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Influence of Motivation on Learning Approaches of Students Using Learning Objects in Graphics Engineering*

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This paper provides details of a study in which multimedia Learning Objects (LOs) have been designed and built for the field of Graphic Expression and then have been used by 54 students into the subject Graphic Expression Applied to Building Design of Building Engineering Program as a teaching aid for the purpose of analysing the affect of motivation on students' approaches to learning following LO use. They were used the instrument "*Motivated Strategies for Learning Questionnaire (MSLQ)*" for measuring motivation and the "*Revised Two-Factor Study Process Questionnaire (R-SPQ-2F)*" was used to measure the approaches to learning, Findings show that following the use of LOs in Graphic expression motivation is linked to approaches to learning, independently of their intensity, producing a significant difference between the variables for Approaches to Learning and the variables for Motivation that correspond to Intrinsic Goal Orientation, Task Value, and Control of Learning Beliefs.

Keywords: learning objects; motivation; approaches to learning; graphic expression; MSLQ; R-SPQ-2F

1. Introduction

The changes that have taken place in university education as a result of the implementation of the educational model proposed by the European Higher Education Area (EHEA) require special attention be paid to aspects such as motivation, a psychological component used to explain voluntary behaviour [1], but also to approaches to learning, or in other words, how students manage their learning based on personal preferences when studying, and context, meaning the setting in which learning takes place [2].

Motivation should be understood as an element linked to the quality of the teaching and learning processes that originate in, and are subsequently developed upon, in the context of our universities [3]; this is needed now more than ever as a means to ensure students make greater efforts in their learning processes [4]. Similarly, the theory behind *approaches to learning* is becoming increasingly relevant, both as a result of the aforementioned academic context, and also the nature of the content that students must learn when adopting one approach or another, and could arguably constitute direct evidence of the quality of the educational process [2].

For these reasons, the teacher who should place value on the importance of motivating students towards achieving their goals, which in essence is simply a case of educating their students as well as possible and establishing greater and better possibilities for knowledge acquisition [5]. In the transformation from being a mere transmitter of knowledge to being a tutor and guide through the learning process, the teacher must play a key role in designing proposals for interactions that facilitate these tasks, and thus stimulate deeper learning [6].

This study contributes to innovation in university education by studying the application of ICT-based "Learning Objects" (LO), designed and built specifically for the field of Architectural Graphic Expression, and how student motivation alters approaches to learning based on LO use.

2. Literature Review

2.1 Learning Objects

Learning Objects (LOs), also referred to as Reusable Learning Objects (RLOs), are digital modular learning resources, stand-alone structures that contain interactive materials for pedagogic purposes and they can be used and reused by students as many times as they desire and to the point at which learning is performed flexibly and independently [7, 8].

Willey [9], defines LOs as "any digital resource that can be used to support learning". Their raison d'être is to: reduce production and distribution timings and costs; make it possible to exchange and reuse educational resources used in the teaching-learning process [10]. A set of standards and/or specifications have been developed and implemented for the construction of LOs that

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support the creation of good quality LOs. All LOs must have well-structured educational content and standards for creating metadata. With regards to this structure, it must be clear in order to facilitate the process of sharing, reusing, importing, or exporting them [11]. The SCORM model (Sharable Content Object Reference Model) is of worthy mention as it is the most widely used model when it comes to LOs creation [12].

Exe-Learning helps teachers to easily create and publish LOs by allowing them to structure content, insert resources, and export tasks. All of this helps them to create a well-structured final product and set of activities. It is clear that the overall success, in terms of reaching set objectives, depends on the correct planning, sequencing and content of the activities being designed [13].

According to the EHEA [14], learning must change from being a one-off activity to a lifelong activity that is pursued throughout our professional careers. What this means in reality is that instruments must be in place to facilitate this task; the most adequate tools for this task are Learning Objects, especially those within the field of Graphic Expression as they have an extended lifecycle, which reduces maintenance and update requirements and thus guarantees their reusability [15].

With these considerations in mind, the authors propose creating a series of Learning Objects that serve as teaching aids in the subjects related to "Engineering Graphic Applied to Building" using the application *Exe-Learning*.

2.2 Motivation

Motivation is a psychological construct that is clearly linked to teaching & learning processes, and most experts agree in defining it as the set of processes involved in the activation, direction and persistence of the behaviour [16].

Motivation is the process through which an individual sets an objective, uses appropriate resources, and continues with a particular behaviour in order to achieve a goal. Within education, this should be perceived as an individual's willingness to learn and to continue doing so independently [17]. It has proven to be a cornerstone in learning given that motivated students will engage more and concentrate better in academic tasks [18].

Pintrich and Schunk [19], state that their research has revealed a positive link between an individual's motivation and engagement in the learning process when: he or she trusts his or her own abilities; takes ownership of the learning objectives; possesses high expectations for their self-efficacy; and values the learning activities.

According to Nolen [17], the overriding aim of the field of education is to ensure students are motivated to learn, and to instil motivation that is strong enough so that an individual is keen to learn and continues to do so, independently, for their own enjoyment or growth, be it academic or personal.

2.3 Approaches to Learning

The construct *approaches to learning* describes the manner in which students relate to the teaching-learning process. In other words, it explains how students respond to the learning environment. It is understood that these responses are not set in stone, rather they are processes arising from a student's particular perceptions of an academic task, which in turn are dependent on an individual's personality traits and character. As such, students will demonstrate a predilection for a particular approach [20].

The result of learning is conditioned by the type of approach adopted by a student [21]. What this means is that any given learning task is tackled in accordance with the student's intentions or motivation, but in order to resolve issues pertaining to motivation, the student will conceive strategies - termed *approaches to learning.* Thus, an approach to learning is the result of a merger between motivation and strategy [22].

To define the study processes used by students, that is to say, to express the intention, the process and the result of learning, the authors Martin and Säljö [23], created the terms *Deep Approach* and *Superficial Approach* (deep and surface learning) to refer to the existence of two qualitatively distinct ways of approaching a task: the first describes learning undertaken for the purpose of understanding and personal development, the second describes learning undertaken to cover institutional demands. The characteristics of these approaches were described by Biggs [20]:

- The *Deep Approach* (deep learning), leads to "a transformation of knowledge". It is based on intrinsic motivation, meaning the student's inner curiosity drives their search for a suitable strategy and motivates them to use it to maximize their understanding of the material being taught.
- The *Superficial Approach* (surface learning), leads to "the reproduction of information". It is based on extrinsic motivation; consequently priority is placed on avoiding failure, effort, or having to work too hard. Strategies are used in order to only have to do the least amount of work possible, and information is recalled using memorization techniques.

These approaches to learning depend on the motivation and strategies (deep or superficial) possessed by the student. The type of approach to

learning adopted will be determined based on whether greater weight is placed on understanding or merely on memorizing [24].

In the pursuit of a more thorough classification system that includes the diverse range of variables that exist, we have seen the emergence of the concept *Approach Intensity*. The intensity of an approach can be classified as *High*, *Medium*, or *Low*. These concepts are used to more accurately describe the differences identified between the *Deep Approach* (DA) and the *Superficial Approach* (SA) adopted by each student [25].

3. Objective, Research Question and Hypothesis

The aim of this paper is to find out if there is a relationship between the use of multimedia learning objects and the motivation of the student, and if this affects the approaches to learning. For this purpose, we enunciate two research questions:

- Are students motivated when use digital learning objects in the subject 'Graphic Expression Applied to Building Design'?
- Do these students adopt approaches to learning focused on deep learning?

To solve them we propose the following hypotheses:

H1. The use of learning objects influences motivation factors

H2. The use of learning objects encourages students to pursue approaches to learning interested in deep learning.

H3. There is a positive relationship between motivation and the approaches to learning for deep learning.

H4. There is a positive relationship between motivation and intensity of approach at deep levels.

4. Methodology

4.1 Study Participants

This study was designed to be run in the context of the University of La Laguna (Spain), in the subject "Graphic Expression Applied to Building Design", which forms part of the Building Engineering Program. Some volunteer students of this subject were the participants of this study.

The sample group contained 54 students (27 male and 27 female). These participants filled out questionnaires designed to measure motivation and approaches to learning before and after the use of LOs designed as teaching aids in the field of Graphic Expression.

Before commencing with the study, the sample size was checked to ensure it was capable of producing statistically viable and consistent results. Calculations were performed to establish the number of participants needed to be able to estimate a given parameter with the desired degree of certainty [26].

4.2 Materials

In order to run this study, a series of 10 Learning Objects were specifically designed and developed for subjects in the field Graphic Expression on building design. For reference purposes, a screen-

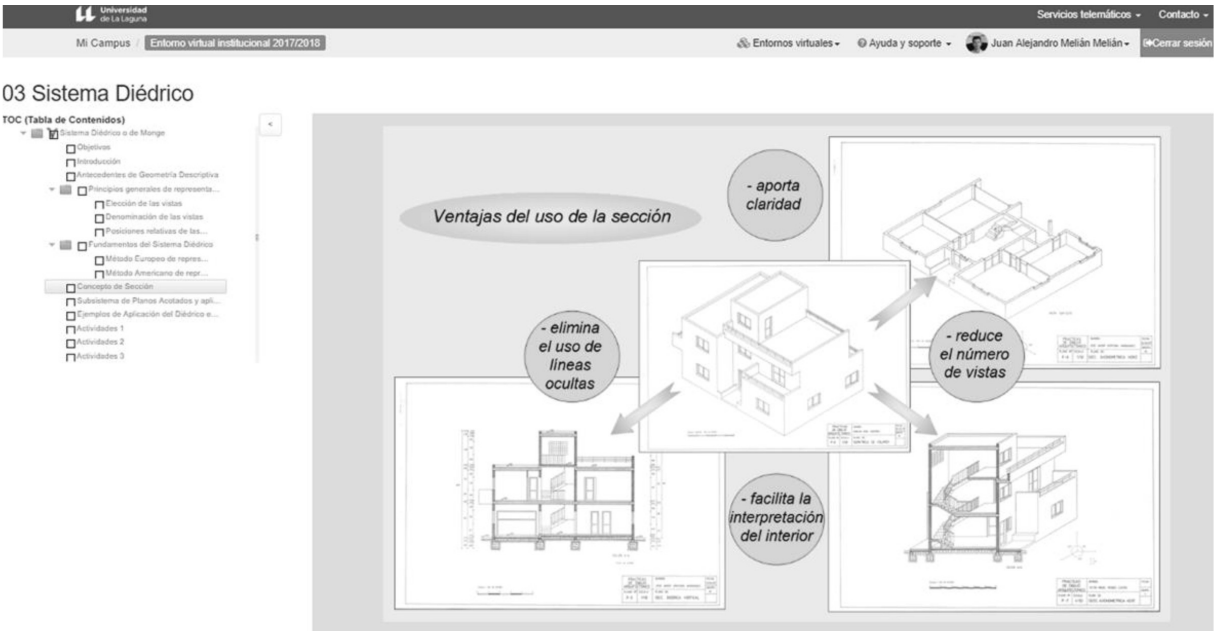

Fig. 1. LO inserted into the Moodle platform as SCORM.

shot taken of one of these LO as seen in the e-learning platform is provided in Fig. 1.

The design phase of each of the LOs begins by establishing the objectives that need to be met through their use. Following this, an initial outline of the LO structure is created that highlights the content that will be dealt with. This outline is then organized into sections and subsections so as to establish a hierarchy based on the importance of content, and suitable activities are programmed so as to meet the objectives previously established. Simultaneously, it is important to analyse how to include digital content whilst always keeping sight the instructional and pedagogical purpose behind the LO.

All Learning objects have a home page containing a general presentation that provides a welcome message and informs the user about content. This is followed by a description of the objectives that will be covered during use, and an outline of the content. This outline always begins with the more general content and works down to the more specific content, all of which contains abundant illustrations to assist in their assimilation.

A series of activities were designed in order to complete each LO, including gap fill exercises, multiple-choice questions, True/False dichotomous questions, tests, or SCORM questionnaires. Students complete these activities at their own convenience and they can choose to adapt them to their own individual pace of working. The activities can be taken as many times as wanted or needed depending on real-time feedback about the number of correct answers or incorrect answers in each attempt. As this feedback is instantaneously provided by the system, students can identify when the have mastered content and are placed in a position in which they can decide whether to progress onwards or not, which encourages self-directed learning.

One noteworthy instrument for measuring motivation is the *Motivated Strategies for Learning Questionnaire* (MSLQ) by Pintrich et al. [27]. This is because it has repeatedly demonstrated its efficiency and good internal consistency when used in a number of different investigations studying motivation. The motivation section consists of 31 items divided into 6 areas covering the following motivational aspects or factors: *Intrinsic Motivation, Extrinsic Motivation, Tasks Value, Control of Learning Beliefs, Self-efficacy Beliefs for Learning and Performance, Test Anxiety.*

Of the several instruments used to measure approaches to learning, the Revised Two-Factor Study Process Questionnaire (R-SPQ-2F) by Bigg, Kember, and Leung [22], is of noteworthy mention and has been used in this paper.

4.3 Experience

The ten LOs designed and built especially for this study were put into use into the Learning Management System (LMS) where students could access them (Moodle in this case), just like any other resource. At this stage it is now possible to study their potential academic benefits. The selected questionnaires were administered at the beginning and the end of the semester course, with the aim of identifying and measuring *motivation* and also *approach to learning*. These questionnaires provide the data that is required to analyse the influence of our object of study.

5. Results

In order to perform the statistical processing of the data gathered from the study's participants, it was first necessary to identify the variables that need to be taken into account and assign each and every one with a code or abbreviated name; these are detailed in Table 1.

Type and Intensity of the approach to learning (TIA) can be: *Deep – High; Deep – Medium; Deep – Low; Superficial – Low; Superficial – Medium; Superficial – High.* The best value for an approach to learning is *Deep – High*, whilst the worst value is *Superficial High* [25].

Using results from the first practical tasks under-

Table 1. Identification of variables in Motivation of MSLQ and Approach to Learning variables for R-SPQ-2F

Identification	**Motivational Factors**
IM	INTRINSIC_GOAL_ORIENTATION
EM	EXTRINSIC_GOAL_ORIENTATION
TV	TASK_VALUE
CLB	CONTROL_OF_LEARNING_BELIEF
SEB	SELF_EFFICACY_BELIEFS
TAX	TEST_ANXIETY
Identification	**Approach to Learning Factors**
DA	DEEP_APPROACH
SA	SUPERFICIAL_APPROACH
TIA	TYPE_AND_INTENSITY_OF_APPROACH

taken before using the Learning objects, sample sizes are checked to ensure they are large enough to run the experimental trials and representative of the population. An analysis of the study participants' marks is performed to check whether they are similar to the total population. To do so, a student T-test for independent samples is performed and the results compared against the total population and the sample. A p-value = 0.546 confirms that the sample size is representative of the population.

Analysed data from motivation questionnaires and learning strategies administered to students who use learning objects at the beginning and end of the course, indicate that there is significant difference for the intrinsic motivation variable, showing p-value = 0.023, and referring to the analysis of learning approaches, the data indicate that there is significant difference in the deep approach showing a p-value = 0.040. (See Table 2). Hypotheses H1: "*The use of learning objects influences motivation factors*" and H2: "*The use of learning objects encourages students to pursue approaches to learning interested in deep learning*" are accepted.

It is then analysed whether there is a relationship between learning approaches and motivational variables for the use of learning objects. Extending the analysis, we check whether there is a relationship between the intensity of the approach and the motivation, i.e. whether the motivation variables can modify the learning strategy of the students.

Table 3 shows the average values and standard deviations referring to the factors in the Motivation of the MSLQ that was administered at the end of course.

These values must follow normal distribution to ensure that the data can be used when performing statistical calculations. As the sample contains more than 50 participants, to demonstrate this the Kolmogorov-Smirnov test is applied (Table 4).

All Motivation variables are above p-value 0.05, as such they all follow a normal distribution and it is possible to use the results of the study to perform calculations and statistical analysis.

To determine students' approaches to learning (based on their responses to the questionnaire R-SPQ-2F), the authors follow the procedure indicated in the questionnaire itself, thus obtaining values for each scale and subscale, as displayed in Table 5.

The student's type of approach (deep or super-

Table 2. T-Student test. Statistical significance of motivational variables and learning approaches (Before and After to the use LOs)

	Related Differences					t	gl	Sig.
				95% Confidence Interval				
	Mean	Std. desv.	Std. error	Lower bound	Upper bound			
IM_B IM_A	–0.264	0.815	0.113	–0.491	–0.037	–2.338	51	**0.023**
EM_B EM_A	0.062	0.864	0.119	–0.178	0.303	0.521	51	0.604
TV_B TV_A	0.035	0.625	0.086	–0.138	0.209	0.415	51	0.680
CLB_B CLB_A	–0.086	0.931	0.129	–0.345	0.172	–0.670	51	0.506
SEB_B SEB_A	–0.026	0.698	0.096	–0.221	0.167	–0.274	51	0.785
TAX_B TAX_A	–0.265	1.223	0.169	–0.606	0.075	–1.564	51	0.124
DA_B DA_A	–1.635	5.605	0.777	–3.195	–0.074	–2.103	51	**0.040**
SA_B SA_A	–0.154	6.581	0.913	–1.986	1.678	–0.169	51	0.867

Table 3. Descriptive statistics of motivation variables using LO

	N	Average	Std.dev	Min-Max.
IM	54	4.9352	0.98117	1.00–6.75
EM	54	4.4907	1.39403	1.25–7.00
TV	54	5.6359	1.08422	1.00–7.00
CLB	54	5.2361	0.96448	3.50–6.75
SEB	54	4.8126	0.90322	2.88–6.50
TAX	54	4.4148	1.25042	1.40–7.00

Table 4. Kolmogorov-Smirnov test (one sample) for motivation variables starting the subject

		IM	EM	TV	CLB	SEB	TAX
N		54	54	54	54	54	54
Normal parameters (a,b)	Average	4.935	4.490	5.635	5.236	4.812	4.414
	Std.dev	0.981	1.394	1.084	0.964	0.903	1.250
Max. differences	Absolute	0.129	0.117	0.149	0.131	0.101	0.121
	Positive	0.078	0.084	0.104	0.111	0.055	0.056
	Negative	–0.129	–0.117	–0.149	–0.131	–0.101	–0.121
Kolmogorov-Smirnov Z		0.947	0.862	1.096	0.964	0.740	0.889
Critical values (2-sided)		**0.331**	**0.447**	**0.181**	**0.310**	**0.644**	**0.408**

a The contrast distribution is Normal.
b Calculated using data.

Table 5. Obtaining scores for Scales and Subscales. R-SPQ-2F

Summary of R-SPQ-2F instrument number items, according to scale and subscale		
Scales	Deep Approach (DA)	1+2+5+6+9+10+13+14+17+18
	Superficial Approach (SA)	3+4+7+8+11+12+15+16+19+20
Subscales	Deep_Motivation (Mot D)	1+5+9+13+17
	Deep_Strategy (Est D)	2+6+10+14+18
	Superficial_Motivation (Mot S)	3+7+11+15+19
	Superficial_Strategy (Est S)	4+8+12+16+20

Table 6. Ranking of Focus Intensity

Value Difference between. . .	**Focus Intensity**
1–13	Low
14–26	Medium
27–40	High

Table 7. Descriptive Statistics. R-SPQ-2F Sample Test using LO

	N	**Average**	**Std.dev**	**Min-Max.**
DA	54	30.46	5.901	13–45
SA	54	23.39	7.342	10–42

Table 8. Descriptive Statistics. Type and Intensity of Approach using LO

	N	**Average**	**Std.dev**	**Min-Max.**
TIA	54	4.11	0.718	2–5

ficial) is determined by the highest value obtained for the type of approach (*Deep Approach*-DA- or *Superficial Approach*-SA-).

The *Focus Intensity value* is calculated following the criteria established by Recio and Cabero [25]. It's based on the difference between the values on the scales for *Deep Approach* and *Superficial Approach*, as displayed in Table 6.

It is important to remember that the ideal value for students would be Deep Approach – High, as this would imply that: there is a high dispositional affect towards study and the quest for understanding. On the opposite end of the scale is the value Superficial Approach – High, which implies that student will employ strategies that allow them to do the bear minimum needed to reach an objective, and will use memorizing techniques instead to trying to understand fully.

Table 7 displays the descriptive statistics for the scales and subscales analysed using the R-SPQ-2F Questionnaire for the academic subject under analysis. The values obtained for the *Deep Approach* (DA) and *Superficial Approach* (SA) scales reveal a predisposition towards DA.

The Kolmogorov-Smirnov test reveals for each variable (DA and SA) are greater than p-value 0.05, as such, the data gathered in the sample follows normal distribution (DA p-value = 0.713 and SA p-value = 0.473).

With regards the *Type and Intensity* of the approach to learning (TIA) presented in Tables 8 and 9, the sample trends towards *Deep Approach – Low* followed by *Deep Approach – Medium*.

Although these results represent the perceptions of a small sample of students participating in what is merely a pilot study, they offer up certain interesting points that are cause for further reflection. For example, what motivates students to perform tasks and the perceptions they have of them, or what motives and strategies emerge when learning, which leads to reflexions on the characteristics and traits of our students. Likewise, the study also obliges us to reflect on the need to analyse and rethink the teaching process.

Lastly, an ANOVA is performed to establish whether there is a relationship between the types of approaches to learning (*Deep* or *Superficial*) and each of the motivation variables following the use of the LOs. In other words, we are testing whether student motivation affects the type approach (TA).

Table 9. Frequency table. Type and Intensity of Approach (TIA)

		Frequency	%	Valid percentage	Cumulative percentage
Valid	Sup. Medium (2)	1	1.2	1.9	1.9
	Sup. Low (3)	8	9.4	15.4	17.3
	Prof. Low (4)	27	31.8	51.9	69.2
	Prof. Medium (5)	16	18.8	30.8	100.0
	Total	52	61.2	100.0	
Lost	System	33	38.8		
Total		85	100.0		

Table 10. ANOVA. Relationship between Type of Approach (TA) and Motivation variables

		Sum of squares	gl	Mean square	F	Sig.
IM	Inter-groups	7.837	1	7.837	9.437	**0.003**
	Intra-groups	43.186	52	0.831		
	Total	51.023	53			
EM	Inter-groups	0.268	1	0.268	0.135	0.714
	Intra-groups	102.728	52	1.976		
	Total	102.995	53			
TV	Inter-groups	13.476	1	13.476	14.352	**0.000**
	Intra-groups	48.827	52	0.939		
	Total	62.303	53			
CLB	Inter-groups	6.769	1	6.769	8.275	**0.006**
	Intra-groups	42.533	52	0.818		
	Total	49.302	53			
SEB	Inter-groups	1.799	1	1.799	2.258	0.139
	Intra-groups	41.439	52	0.797		
	Total	43.238	53			
TAX	Inter-groups	0.214	1	0.214	0.135	0.715
	Intra-groups	82.654	52	1.590		
	Total	82.868	53			

Table 11. ANOVA. Relationship between Type and Intensity of Approach (TIA) and Motivation variables

		Sum of squares	gl	Mean square	F	Sig.
IM	Inter-groups	24.450	3	8.150	15.335	**0.000**
	Intra-groups	26.574	50	0.531		
	Total	51.023	53			
EM	Inter-groups	12.057	3	4.019	2.210	0.098
	Intra-groups	90.938	50	1.819		
	Total	102.995	53			
TV	Inter-groups	34.547	3	11.516	20.745	**0.000**
	Intra-groups	27.756	50	0.555		
	Total	62.303	53			
CLB	Inter-groups	9.008	3	3.003	3.726	**0.017**
	Intra-groups	40.294	50	0.806		
	Total	49.302	53			
SEB	Inter-groups	5.543	3	1.848	2.451	0.074
	Intra-groups	37.695	50	0.754		
	Total	43.238	53			
TAX	Inter-groups	1.256	3	0.419	0.256	0.856
	Intra-groups	81.613	50	1.632		
	Total	82.868	53			

The results indicate that there is significant difference between the type of approach (Deep/Superficial) and the three motivation variables: Intrinsic Goal Orientation, Task Value, and Control of Learning Beliefs. Hypothesis H3: "*There is a positive relationship between motivation and the approaches to learning for deep learning*" is accepted.

Furthermore, the authors studied whether Type and Intensity of the approach (TIA) is related to the variables of motivation.

The results display the same levels of significance as when analysing the Type of Approach (TA). There is a significant relationship between the Type and Intensity of Approach to Learning and the Motivation variables: Intrinsic Goal Orientation, Task Value, and Control of Learning Beliefs; therefore, for this experiment it is possible to state that motivation is linked to the type of approach, independently of its intensity. The hypothesis H4: "*There is a positive relationship between motivation and intensity of approach at deep levels*" is therefore accepted.

6. Conclusions

The study that was performed involving the use of a series of LOs that were designed and implemented as teaching aids in the area of Graphic Expression in Building Design has allowed the research team to verify the following statements relating to the correlation between types of learning approach and motivational factors.

The findings indicate that significant difference is present between the Type of Approach-TA (Deep or Superficial Approach) and the motivation variables corresponding to Intrinsic Goal Orientation, Task Value, and Control of Learning Beliefs. In other words, there is a relationship between the learning strategy employed and the motivation that drives the student to make and effort. The motivation variables that improve with the use of LOs lead the students to adopt a Deep Learning Approach. In other words, a student's focus is on learning rather than on "learning for the sake of study". As such, Intrinsic Motivation drives a student to manage his or her own learning, which in turn implies developing an interest in working hard and enjoying focusing all efforts on the task at hand until the learning objective has been completed. The student does not expect a reward other than the satisfaction of learning for learning's sake. For its part, the Task Values encourages the students to reflect on how interesting, useful, or important they found a task to be; this in itself leads them to participate more fully in their own learning. Finally, the Control of Learning Beliefs allow the students to perceive the degree to which they are in control of their own learning process, and serves to help them to understand that their success and achievements are the fruit of their own efforts, rather than as a result of external factors (e.g., the teacher's explanation). Therefore, students can gain confidence in their own abilities and trust that they are capable of performing the tasks they have learnt. As such, these variables influence the way in which students approach learning, their depth of comprehension (Deep Approach), or their reproductive learning, seen as rote learning-reproduction (Superficial Approach).

Furthermore, the aforementioned motivation variables influence the degree and manner in which students approach their studies (Type and Intensity of learning approach-TIA), producing results that range from the best to the worst; in other words, those demonstrating thorough understanding (Deep High and Deep Medium, followed by those at intermediate levels who show little difference in their attitude, followed by others who show a mix of understanding and rote learning (Deep Low and Superficial Medium), and finally with those who rely solely on rote learning-reproduction (Superficial Medium and Superficial High).

The significant difference between the Type and Intensity of the approach to learning (TIA) and the same motivation variables mentioned are in accordance with Biggs [19], who noted the presence of a certain association between types of motivation and the approaches to learning adopted by students when tackling a task. With this we can state that the intrinsic motivation observed in students is closely associated with the use of specific learning strategies, and consequently with the type of approach adopted by the student.

All of this leads the authors of this study to agree that motivation following the use of LOs in Graphic Expression is related to approaches to learning. However, caution is advised when looking at the results and conclusions of this study, as the authors' initial aim was to merely build a pilot study that would reveal a suitable approach for a larger scale experiment. In particular, one great limitation relates to the scarce number of students undertaking Building Engineering Program offered as part of university degrees. Nevertheless, there is no doubt that the results have delivered positive findings. The fact that this study has provided good results can, and should, serve as an invitation to further exploit the use of these types of pedagogical methodologies and initiatives as a means through which to comfortably handle the new teaching styles that are currently being imposed.

It is also worth noting that this study has proven an incredibly positive experience and is highly

recommended for university teaching. This study, in focusing attention on the design and implementation of LOs in the field of Graphic Expression and on the analysis of their impact on student motivation and approaches to learning, has proven innovative, and based on the results presented there is hope that this study will serve as inspiration to the academic community to continue building on the findings and strengthen the desired relationship between teaching and research. In terms of future courses of action, there exists the possibility of taking the experiences of first-year Building Engineering Program students and expanding on them to include all Engineering students in order to analyse the variances that arise from larger and more heterogeneous sample sizes.

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