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Article

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Investigation of the effectiveness of online learning tools for energy performance certificates preparation

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Abstract

From 2013, it is compulsory to provide an *Energy Performance Certificate* (EPC) for anyone who puts a property either for sell or for hire in Spain. Since such EPCs are to be issued by qualified specialists, learning about them has become vital for engineering and architecture students. The aim of this work is to determine whether such knowledge can be acquired by the employment of *online tools*.

To do so, it was set a survey sample consisting of students enrolled in University of Oviedo *Mining Engineering Master Degree*, during 2017–2018 and 2018–2019 academic years, and also of 2018–2019 *Mining Technologies Engineering* undergraduates. They were all provided with different EPC online course materials whose effectiveness was evaluated later on, by the filling out of a tailored form.

The survey results revealed that most of the questioned students recognized the value of *online learning*, but merely with a subordinate role. Only 4.9% of them would gladly renounce to on-site lectures and just 12.20% would accept more than 50% of online training in any course they were to follow. Anyway, such results were not particularly surprising, since they were obtained from people who had chosen to study at an on-site university.

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Keywords: Energy Performance Certificate; Engineering; Evaluation; Online Learning

1. Introduction

Online learning techniques have spread so widely in recent years that most students are familiar with them. As a result, scholars' perspectives [1–3], experiences [4] and opinions Young and Norgard [5] about internet-supported self-learning have become academic work's subject matter. Unfortunately, survey-based research results

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Nomenclature

EPC	Energy Performance Certificate
FT	Full Text
SP	Screen Presentation
EV	Explanatory Video
SAT	Self Assessment Test

vary tremendously by both the group of population and the object of inquiry and therefore, results are not easily comparable.

On the other hand, it is obvious that the primary advantages of these methods are flexible hours and remote-working. But, in spite of such notorious easiness for attendance, students' continuance in online courses has proved not to be optimal [6]. As a consequence, different facilitating strategies have been developed [7], trying to improve both self-efficacy and learning satisfaction [8]. Thus, for example, Moore et al. [9] looked into the roles of learning environment, Kumpas-Lenk et al. [10] focused on the design of outcomes, Broadbent [11] incorporated the possibility to employ blended self-regulated strategies and Guerrero-Roldán and Noguera [12] presented a model for aligning competences and learning activities in online courses.

In addition to all the foregoing, it would also be worth identifying the strengths of onsite lectures for further improvement of online tools.

2. Materials and methods

The production of EPCs has become an employment niche in Spain for either engineers or architects. That is why a small group of forty one University of Oviedo engineering students were selected as survey subjects.

Nine of these people were fourth-year *Mining Technologies Engineering Degree* undergraduates and the rest attended the second year of *Mining Engineering Master Degree*. Grade students were enrolled in *Energy Resources and Nuclear Technology* during 2018–2019 academic year, just as master's did in *Energy Conversion and Management* during 2017–2018 and 2018–2019 school periods.

Pursuing these subjects enabled the access of students to University of Oviedo corporative moodle. Such was the channel for the provision of the following EPC online course materials: 1. *Full text* (FT), for eventual printing and employing as working paper. 2. *Screen presentation* (SP), where contents were summarized. 3. *Explanatory video* (EV), which was recorded by the lecturer in charge. 4. *Self assessment test* (SAT).

After careful consideration, scholars were finally asked to fill out a tailored form, where the following issues were evaluated:

- Effectiveness of the supplied resources in their own learning process.
- Relevance (or irrelevance) of an agreed set of attributes on course materials.
- Suitability of blended lecturing with a variable proportion of distance learning.

3. Results and discussion

Results are directly dependent on the characteristics of both the survey group and the design of the question paper. When it comes to the first, students' answers were analyzed separately, regarding their grade or master condition and school year. With respect to the second, the *high relevance* of any category was scored with a 5, while the *non relevance* did with a 1. A small number of free-response questions were also included in the tailored form.

3.1. Effectiveness of supplied resources

FT and EV were the most valued learning resources, just as SC and SAT were the least (Fig. 1). Such results were the same to the three survey subgroups (Grade 2018–2019, Master 2017–2018 and Master 2018–2019).

It is worth highlighting that undergraduate students were more critical with the effectiveness of those files which implied a higher degree of self-regulation (3.44 for EV and 2.78 for SAT, according to 1–5 gradation scale), while

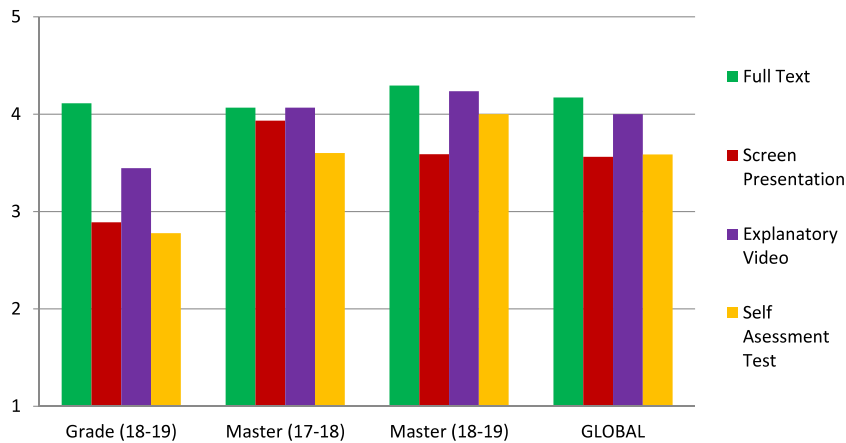


Fig. 1. Relevance of supplied learning files. 1–5 scale . (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

master's did reversely (Fig. 1). The highest opinion was held by master's 2018–2019 class, with a grade of 4.24 for EV and a score of 4.07 for SAT (Fig. 1).

The overall rate of students who would gladly incorporate either FT or EV to their onsite learning experience jumps up to 58.54%. The grade of acceptance of SAT is a little lower (51.22%), yet the minimum rate corresponds to SP (41.46%) (Fig. 2). Since both texts and screen presentations are day by day lecturing tools at University of Oviedo, the peculiarity of these results is obvious.

Former global numbers can be broken down according to survey subgroups. So, as it can be easily seen in Fig. 2:

- When it comes to master's students (either 2017–2018's or 2018–2019's), appreciation for EV is higher to that for SAT, which is in turn superior to that for SP.
- With respect to undergraduates, only 22.2% of them would employ any of the above mentioned files in their onsite classes.
- The acceptance of FT is up to 77.8% for undergraduates, but falls down to 33.3% for 2017–2018 master's students.

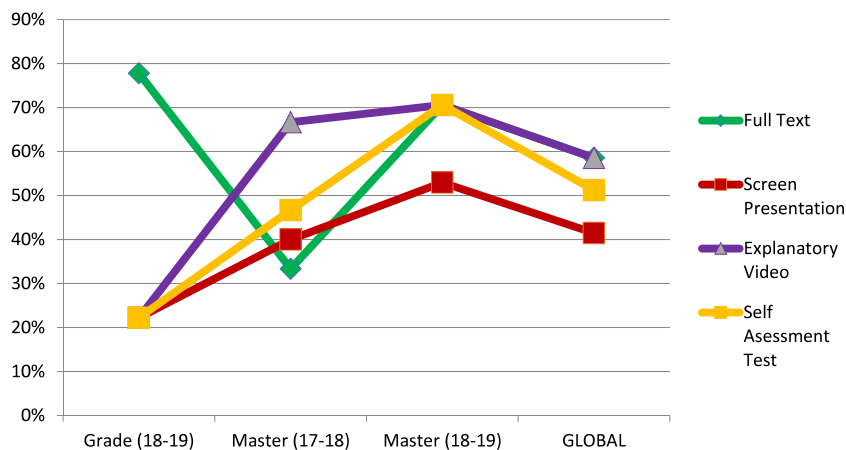


Fig. 2. Level of acceptance of supplied learning files in onsite education . (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

3.2. Relevance of a set of attributes on the quality of online course materials

Identifying strengths and weaknesses of learning resources is vital for both their initial design and any further improvement. In the present case, a set of customized attributes has been evaluated according to the already described 1–5 gradation scale. A color code has also been added to the graphs to identify what is the contribution of every survey subgroup to the final score.

Data show that the strongest point of the FT is the presence of *Practical Examples* (4.76), although *Clear Structure* (4.59) and *Conciseness* (4.54) are also highly appreciated (Fig. 3). Conversely, including either a *High Number of Figures* or a *High Number of Diagrams* has proved to be of little relevance (3.61) (Fig. 3).

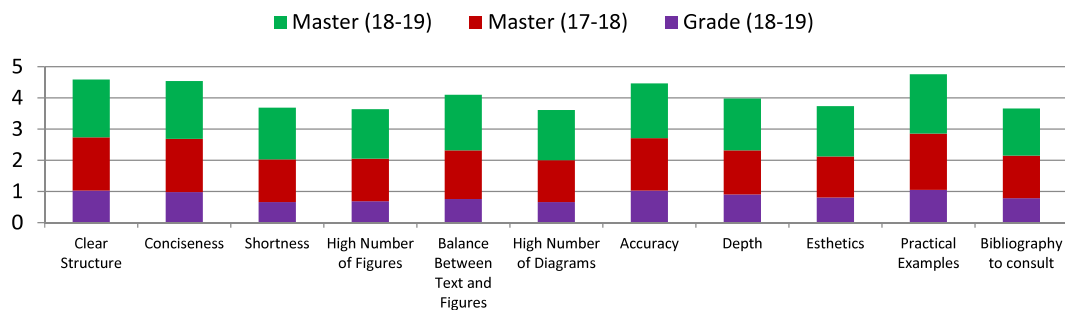


Fig. 3. Relevance of different attributes of FT. 1–5 scale . (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

When it comes to SP, most highly valued characteristics (such as *Clear Structure* (4.54), *Accuracy* (4.40) and *Conciseness* (4.32)) are linked to the quality of either the message or the output (Fig. 4). Curiously, some characteristics that contribute to achieve so (such as *Links to Videos* (3.52), *Website Links* (3.52) or *Esthetics* (3.66)) are not particularly well-considered (Fig. 4). Anyway, the lowest mark is that of *Long Text* (3.37) (Fig. 4), which seems to demonstrate a clear interest for more interactive resources.

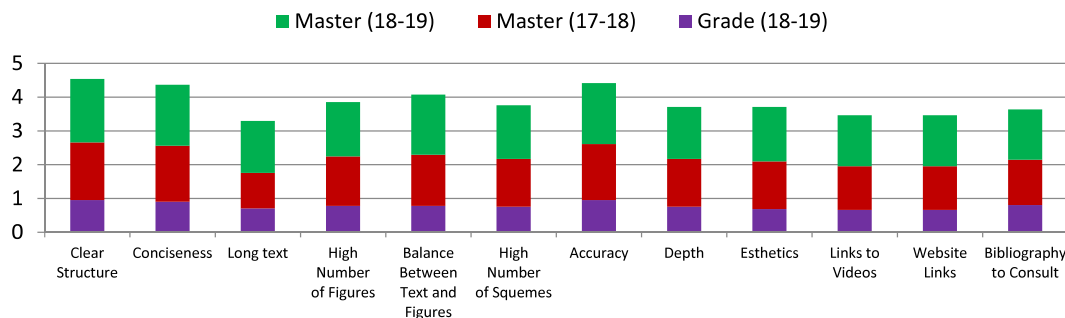


Fig. 4. Relevance of different attributes of SP. 1–5 scale . (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

The employment of EVs is characteristic for distance learning. Since real-time interaction with the lecturer could be not always available, videos should be able to ensure efficient communication. The high valuation achieved by *Dynamism* (4.51), *Clear Structure* (4.44) and *Conciseness* (4.32) with regard to those of *Accuracy* (4.17) and *Depth* (3.76) (Fig. 5), seem to corroborate so.

Moreover, other aspects which are directly linked to the technical quality of the videos, such as *Speaker at Sight* (2.76), *Recording at Different Settings* (2.93) or *Sense of Humor* (3.61) (Fig. 5) are badly rated. And even the *Ease of Sustaining Attention*, which should be an absolute goal, does only get a mere score of 3.34.

SATs are vital for the efficacy of self regulated learning. Nevertheless, *Time Constraints* get the lowest mark (2.98) (Fig. 6), even if few evaluation results can be considered valid if their production was not time-limited. When it comes to the other attributes, only *Practical Approach* (4.05) overcomes the 4 points line, although both *Theoretical Approach* (3.88) and *Critical Questions* (3.95) achieve good assessment rates (Fig. 6).

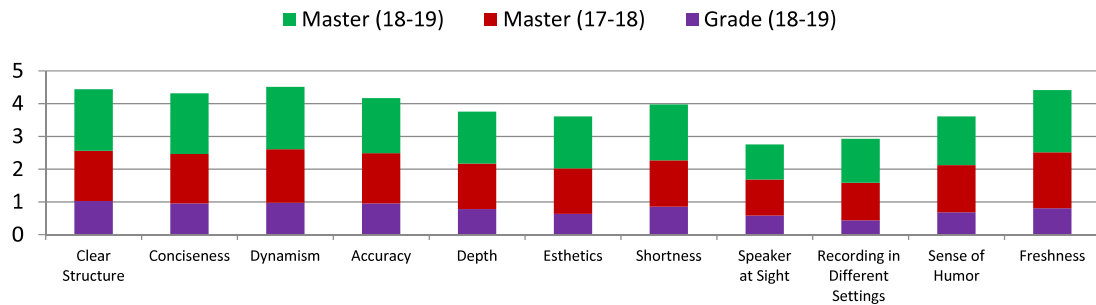


Fig. 5. Relevance of different attributes of explanatory videos. 1–5 scale . (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

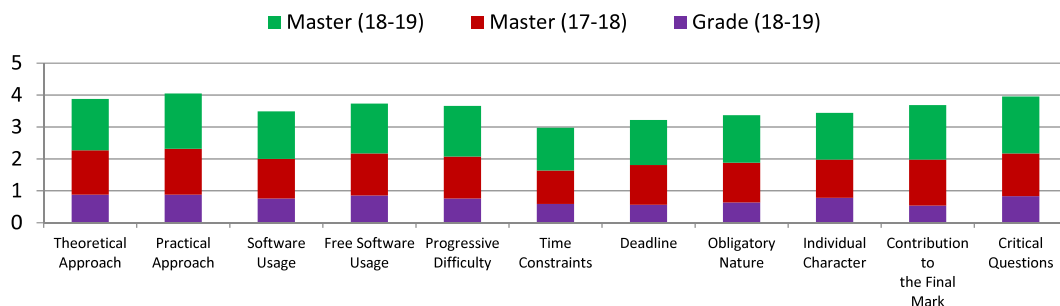


Fig. 6. Relevance of different attributes of self assessment tests. 1–5 scale . (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

3.3. Suitability of blended lecturing

Up to 24.39% of the students from the survey group would welcome a blended learning method, where EVs coexisted with traditional lectures. These results, although minority (70.73% of respondents would stick to onsite methods) make worth considering the incorporation of online resources to the subjects studied in University of Oviedo.

However, although the promotion of *online learning* reaches a 3.59 (1–5 gradation scale) for our survey group, it is necessary to figure what fraction would be acceptable for them. Thus, as it can be seen in Fig. 7, 66.67% of undergraduates and 88.24% of 2018–2019 master's students would reject more than 50% of distance learning. And, when it comes to 2017–2018 master's subgroup, the gap is even narrower, as none of them considers that more than 40% of self-regulated strategies would be of any learning relevance (Fig. 7).

4. Conclusions

Supplied online learning resources got high (but not extraordinary) results from the evaluation. The younger the contestants, the bigger their reluctance to self-regulated learning and consequently, the poorer the marks undergraduates put to more interactive work files. The same effect was observed with 2017–2018 master's students with regard to their mates of 2018–2019 year. Lack of maturity and unfamiliarity with technology could explain such behavior.

The most highly valued set of attributes were those from traditional files. Thus, FT's average grading was 4.07, SP's was 3.88, EV's was 3.82 and SAT's was 3.59 (1–5 gradation scale).

Only 14.63% of the survey group would agree with including more than 50% of distance learning stuff in any of the subjects they were enrolled to. Anyway, these numbers could grow by providing EPC training by means of non-university, non-formal formats. Looking into it would be an interesting line of future work.

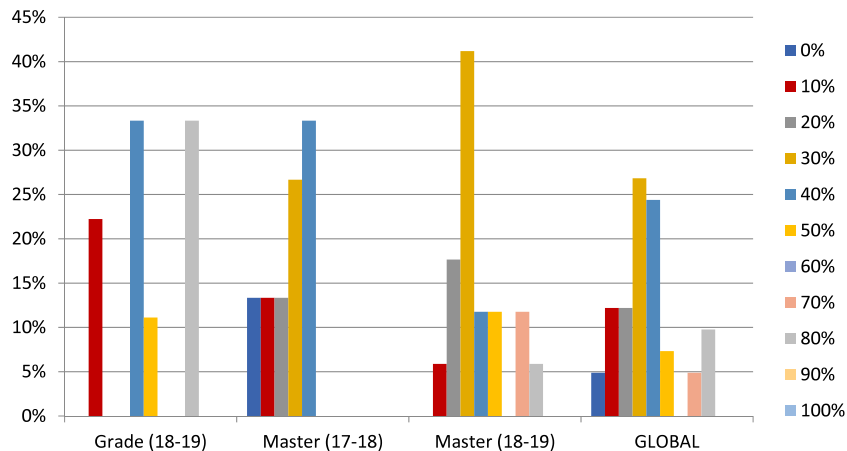


Fig. 7. Fraction of online learning in blended academic work scale . (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

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