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Student engagement in the Flipped Classroom model implemented in online learning

O envolvimento do aluno no modelo Flipped Classroom implementado na aprendizagem online

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Abstract: Student engagement is a determinant factor of students' academic success, with added relevance for online learning. The aim of this study was to analyse students' cognitive, affective, and behavioural engagement in a pedagogical proposal based on the Flipped Classroom model, with Portuguese secondary school students. The study, conducted during the COVID-19 pandemic, combined asynchronous and synchronous lessons divided into learning episodes (Summary, Quiz and Rooms). Mixed methods were used to analyse students' discourses, behaviours, perceptions of the experience and academic performance. The results showed that the proposal enhanced a high level of behavioural engagement in the students as expressed by the indicators of task completion, peer interaction and participation. Students showed higher levels of cognitive engagement in the Rooms episodes as they were conducive to peer interaction, explicitness of knowledge and reflection facilitated by interaction with the teacher. Satisfaction was the most prominent indicator of student affective engagement. This study offers a better understanding of the factors that influence student engagement in the Flipped Classroom model and suggests practical implications for enhancing it in online learning.

Keywords: Student engagement, Flipped Classroom, Online learning, Student-centred Learning, Student experience.

Resumo: O envolvimento do aluno é um fator determinante do sucesso académico dos alunos com acrescida relevância na aprendizagem online. Este estudo teve como objetivo analisar o envolvimento cognitivo, afetivo e comportamental dos alunos numa proposta pedagógica baseada no modelo Flipped Classroom, com estudantes do ensino secundário português. O estudo realizado durante a pandemia COVID-19 conjugou aulas assíncronas com síncronas divididas por episódios de aprendizagem (Resumo, Quiz e Salas). Através da utilização de métodos mistos analisaram-se os discursos, comportamentos, perceções sobre a experiência e o desempenho académico dos alunos. Os resultados mostraram que a proposta potenciou um elevado nível de envolvimento comportamental dos alunos expresso pelos indicadores realização das tarefas, interação com os pares e participação. Os alunos apresentaram níveis superiores de envolvimento cognitivo nos episódios Salas por serem propícios à interação com os pares, explicitação de conhecimentos e reflexão facilitada pela interação com a professora. A satisfação foi o indicador mais proeminente do envolvimento afetivo do aluno. Este estudo contribui para um melhor entendimento dos fatores que influenciam o envolvimento do aluno no modelo Flipped Classroom, apresentando implicações práticas para o aprimorar na aprendizagem online.

Palavras-Chave: Envolvimento do aluno, Flipped Classroom, Aprendizagem online, Aprendizagem centrada no aluno, Experiência do aluno.

1. Introduction

When integrated into educational systems, Digital Information and Communication Technologies (DICT) broaden the concept of education by generating new learning spaces and changing the role of the agents involved (Ruiz, 2021). In this sense, online education overcomes geographical limitations by offering students ubiquitous learning opportunities. In this context, student engagement has been identified as a critical factor for learning success, as it is associated with student satisfaction and academic performance (Xu et al., 2020).

Since there is no guarantee that the widespread use of technology will promote active learning and improve school results (Bond & Bedenlier, 2019), it is important to investigate methods to enhance the effectiveness of online learning and, consequently, student engagement (Xu et al., 2020).

Although student engagement is extensively researched, there is no consensus about its exact nature and composition (Eccles, 2016), with various definitions and conceptualisations emphasising the multidimensional character of this concept (Xu et al., 2020). In this sense, student engagement reflects the student's internal psychological state, including behaviour, cognition and emotion (Kahu, 2013). It relates to the student's behaviour, experience and thinking about the learning content (Schindler et al., 2017). It is the energy and effort that students use within their learning community, observable through behaviours, cognitive and affective indicators in a continuum and shapable through the complex interactions of the environment, relationships and learning activities (Bond & Bedenlier, 2019).

There are substantial overlaps and similarities in the definitions presented, namely the existence of three dimensions of engagement: cognitive (CE), affective (AE) and behavioural (BE) (Fredricks et al., 2004). According to these authors, BE refers to students' participation in a learning activity, such as completing a task, attending classes or contributing to discussions. AE relates to students' emotional responses or feelings towards teachers, peers, learning and school. Lastly, CE refers to students' psychological investment in tasks and how they use self-regulatory and metacognitive strategies to understand and master knowledge.

When we talk about engagement, we also have to consider the existence of the opposite, i.e., disengagement, evidenced when students are not committed to their own learning, showing little interest and low academic results (Rumberger & Rotermund, 2012). Therefore, each dimension of engagement is associated with a series of indicators of student engagement and disengagement that fluctuate in a continuum depending on their activation and valence (Bond, 2020), and that can be measured as they are attributes that belong to the construct.

In online learning, pedagogical approaches that have adopted the Flipped Classroom Model (FCM) have proven to be pedagogically effective (Ribeirinha & Silva, 2021). Theoretically based on collaborative learning theory and constructivism (Bishop & Verleger, 2013), the model proposes an inversion in the order in which activities are presented to students. In this sense, it shifts the process of transmitting knowledge (factual knowledge) to virtual environments by simply reading or watching educational videos, reserving the processes of expanding knowledge for meetings with the teacher

and peers (Ribeirinha & Silva, 2021). The model offers students several pedagogical advantages (Lai et al., 2021): (1) it allows for reading flexibility associated with the pre-lesson component, where the wide variety of formats through which content can be made available caters to students' different learning styles; (2) it integrates technology, as the properties of technological resources (platforms and educational videos) allow students to take greater control of their learning, both through the pace and frequency with which they interact with the content, as well as the feedback they receive, and (3) it facilitates active learning, which is associated with meaningful interactions with peers and the teacher. However, the success of the model is heavily dependent on student engagement (Lai et al., 2021).

This study adopted the bioecological model of student engagement in technology-enhanced learning environments proposed by Bond and Bedenlier (2019), which was later adapted by Bond (2020) for the FCM. According to the author, the classroom where FCM is applied constitutes a microsystem. In this microsystem, the student occupies a central place and interacts with the teacher, classmates, technology, activities and the learning environment (identified as facilitators of student engagement). The action of each facilitator on the student's engagement takes place through a series of influencing factors. So, for example, with regard to the teacher, the following are influencing factors: presence, feedback/support, time invested, digital skills, acceptance and use of technology, previous experience of DICT, expertise in curriculum content, professional development and professional networks. [Other influencing factors can be found in Bond (2020)]. Influencing factors can affect various indicators of student engagement, for example, task fulfilment (BE), comprehension (CE), satisfaction (AE) (Bond, 2020).

Although this conceptual framework was designed for blended learning environments, it was adopted to study student engagement in an online environment. Given that the FCM is flexible enough to adapt to the needs and restrictions of this context and robust enough to maintain its identity and the inherent advantages of its use (Ribeirinha et al., 2022). In addition, by including the interactions that the student establishes within the learning community that shape student engagement, it is in line with studies on interactions in distance education (Moore, 1989).

Studies on FCM and student engagement have revealed not very consistent results (Bond, 2020). O'Flaherty et al. (2015) found very limited evidence to support increased student engagement, suggesting future research to examine other engagement indicators. The study by Bhagat et al. (2016) showed that students perceive themselves as more involved and active in the FCM. However, Lo and Hew (2021) found no significant differences in student BE between flipped and traditional classrooms. In a systematic review of 107 studies in K-12 education, Bond (2020) indicated that in 93% of the studies analysed, the FCM positively affected at least one dimension of student engagement. The indicators positive collaboration and peer-to-peer learning were particularly boosted, as were the increase in satisfaction, participation and the improvement in student-teacher relations. However, it also pointed out that 50% of the studies showed at least one side of student disengagement, with the most cited indicators being incomplete tasks, frustration, lack of will and confusion. In this sense, further research is suggested to understand exactly how the FCM improves student engagement (Bond, 2020). Therefore, this study attempts to overcome the abovementioned limitations by exploring multiple resources to investigate student engagement in a pedagogical proposal based on the FCM in

online learning. The aim was to assess student engagement by analysing student discourse, behaviour, perceptions of the experience and their academic performance in a study guided by four research questions: (1) What is the student's level of BE in the presented pedagogical proposal? (2) What levels of student CE were found in the different episodes of the synchronous sessions? (3) Is there any relationship between the student's level of CE in the synchronous sessions and their academic performance? (4) How do the different facilitators influence students' CE, BE and AE in the context of online learning?

2. Method

This is an evaluative research orientated towards change, with the aim of understanding and interpreting the educational reality to propose actions for improvement. This research used an exploratory sequential mixed methods approach (Cresswell & Clark, 2013). It began with the collection and analysis of qualitative data, followed by quantitative analyses and finally, the interpretation of the entire analysis, integrating qualitative and quantitative results.

Mixed methods research can be particularly revealing in exploring the complexity of a constantly evolving concept such as student engagement (Bond, 2020), aiming to understand better how the different facilitators present in the learning environment influence it. In addition, the mutual contribution of the potential of each method generates more comprehensive and robust answers to the initial questions (Cresswell & Clark, 2013).

2.1. Participants and the context

The research was carried out with 24 students (14 female and 10 male students, with an average age of 16.25 years) in the 11th year of Portuguese secondary education. Data collection took place in the Physics and Chemistry subject, between February and April 2021, corresponding to the second closure of schools in Portugal caused by Covid-19.

In this context, a pedagogical proposal based on the FCM was implemented with two components: asynchronous lessons (AssL) and synchronous lessons (SL). For the AssLs, the Edmodo platform was used, where the programme content was made available in the form of educational videos accompanied by a set of slides, a monitoring quiz, the pages of the class book related to that content and the list of exercises to be solved.

The SLs were held on the Zoom web conferencing platform. They were organised in learning episodes, the first few minutes of which were for welcoming and monitoring the tasks set out in the AssL. Then, through dialogue with the students, a summary of the AssL content was constructed, and the aspects that had raised the most queries were explored (Summary). Afterwards, the quiz (Quiz) questions were analysed and corrected with the participation of the students. Lastly, the students were randomly assigned to six breakout rooms to work in groups on a set of activities that included solving problems, exploring simulations, and analysing experimental results (Rooms). The timetable for the subject included two AssLs, one of 50 minutes and another one of 100 minutes, interspersed with two SLs of 100 minutes each.

2.2. Data collection and processing

Data was collected from four sources to answer the research questions: records from the Edmodo platform and the teacher, discourse produced on the Zoom platform, knowledge assessment tests and a group interview. The semi-structured interview was conducted using a script organised into two main areas of information: the AssL and the SL. The different types of interactions were explored in each area: teacher-student, student-student, student-content and student-technology. Twenty-one students volunteered to take part in the interviews. They were interviewed virtually and in groups of three. The average length of the interviews was 35 minutes, and the audio was recorded with the participants' permission. After transcribing the interviews, a categorical content analysis was carried out (Bardin, 2011). The data was classified according to the categories corresponding to the different facilitators of student engagement proposed in the Conceptual Framework for Student Engagement in the FCM (Bond, 2020). This analysis aimed to identify the influencing factors of each facilitator present in the students' discourse and describe their effect on student engagement. Content analysis was also conducted on the students' discourse produced during the SLs. The students' discourse was transcribed, and then the units of analysis were categorised using the analytical framework proposed by Zhu (2006) (table 1).

Table 1. Analytical framework for student CE in online group discussion adapted from Zhu (2006)

Category		Description
Question	Vertical (QV)	Question that has a direct and correct answer.
	Horizontal (QH)	Question that has no direct and correct answer. Inquiring or starting discussion.
Statement	Responding (SR)	Statement that is made in direct response to a previous message(s).
	Informative (SI)	Statement that provides information (anecdotal or personal) related to the topic under discussion.
	Explanatory (SE)	Statement that presents factual information with limited personal opinions to explain previous messages.
	Analytical (SA)	Statement that offers analytical opinions about the topic under discussion.
	Synthesizing (SS)	Statement that summarises or attempts to provide a summary of discussion.
	Evaluative (SEv)	Statement that offers evaluative or judgmental opinions of key points in the discussion.
Reflection	Reflective of changes (RC)	Statement that reflects on changes in personal opinions and behaviours.
	Reflective of using cognitive strategies (RS)	Statement that explains or reflects on one's use of cognitive strategies/skills in accomplishing certain learning tasks.
Scaffolding	Scaffolding (S)	Statement that guides students in discussing concepts and in learning content materials by offering suggestions.

According to this structure, each categorised unit of analysis can be assigned a score based on how cognitively deep it is. Thus, QV was assigned a value of 1, QH a value of 2 and so on up to S with a value of 11 (Xu et al., 2020). As each SL was divided into three learning episodes, this categorisation made it possible to assess the number of interactions per student and the student's level of CE (based on the score awarded) in each episode. Subsequently, the possibility of a correlation between the student's CE and his/her academic performance (obtained through knowledge assessment tests) was analysed.

The evaluation of the students' BE used the number of students who answered the various quizzes (Edmodo platform), the number of students who summarised the AssL (records of the teacher of the subject) and the results of the analysis of the students' interviews. The student's AE was only assessed based on the results of analysing the interviews. To ensure the consistency of the analysis procedures, 20% of the coding of the interview content and the students' discourse in the SL was done simultaneously by two coders, with the agreement level between the two being respectively 0.79 and 0.87.

3. Results

3.1. Records of the Edmodo platform and the teacher

In each AssL, the students had to answer a monitoring quiz and summarise the materials provided. The average number of students who completed all the quizzes (23.3 students) and all the summaries (23.8 students) was calculated by adding up the number of students who completed these tasks and dividing it by the number of AssLs.

3.2. Speeches produced on the Zoom platform

Table 2 shows the number of students' discursive interactions categorised in each learning episode and the respective duration of the episodes.

Table 2. Number of interactions categorised in SL.

		Summary		*Quiz*		Rooms	
SC	N (students)	n (interactions)	t (minutes)	n (interactions)	t (minutes)	n (interactions)	t (minutes)
1	24	23	18,28	9	6,46	20	12,10
2		25	14,85	15	9,35	35	18,27
3		11	9,01	11	7,87	49	30,41
4		23	26,55	5	9,84	56	26,99
5		8	7,72	12	6,94	33	45,72
6		25	22,04	15	12,96	67	32,03
7		29	25,04	19	18,57	22	19,91

Given that the duration of the episodes varied throughout the SLs, in order to check whether the number of discursive interactions varied with the type of episode, it was necessary to normalise the data. To do this, the number of interactions of each

student was divided by the duration (in minutes) of the learning episode. The total number of discursive interactions per minute for each student was then calculated by adding up their interactions in the seven episodes of the same type. Table 3 shows the descriptive analysis of the total number of interactions per minute for each student in the three learning episodes.

Table 3. Descriptive analysis of the total number of interactions per minute of each student in the three learning episodes and respective statistical analysis .

	N	Minimum	Maximum	Median	Shapiro-Wilk, W	Shapiro-Wilk, p	Friedman test		
							χ^2	df	p
Resumo	24	0	1,09	0,211	0,880	0,008			
Quiz	24	0	1,14	0,309	0,917	0,051	3	2	0,223
Salas	24	0,0371	2,41	0,350	0,679	< 0,001			

The results of the Shapiro-Wilk test showed that the data did not have a normal distribution ($p < 0.05$), so the medians of the total number of interactions per minute in the three episodes were compared using the Friedman test. The Friedman test showed no statistically significant differences in the medians of the total number of interactions per minute in the three learning episodes.

Table 4 shows the categories of student CE present in the different learning episodes. There is SR in all the learning episodes, but there is a broader spectrum of the student's CE in the Rooms.

Table 4. Categories of CE of the student observed in the three learning episodes.

SC	Summary	*Quiz*	Rooms
1	QV; DR; DI; DE; DA	DR	QV; DR; DI; DA; RM
2	QV; DR; DI; DA	DR; DI; DE; DA	QV; QH; DR; DI; DE; DA; DS; DAv; RM
3	DR; DA	DR; DE	QV; DR; DI; DE; DA; RM
4	QV; DR; DI; DE; RM	DR; DI	QV; QH; DR; DI; DE; DA; DS; RM; RE
5	DR	QV; DR; DI; DE; RE	QV; DR; DI; DA; RM
6	QV; DR; DI; DE; RM	QV; DR; DI	QV; QH; DR; DI; DE; DA; DAv; RM
7	QV; DR; DI; DE	QV; DR; DI; DE; DA	QV; QH; DR; DI; DE; DA; RM

When comparing the student's level of CE in the three learning episodes, the level of CE achieved in each episode was determined for each student. To do this, we added up the values (attributed according to the indication given in 2.2) of their discursive interactions produced in that learning episode. Subsequently, for each student, the value of the CE in the seven episodes of the same type was added up. Table 5 shows the descriptive analysis of the total value of the student's CE in the three learning episodes and the statistical procedures used to compare them.

Table 5. Descriptive analysis of the total value of the students' CE in the three learning episodes and the respective statistical analysis.

	N	Minimum	Maximum	Media n	Shapiro-Wilk, W	Shapiro-Wilk, p	Friedman test χ^2	df	p
Resumo	24	0	79	14	0,800	< 0,001			
Quiz	24	0	37	10	0,888	0,012	14,5	2	< 0,001
Salas	24	1	251	28	0,598	< 0,001			

The results of the Shapiro-Wilk test showed that the data did not have a normal distribution ($p < 0.05$), so the student's level of CE in the three episodes was compared using the Friedman test. This test showed statistically significant differences in the student's CE level medians in the three learning episodes. Subsequently, the Durbin-Conover test was carried out, which showed that the students' level of CE in the Rooms is statistically different from the CE in the Summary and the Quiz (table 6).

Table 6. Comparison between peers (Durbin-Conover test).

	Statistics	p
Resumo - Quiz	1,12	0,270
Resumo -Salas	3,18	0,003
Quiz -Salas	4,29	< 0,001

Combining the results of table 6, which show a higher median student CE in the Rooms, with the result of the Durbin-Conover test, it can be seen that the student CE in the Rooms was higher than the student CE level in the Summary and in the Quiz.

3.3. Academic performance results versus student's CE

The possibility of a correlation between the student's CE and his/her academic performance was analysed using the results of each student's assessment tests (on a 200-point scale) and the respective total CE value obtained in the seven SLs (table 7).

Table 7. Descriptive analysis of the student's total CE value and the assessment tests combined with the results of the correlation between the two.

	N	Min.	Max.	Median	Shapiro-Wilk, W	Shapiro -Wilk, p	Spearman's correlation, ρ	Spearman's correlation, p
teste	24	46	196	117	0,933	0,113		
EC	24	8	338	54,0	0,668	<0,001	0,005	0,982

The results of the Shapiro-Wilk test showed that the data did not have a normal distribution ($p < 0.05$), so Spearman's correlation was used. This showed that there was no correlation between the student's CE and his/her academic performance.

3.4. Interview analysis

The interview analysis allowed to assess the action of the different facilitators present in the learning environment on student engagement. This action was described through the influence factors of each facilitator identified in the students' discourse, which

could be positive, negative or both (in tension), depending on the indicators of student engagement or disengagement that they promote.

Teacher

The influencing factors identified were *presence/feedback/support* and *use of technology/digital skills,* both of which positively affected student engagement. The action of the first factor facilitated *comprehension* through *reinforcement/consolidation, focus/explanation* and *reflection on prior knowledge (self-perception).* The action of the second appeared associated with the videos made by the teacher and promoted *attention* and *comprehension*.

Curriculum activities

Two factors of influence were identified *design/quality/usefulness/relevance* and *alignment*, both in tension. The *alignment* between the materials provided and the tasks facilitated *carrying out the tasks* and enabled *comprehension* of the content, and, in the SL, allowed more time for *interaction with peers*. The negative valence arose from the need to search for additional information to carry out some AssL tasks, which led to *disinterest* and *not carrying out the tasks*. Regarding *design/quality/usefulness/relevance*, the positive action was related to the design of the curriculum activities being based on the FCM, which provided *satisfaction* with the activities, made it possible to take *responsibility* for learning, creating *study and work habits* that translated into a *positive self-perception.* In addition, the design of the SL fostered *participation* of the students, *quality interactions with the teacher*, *learning with peers, understanding of the content and positive self-perceptions.* The negative action was associated with the obligatory nature of the AssL's tasks, which translated into *disinterest*.

Virtual learning environment (VLE) and technology

Regarding this facilitator, the following influence factors emerged in the students' discourse: *content size*, *evaluation* and *accessibility/usability/support*. The fact that the videos provided were short had a positive effect on the *interest* and *attention* with which the students viewed them. In *evaluation,* both positive and negative actions on student engagement were found. The application used to carry out the knowledge assessment tests *did not allow reflection* on the answers given (it was impossible to go back to the previous answer), and the immediate self-correction of the response caused *anxiety* and *stress* in the students. The positive action came in the self-correction of the AssL's *quiz*, which made it possible not only to gauge the quality of the self-study, *self-efficacy*, but also to decide on the need for more in-depth study of the content, *self-regulation*. The factor *accessibility/usability/support* also had positive and negative effects on student engagement. Some students were *satisfied* with this environment because it was more comfortable, allowed for greater autonomy, made it possible to investigate content and *ensured interactions with the teacher and peers*. The functionalities of the videos (pause, rewind, fast forward) helped in *understanding* the content and maintaining *attention* levels. The virtual rooms facilitated interaction with the teacher and *peers*, as they created a more private environment. The negative actions were associated with the distracting factors of the VLE, which *hindered study and work habits* and translated into *non-understanding* of the content, generating *dissatisfaction*. In addition, the excessive exposure of the students in the main VLE

room caused *discomfort* in the more introverted students, making it difficult to *interact with the teacher*. In addition, it was difficult to clarify doubts in more complex exercises, with several stages of resolution, which led to *dissatisfaction*.

Classmates

The influencing factor identified was the *opportunity for collaboration,* in tension. The positive action arose from the possibility of the AssL activities being carried out virtually in groups at the students' initiative. This promoted *interactions with peers*, allowed *reflection* on discrepancies in how tasks were solved and *learning with classmates*. In the SL, the random formation of the working groups allowed them to *manage expectations* since completing the task was the group's goal, and although there was no affinity in the group, this promoted *joint learning*. In other cases, the lack of affinity created awkward environments, where students *didn't feel comfortable*, *decreasing the interaction between them*.

Student

The influencing factors related to this facilitator were *motivation* and *personality,* both in tension. For Bond and Bedenlier (2019), motivation is the force that energises behaviour, an antecedent to student engagement, and can have external (extrinsic) or internal (intrinsic) causes for the student. Thus, the positive action of the *motivation* of the students appears to be associated with the organised, sequential and interactive structure of the proposed activities that made sense and made them *complete the tasks, interact and participate*. In addition, the need for *comprehension* of the content enabled them to perform better in the lessons and contribute more effectively to group tasks. On the contrary, the fact that it was a repeated experiment and implemented over a longer period had negative repercussions on the *enthusiasm* with which the students carried out the activities. Regarding *personality*, some students, regardless of the working group, *felt good and interacted with the group and the teacher*. Others, although they didn't interact on their own initiative, liked group activities because it "forced" them to *interact with their classmates*. However, the more reserved students or those who preferred to carry out the tasks individually found it more difficult to *interact with the working group*.

4. Discussion

4.1. Behavioural engagement

In the evaluation of the student's BE, the data collected showed that a large number of students always carried out the asynchronous tasks, namely the summary and the quiz. This result somewhat contradicts previous studies, as non-completion of tasks is the most prominent indicator of student behavioural disengagement in FC environments (Bond, 2020). However, this result can be justified by analysing the interviews, where the indicator carrying out tasks appeared to be associated with the positive action of alignment of curriculum activities and the positive action of student motivation. The following statement illustrates this:

> It was a very methodical study because everything was organised; to do the task ahead, we had to do the previous task, which was motivating because it made sense (Student1)

Although previous research indicates that extrinsic motivation can hinder BE in the FCM (Lai et al., 2021), as its increase leads to activities being carried out due to psychological pressure, the *alignment* of activities, translated by the use of the results of asynchronous learning to direct the student's synchronous learning, seems to have generated an integrated learning experience giving meaning to the work of the AssL, as it promoted student autonomy and a change in learning habits (Lo & Hew, 2017). The positive action of the group of influencing factors *design/quality/usefulness/relevance* of the curriculum activities supports this, as it enabled students to take *responsibility* for their learning by creating *study and work habits*.

In the literature, the *increase in interactions with peers* is the BE indicator most often quoted as a result of the FCM (Bond, 2020). In analysing the interviews, this indicator is present and resulted from the positive action of various influencing factors present in the different facilitators. It was associated with the *alignment* of the curriculum activities, which made it possible to optimise lesson time, the *accessibility/usability/support* of the VLE, which made it possible to create breakout rooms, and the *opportunities for collaboration* with classmates generated by the AssL tasks, which led to students coming together virtually to complete them.

In the AssL component, the videos made by the teacher positively affected the BE attention indicator, as can be seen in the following statement:

> In the video, the teacher explained everything in a slow, thorough way so that we understood everything. I think videos are essential, especially when she makes them (Student2)

This result is in line with the literature, which indicates that videos that are not made by the teacher are more likely not to be watched (Bond, 2020). Of course, the students' *attention* when watching the video will have repercussions on their *participation* and the *quality of interactions* (Olakanmi, 2017). The interviews suggest that, by indicating that these BE indicators are present in the SL.

4.2. Cognitive engagement

The evaluation of the student's CE showed that there was no influence of the learning episode on the number of interactions per minute produced by the students. However, the level of student CE in the *Rooms* was higher than that achieved in the *Summary* and the *Quiz*. The teacher led these two learning episodes, i.e., they were based on a question-answer dynamic, the categorisation of which led to a smaller spectrum of students' CE, with a superficial level of information processing (Zhu, 2006). In the *Rooms* there was a different learning dynamic; the interaction came from the student to the teacher. The sequence of interactions, as well as making it possible to "visualise" the process of building knowledge, supported it, as the teacher's actions boosted the cognitive processing of information. As a result, the *Rooms* have a more comprehensive range of interactions and a higher level of student CE. A result corroborated by the analysis of the interview, in which the positive action of the influence factors *presence/feedback/support* of the teacher facilitated *comprehension* through *reinforcement/consolidation*, *focus/explanation* and *reflection on prior knowledge*. Thus, when the teacher acts as a facilitator of learning, students exhibit greater behavioural and cognitive engagement, which is consistent with the results of previous research (Xu et al., 2020). The interviews also highlight the influence of the

VLE's *accessibility/usability/support* factor on student engagement, as the *Rooms* facilitated interaction with the teacher and colleagues by creating a more private environment. This contrasted with the excessive exposure the students felt in the main VLE room (*Summary* and *Quiz*), which caused *difficulties in interacting with the teacher* in the more introverted students.

A quarter of the studies on the FCM and student engagement indicate that the model improved indicators of student CE, *positive self-perceptions* and *self-efficacy* (Bond, 2020). These two indicators are also present in the analysis of the interviews and appeared in relation to the positive action of the *design/quality/usefulness/relevance* of the curriculum activities that created *study and work habits*; with the possibility of gauging the quality of autonomous study, provided by the self-correction of the *quiz* and in the SL, with the teacher's questioning. Therefore, this result reinforces the idea that the process of knowledge construction does not occur naturally in the VLE, but rather due to the careful planning of activities and teacher facilitation during the learning process (Zhu, 2006).

Another consequence of the FCM is an increase in the student's CE indicator *comprehension* of the content (Kong, 2015). In the interviews, this indicator was associated with the *presence/feedback/support* of the teacher, as well as her videos, the *alignment* and *design/quality/usefulness/relevance* of the curriculum activities and the *intrinsic motivation* of the student himself/herself.

There is a greater likelihood of understanding content when students' discourse shows deeper levels of information processing associated with the elaboration of concepts and the debate or negotiation of meaning (Zhu, 2006). Whether or not there was a correlation between the student's CE in the online environment and his/her academic performance was checked. The results of this analysis showed that the students who showed the most CE during the SL were not necessarily the ones who achieved the best results in the knowledge assessment test.

One possible explanation lies in the skills that help them learn. The students who learnt more easily didn't interact as much with the teacher to facilitate *comprehension* of the content, so they performed well academically without exhibiting high levels of CE. This result contradicts the study by Pietarinen et al. (2014), who found a positive correlation between the student's CE and his/her academic performance. However, it is in line with studies that indicate that the correlation between CE and academic performance is weak or that it is positively correlated with the student's BE and AE (King, 2015).

4.3. Affective engagement

Analysing the interviews showed that the most frequent AE indicator in the students' discourse is *satisfaction*. This indicator was associated with the *design/quality/usefulness/relevance* of the curriculum activities, which, being based on the FCM, provided *satisfaction* with the activities. This fact reported in the literature (Bond, 2020) is illustrated in the following statement:

> If we were told to answer questions from the book, we would, but it was more boring. So, as it was more interactive, I enjoyed doing the tasks (Student3)

The interactivity resulting from the *quiz* or educational games in the pre-lesson component of the FCM is a critical factor for the model's success (Van Alten et al., 2019). *Satisfaction* was also associated with the influence factor *accessibility/usability/support* of the VLE. Some students were *satisfied* with this environment because it was more comfortable, allowed for greater autonomy, made it possible to investigate content and *ensured interactions with the teacher and peers*. However, this influencing factor was also the cause of the student's affective disengagement because the distracting factors of the VLE *hindered study and work habits*, which translated into *non-understanding* of the content, generating *dissatisfaction*.

Previous research has shown that students' personal beliefs influence how they experience factors related to their learning, with negative beliefs being the basis of a spiral of student disengagement. In a study carried out during the Covid-19 pandemic, Pelikan et al. (2021) concluded that students with high perceived competence were better able to cope with learning in an online context because they exhibited self-regulation strategies. These students often reported success in autonomous learning and even enjoyed greater self-sufficiency because they could learn at their own pace and time. Meanwhile, the group with low perceived competence needed more support.

Although *satisfaction* is also associated with working with peers (Olakanmi, 2017), in analysing the interviews in relation to this facilitator, other indicators of the student's AE were found. In the SL, the formation of the working groups was random, which allowed them to *manage expectations* when there was no affinity in the group to complete the tasks. The following statement clarifies this:

> Randomness 'forces' us to know how to work with different people who think differently from us. In the future, it will be like this, in the labour market, we don't choose (Student4).

However, some students mentioned that randomness sometimes created *uneasiness*, as the following statement indicates:

> There are people who prefer to work alone, and in that case, the whole group does [the tasks] individually, leaving an awkward atmosphere. It's strange (Student5).

These statements alert us to the need to adjust pedagogical strategies in the online context to avoid a spiral of disengagement.

4.4. Implications for practice

Given that most of the different facilitators' influencing factors also negatively affected student engagement, it is essential to rethink some of the strategies adopted in the online context. Some students referred to the *non-completion of tasks* of the AssL due to the need to search for additional information to complete them. Others emphasised the *disinterest* resulting from the compulsory nature of the tasks.

In this context, the flexibilisation of learning paths associated with AssL can respond to these challenges, and it may include: (1) providing additional materials that allow for a more in-depth reading of the content and (2) allowing for a flexible exploration of the materials that meets the different learning styles of the students,

since the existence of different options encourages them to practise learning processes inside and outside their comfort zone (Fauzi & Hussain, 2016).

In the SLs, the distracting factors of the VLE *hindered study and work habits*, which translated into *non-understanding* of the contents, generating *dissatisfaction*. The difficulties in clarifying doubts on more complex exercises also caused *dissatisfaction*. In addition, the excessive exposure of the students in the main VLE room caused *uneasiness* in the more introverted students, *making it difficult to interact with the teacher*.

In this sense, it is important to promote self-regulated learning strategies, which involve helping students to set achievable goals, manage their time and monitor their execution. So, by achieving them, they experience greater perceived competence, with repercussions on intrinsic motivation and learning success (Pelikan et al., 2021). Another possibility is to increase the channels and forms of communication so that everyone feels comfortable interacting, also allowing the teacher to send feedback, which can boost self-efficacy and the teacher-student relationship.

The application used to carry out the assessment tests did not allow *reflection* on the answers given, and the immediate self-correction of the response caused, according to the students' perceptions, *anxiety and stress*. Also, the randomness in forming the working groups sometimes created awkward environments where the students *didn't feel comfortable,* decreasing the *interaction between them*.

Based on these results, it should be noted that the choice of learning applications and platforms should be cautious and adapted to the profile of the students. Building a profile of each student's engagement, which brings together multiple pieces of evidence from their journey, could be a more viable option for assessing students in this context (Riordan et al., 2016) and alternating between working groups chosen by the students and random groups could boost student engagement.

5. Conclusion

This study has certain limitations that make it unrepresentative, and its conclusions can't be generalised. The sample size is very small, only 24 students. It was implemented during a critical period (the Covid-19 pandemic), which may have influenced some of the students' behaviours and perceptions, skewing the results obtained.

Additionally, the *Zoom* platform only recorded the breakout room where the host (the teacher) was, not allowing access to the students' discourse produced in her absence, which could lead to a different spectrum of interactions. However, the use of mixed methods to research student engagement in a pedagogical proposal based on the FCM and presented in online learning enabled greater acuity in analysing and understanding the phenomenon under study. In addition, it provided, in the students' own words, concrete information on the aspects to be improved in online learning.

The pedagogical proposal led to high levels of student BE expressed by the indicators *task fulfilment*, *interaction with peers (and teacher)* and *participation*. This

was made possible by aligning the tasks proposed in the AssLs and the SLs, whose effect on student motivation created *study and work habits*. The characteristics of the videos made by the teacher and the optimisation of the SL's time, when combined with the technological support of the VLE, ensured *participation* and *(quality) interactions with peers and the teacher*. The students showed higher levels of CE in the *Rooms* compared to the other two learning episodes. The *Rooms* created a more private learning environment, where students had a more active learning dynamic, favourable to interaction with peers, the *explanation of knowledge* and *reflection* facilitated by interaction with the teacher. No correlation was found between the student's CE levels in the synchronous sessions and his/her academic results.

The most prominent indicator of the student's AE was *satisfaction*, but most of the facilitators analysed also negatively impacted the student's AE. In this context, the increased importance of the teacher in supporting the students' emotional development and the construction of knowledge is highlighted.

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