Platforms

This study evaluates learning achievements of first-year engineering students enrolled in a programming course at the Universidad Politécnica Salesiana (Guayaquil, Ecuador) through a Python Experimental Educational Platform (PEEP) hosted in a virtual Moodle 3.9 environment integrated with H5P. PEEP\(^3\) is used to create unique virtual instructional spaces including digital materials, collaborative work (discussion forums, chats, emails, etc.) and interactive evaluation material meeting the specific needs of users (both students and teachers) in a specific study program (Fig. 3).

\(^3\) Available at [https://academiadevcode.com/moodle30/login/index.php](https://academiadevcode.com/moodle30/login/index.php).
The structure of the platform on Moodle allows for the integration of H5P, adapting the platform’s own classroom resources and turning them into interactive learning objects. By using the Learning Tool Interoperability (LTI) it incorporates objects with different formats such as video formats or links from YouTube to integrate them into VLE and enrich them with H5P technology (tool provider) for interaction (see Fig. 4).

For example, the interactive videos of a teacher hosted on a YouTube channel, created for a class, can be reused in the VLE by automatically incorporating interactive questions (tool consumer) assigned at times, and specific to each activity. The student responds to the questions as he or she watches the prerecorded class, verifying acquired knowledge and testing comprehension by choosing an answer (in real time), and finally receiving the total score achieved at the end of the video. A traditional multiple-choice questionnaire is improved by using it as a dynamic interaction learning tool (see Fig. 4).

The study conducted two evaluations at different times with questions about the Python programming language and good practices for developing programs (see Fig. 5). Students were invited to participate in the evaluation experience using new technologies. Of a universe of one hundred and seven students (four courses of engineering students) sixty-eight students freely chose to participate in the study. Two evaluations are applied,
one without H5P technology and one incorporating H5P technology in the teacher’s pre-
viously developed evaluation resource. The first test used a VLE questionnaire whereas
the second used an interactive resource integrated with H5P in the VLE. After com-
pleting the tests, a survey was applied to teachers and students to gather data about the
design of the learning environment using H5P resources, learning motivation and its
evaluation, and satisfaction levels while using the PEEP integrated with H5P.

3 Results and Discussion

Students participating in the PEEP testing were assigned a username and password
to authenticate their identities. Sixty-eight students volunteered to participate in the
study, 64% of the total universe. Participants had the following age distribution: 10% under 18 years old, 78% between 18 and 20 years old, and 7% older than 24 years old
(see Fig. 6). The heterogeneity in students’ ages allows us to understand generational
differences in classroom interaction and how students benefit or understand differently
the use of technology in an evaluation process. Students adaptation to new technologies
is improved when the new technology is used consistently.

Two tests are given: the first with traditional content we will define as “static” and
the second integrated with interactive H5P resources we will define as “dynamic”.

The results of the evaluations show a variation in the grade obtained by the students
before and after using H5P. 6% receive a lower grade, 19% maintain the same grade and
75% improve their grade (see Fig. 7).
The results show the percent that grades improved or reproved (see Fig. 8). The group that received a lower grade on the second test received generally high grades on the first test (7, 9, 10 and 9 out of 10 on the first test and 6, 8, 6 and 4 on the second test). This data shows that for the second evaluation to be effective participants must understand the use of technology and the way to select the correct response, and they must be more observant during the evaluation. Furthermore, these results indicate that the connectivity and proper use of the device used by the student should not affect the evaluation process, although this possibility remains open.

Participants were asked to evaluate on a scale of 1 to 5, 5 being the highest evaluation, the assessment potential of the H5P interaction tool applied in the evaluation process. 62% of the sample valued it as 5, 28% as 4, and 10% as 3, showing that 90% of participants accept the tool. No participants evaluated the tool’s assessment potential as 1 or 2 (see Fig. 9).

To the question “By using videos with automatic questions from time to time, do you believe that student attention improves?” 97% responded that “Yes, attention improves” and only 3% replied that “No, attention does not improve”, implying that attention improves when students must answer interactive questions such as those generated through the application of H5P resources (see Fig. 10).
When asked if technology and technological services can improve learning, the results show that 59% believe that learning can be improved by 100%, 29% believe that learning can be improved by 75%, 9% believe that learning can be improved by 50% and 3% believe that learning can be improved by 25%. This means that 88% of participants believe that technology and technological services can improve learning by at least 75% (see Fig. 11).
Lastly, participants were asked about their motivation and interest in the instructional content used for the development of the teaching and learning of the Programming subject through interactive resources housed in the Python Experimental Educational Platform, PEEP. 94% indicated that interest in the content used on the platform was motivated by the interactive resources used by the teacher during the Programming class (see Fig. 12).

![Motivation generated while using the interactive resources of the Python Experimental Educational Platform (PEEP) to learn programming, percentage](image)

Currently, choosing instructional content means choosing tools that not only permit the replication of a classroom activity in a virtual environment, but also empowering learning even more than the same activity would have in a traditional classroom. According to the research contained in the Bibliography and the author’s experience, there exist technology and technological services that allow a teacher to develop a learning activity (for example, an interactive video) that can also enhance said learning. Teachers must assess the learning results that are expected to be obtained from the application of a new technological resource versus the time it will take for the teacher and students to master the technology to prioritize (or not) its use in a learning environment; this subject continues to be open to discussion.

## 4 Conclusions

Active learning allows a student to involve him or herself in a more dynamic way, stimulating abilities that allow detailed observation, acuity in attention and strength knowledge retention, increasing interest in the proposed activity and enhancing learning. Active learning evaluations involve techniques that make use of existing technologies or technological services chosen specifically for their applicability from the teacher’s experience.

Students are motivated when they are involved in dynamic, interactive activities. The new generation of students accepts multimedia resources as they already have great familiarity with them from their daily lives. Teachers increasingly require technological tools that are easy to manage and effectively achieve learning goals.
Worldwide, communities of professionals, technicians and developers have services that can be applied to digital educational resources that can be reused to improve and augment learning. Teachers can validate technological educational tools through a constant exchange of experience between professionals and specialized entities examining changes in student achievement when using technological tools. This study also shows that traditional methodologies do not need to be replaced by digital resources, rather that technology can strengthen traditional methodologies making them more effective for virtual learning.

This study shows that 75% of participants improve their learning process when using interactive technology. More research can be conducted to further understand how different learning tools can be strengthened by technologies to further achieve the learning goals of university students. This study provides direction for others analyzing the feasibility of using interactive technologies to improve inclusive learning.

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