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FLIPPED LEARNING AND STUDENT APPROACH TO LEARNING IN A FIRST YEAR CHEMISTRY SUBJECT

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Abstract

Flipped learning methodology transfers instruction from group learning space to the individual learning space, transforming the classroom in an interactive learning environment where the teacher uses the previously generated knowledge and outcomes to apply concepts and engage the subject matter. Student's approach to learning is how the student faces subjects from his/her personal point of view. It can be classified in deep and surface approach, that differ in the aim of the student with an intrinsic motivation for learning in the first and a meet of the requirements of the subject in the second. The influence of flipped learning on the student's approach to learning in a first-year subject of food science technology degree was assessed using the R-SPW-2F questionnaire. The reliability of the questionnaire was strong for the main subscales, but weaker for the secondary scales, with high correlations between the main scales and their related subscales. The students showed a slightly higher deep approach than surface approach, with no differences between flipped and non-flipped methodology. Male students showed higher surface approach than females. The students maintained their approach to learning regardless of the methodology used. Combining both methodologies in a same subject seems not to affect the election of the student approach to learning, but improvements can be made to high deep approach to reach higher performance results.

Keywords: Flipped classroom; R-SPQ-2F; motivation; teaching methodologies.

1   INTRODUCTION

The flipped methodology or flipped classroom (FC) is a type of learning where the traditional transmissive lecture is replaced by active in-class tasks using available materials previously developed by the teachers [1]. Before the FC lecture, students have to prepare some preliminary learning on line and later develop that learning in the classroom with their teachers and pairs [2]. This change of the methodology obligates instructors to develop new activities further than the explanation of concepts [2]. In previous studies, it has been found that this methodology increases the satisfaction of the students as well as their engagement [3].

The engagement of students is related to the student's approach to learning, a concept developed by Marton and Säljö [4], [5], and has two main approaches: deep approach (DA) and surface approach (SA) [6], [7]. However, other approaches have been also identified [6], [8]. DA is characterized by an intrinsic motivation of the student in his/her own learning, while SA is related to a lack of personal connection [9], [10]. Deep and surface approaches in turn have two related subscales, namely deep motivation and strategy (DM and DS) and surface motivation and strategy (SM and SS). The approach to learning that a student shows in a given learning environment is not a fixed characteristic of the student, and several factors affect the election of the main approach in a context [11]. These factors can be classified as personal, contextual or perceived [12]. Contextual factors are related to the type of studies, discipline, subject and teaching / assessment methodologies [12]. FC is one methodology that can influence the student's approach to learning.

Several tools can be used to measure the student's approach to learning, such as the *Approaches and Study Skills Inventory for Students* (ASSIST) [13], [14] or the *Inventory of Learning Styles* (ILS) [15], but one of the most used is the *Revised Two-Factor Study Process Questionnaire* (R-SPQ-2F) [8], that is a shortened version of the Study Process Questionnaire (SPQ) [6]. The R-SPQ-2F questionnaire consists of 20 questions that measure the two main scales (DA and SA) and two related subscales (Motivation and Strategy). This questionnaire has been validated in several and different cultural contexts [16]–[20].

In the present study, the influence of FC in the student approach to learning is assessed in a first year subject and the results are discussed.

2 METHODOLOGY

The subject Foundations of Chemistry for Science and Food Technology is located in the first year of the bachelor's degree in Food Science and Technology of the Universitat Politècnica de València (UPV). It has 12 ECTS (European Credits Transfer System) and is organized in three different learning units, namely (1) Organic Chemistry, (2) Thermodynamics applied to simple systems and (3) Chemical kinetics and equilibrium. This study was carried out in the context of the second unit. In total, 19 lectures were given, the first nine of which were taught using FC. Over this initial period, students were requested to watch 1 to 3 short videos (3-8 min) before each lecture, and all the time available in the classroom was spent on resolving qualitative and quantitative questions on the concepts treated. The students did this in little groups and were assisted by the teacher. During the rest of the unit, traditional methodology was used in the classroom. Both at the end of the FC lectures and at the end of the unit, the R-SPQ-SF questionnaire developed by Biggs [8] was submitted to the students on-line through *UPV* learning platform PoliformaT. A Spanish translation of the questionnaire was used [21]. Statgraphics Centurion XVII (Statpoint Technologies, Inc.) was used to analyse the results, calculating correlations between factors and Cronbach's alpha values.

3 RESULTS

The participation in the study was high as more than half of the students answer the questionnaire (Table 1), with no differences regarding gender or methodology. The DA value was higher than the SA value, but the difference was very small compared to other studies [22]–[24], which probably indicates that the students are engaged in their learning while extrinsic responsibility is also very high. No differences were observed regarding the methodology used or the gender, except for the SA where females obtained a lower score. Gender is one of the personal factors that can affect the student's approach to learning [12], but other studies found no differences regarding gender [22], [25], [26]. For the secondary scales (Table 2) no differences were observed except for surface motivation where male obtained a higher value.

Table 1. Number of students who answered the questionnaire by subject, gender, year and degree. Values (average and standard error) of the R-SPQ-2F questionnaire scales in the deep approach (DA), surface approach (SA), difference between DA and SA and null hypothesis DA-SA.

	No. answers (% enrolled)	DA[1]		SA[1]		Difference DA-SA[1]		Null hypothesis DA-SA[2]
Subject								
Flipped	73 (0.49)	2.68 ± 0.08	a	2.54 ± 0.08	a	0.14 ± 0.11	a	NS
Non-flipped	85 (0.57)	2.81 ± 0.07	a	2.56 ± 0.07	a	0.25 ± 0.09	a	**
Gender								
Female	94 (0.51)	2.75 ± 0.06	a	2.47 ± 0.06	a	0.27 ± 0.08	a	***
Male	64 (0.56)	2.75 ± 0.08	a	2.66 ± 0.09	b	0.09 ± 0.12	a	NS
Gender non-flipped								
Female	44 (0.47)	2.69 ± 0.09	a	2.42 ± 0.07	a	0.27 ± 0.11	a	*
Male	29 (0.51)	2.66 ± 0.14	a	2.72 ± 0.15	b	-0.06 ± 0.21	a	NS
Gender non-flipped								
Female	50 (0.54)	2.80 ± 0.09	a	2.52 ± 0.09	a	0.28 ± 0.12	a	NS
Male	35 (0.61)	2.82 ± 0.09	a	2.62 ± 0.10	a	0.20 ± 0.14	a	NS
Total	158 (0.53)	2.75 ± 0.05		2.55 ± 0.05		0.20 ± 0.07		**

[1]*Different letters in the same column indicate significant differences (P-value<0.05) between groups according to Tukey's test*
[2]***: P<0.0001

Table 2. Values (average and standard error) of the R-SPQ-2F questionnaire scales in the deep motivation (DM), deep strategy (DS), surface motivation (SM) and surface strategy (SS) for subject, gender, year and degree.

	DM[1]		DS[1]		SM[1]		SS[1]	
Subject								
Flipped	2.71 ± 0.08	a	2.65 ± 0.08	a	2.33 ± 0.09	a	2.75 ± 0.08	a
Non-flipped	2.85 ± 0.07	a	2.77 ± 0.07	a	2.27 ± 0.07	a	2.85 ± 0.08	a
Gender								
Female	2.83 ± 0.07	a	2.67 ± 0.07	a	2.14 ± 0.07	a	2.80 ± 0.07	a
Male	2.73 ± 0.09	a	2.77 ± 0.09	a	2.52 ± 0.10	b	2.81 ± 0.10	a
Gender non-flipped								
Female	2.75 ± 0.10	a	2.63 ± 0.09	a	2.15 ± 0.09	a	2.70 ± 0.09	a
Male	2.65 ± 0.15	a	2.68 ± 0.14	a	2.60 ± 0.18	b	2.83 ± 0.15	a
Gender non-flipped								
Female	2.89 ± 0.10	a	2.71 ± 0.10	a	2.14 ± 0.10	a	2.90 ± 0.10	a
Male	2.79 ± 0.10	a	2.85 ± 0.10	a	2.45 ± 0.10	b	2.79 ± 0.13	a
Total	2.79 ± 0.05		2.71 ± 0.05		2.29 ± 0.06		2.81 ± 0.06	

[1]Different letters in the same column indicate significant differences (P-value<0.05) between groups according to Tukey's test

Figure 1 shows the distribution of SA vs DA of the student population, both for flipped methodology (top) and non-flipped (bottom). No significant effect of the methodology was found. The number of students scoring higher in SA than DA was 22 in flipped methodology and 31 in non-flipped methodology. The proportion of students in this situation is higher than that in other studies in a similar context [22], which indicates that a high percentage of students had more involvement in getting a mark than learning the subject.
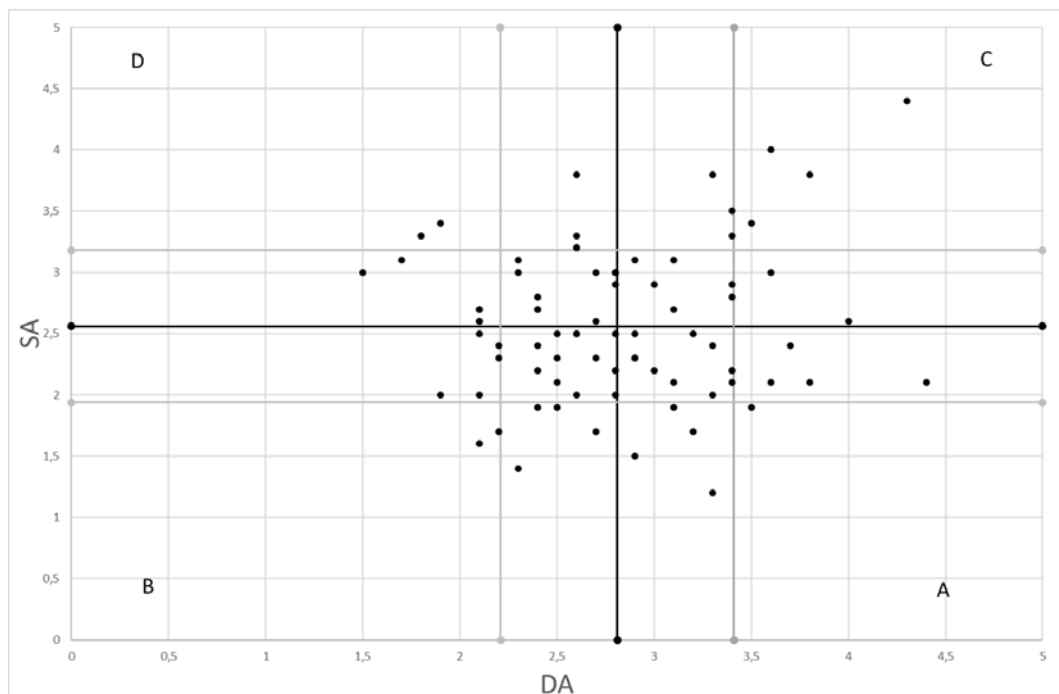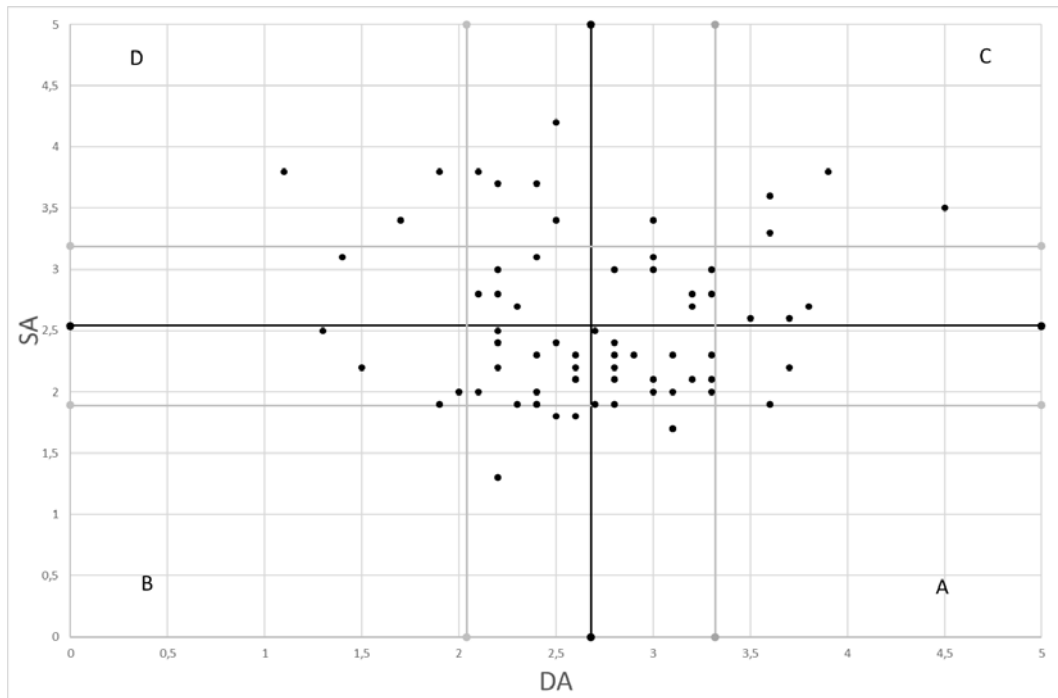
Figure 1. Deep approach (DA) minus surface approach (SA) distribution of scores for each student of Non-flipped (top) and Flipped (bottom) methodologies. The black lines depict mean values for DA and SA and the grey lines the mean plus or minus the standard deviation.

Correlations between the main scales of the questionnaire (DA and SA) was low (Table 5) but high correlations were observed between the main scale and their related subscales coherently with previous studies [17], [27]. In this sense, our results would support the hypothesis according to which just the two main approaches would suffice [20]. The results of the Cronbach alpha (item reliability analysis, shown in Table 6) are in accordance with this, given that the overall reliability of DA and SA is higher than that of the subscales, which are often under the acceptance value (0.7).

Table 5. Correlations between different factors of the R-SPQ-2F questionnaire scales. Deep approach (DA), surface approach (SA), deep motivation (DM), deep strategy (DS), surface motivation (SM) and surface strategy (SS).

	DA	SA	DM	DS	SM
SA	0,17 *				
DM	0,93 ***	0,13 NS			
DS	0,93 ***	0,18 *	0,72 ***		
SM	0,15 NS	0,90 ***	0,10 NS	0,18 *	
SS	0,15 NS	0,89 ***	0,14 NS	0,14 NS	0,60 ***

***: P<0.0001, ** 0.001<P<0.0001, NS>0.01

Table 6. Cronbach alpha coefficient values (95% lower confidence band) among the different R-SPQ-2F questionnaire scales of the questionnaires evaluated. Deep approach (DA), surface approach (SA), deep motivation (DM), deep strategy (DS), surface motivation (SM), and surface strategy (SS) for subject, gender, year and degree.

	DA	SA	DM	DS	SM	SS
Subject						
Flipped	0.80 (0.76)	0.76 (0.72)	0.67 (0.60)	0.63 (0.54)	0.70 (0.63)	0.57 (0.48)
Non-flipped	0.79 (0.75)	0.75 (0.70)	0.62 (0.54)	0.69 (0.62)	0.58 (0.48)	0.65 (0.57)

Gender						
Female	0.81 (0.77)	0.76 (0.71)	0.66 (0.59)	0.67 (0.59)	0.66 (0.58)	0.62 (0.54)
Male	0.79 (0.74)	0.76 (0.70)	0.63 (0.54)	0.66 (0.58)	0.59 (0.50)	0.63 (0.54)
Gender non-flipped						
Female	0.75 (0.70)	0.63 (0.55)	0.60 (0.51)	0.54 (0.43)	0.54 (0.44)	0.53 (0.43)
Male	0.85 (0.82)	0.83 (0.79)	0.74 (0.68)	0.72 (0.65)	0.76 (0.70)	0.63 (0.54)
Gender non-flipped						
Female	0.85 (0.82)	0.82 (0.78)	0.71 (0.64)	0.75 (0.69)	0.73 (0.67)	0.67 (0.60)
Male	0.67 (0.60)	0.63 (0.56)	0.44 (0.32)	0.57 (0.48)	0.19 (0.01)	0.63 (0.55)
Total	0.80 (0.76)	0.76 (0.71)	0.65 (0.57)	0.66 (0.59)	0.64 (0.56)	0.62 (0.53)

Only the students that had answered both rounds of the questionnaire were considered to compare the value of DA minus SA in both methodologies. Figure 2 represents the scatter plot of DA-SA for flipped methodology versus DA-SA for non-flipped methodology. A linear tendency was found, which indicates that these students did not extensively vary their approach to learning to adapt to the methodology used. Contextual factors can influence the student's approach to learning [6], [12] and teaching methodologies are one of the factors that are in teacher's domain. However, the results of this study do not support this statement and further studies are necessary in order to reach a deeper understanding of the role of methodology on the students approach to learning in our context.
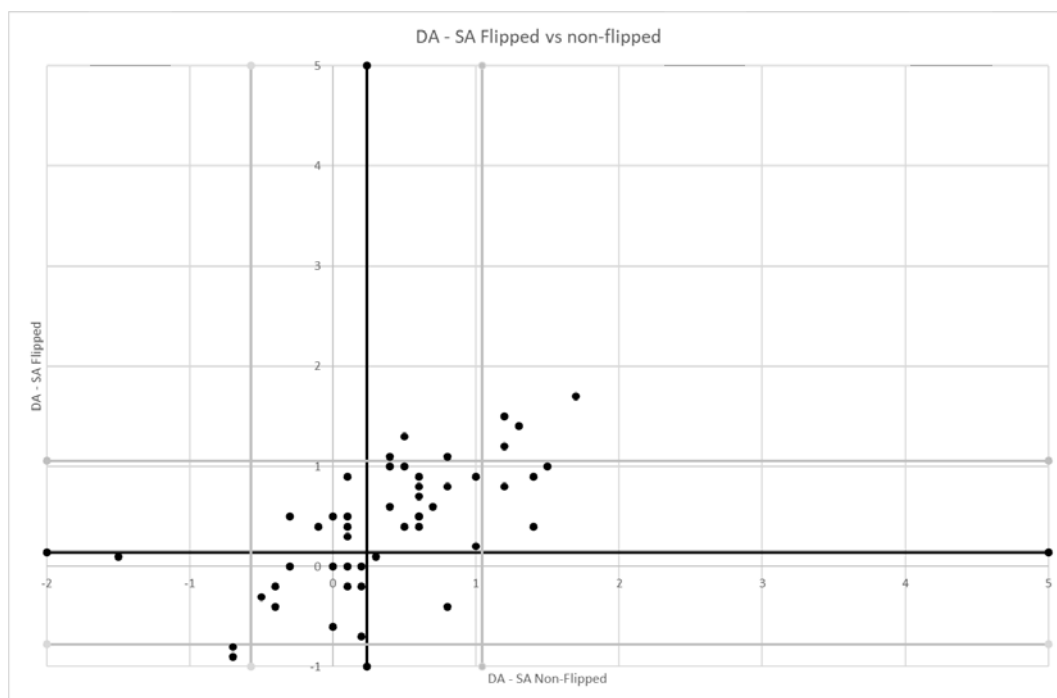

Figure 2. Deep approach (DA) minus surface approach (SA) distribution of scores for each common student of flipped and non-flipped modality. The black lines depict mean values for DA and SA and the grey lines the mean plus or minus the standard deviation.

4   CONCLUSIONS

FC has no effect in the student approach to learning of the students assessed in this study. Students did not change their approach to adapt to the teaching methodology used. Improvements should be made aiming to increase the involvement of the students and to get higher DA scores.

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