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The effect of flipped learning on students' basic psychological needs and its association with self-esteem

Esma I. Avakyan^{1,2*}  and David C. M Taylor² 

Abstract

Background Modification of the learning environment enhances academic performance, and meta-motivational skills. Yet it is largely unknown which underlying cause potentiates these effects. The study's goal is to analyse flipped classroom (FC) effect on basic psychological needs and self-esteem.

Methods 40 undergraduate medical students participated in a one-site two phased study. In Phase I, students attended a traditional lecture-based classroom (TC). In Phase II, the same group attended FC. Upon completion of each Phase students completed two questionnaires: Basic Psychological Need Satisfaction and Frustration Scale, and Rosenberg self-esteem scale.

Results Autonomy satisfaction was significantly higher in FC ($n=40$, $z=5.520$, $p<.001$), the same tendency was seen for Competence satisfaction in FC ($n=40$, $z=5.122$, $p<.001$). As for the frustration of all three needs, the statistical difference was observed for all three subscales between TC and FC. In FC, autonomy ($n=40$, $z=-5.370$, $p<.001$), relatedness ($n=40$, $z=4.187$, $p<.001$), and competence ($n=40$, $z=-5.323$, $p<.001$) frustration was significantly lower. Self-esteem was significantly higher in FC ($n=40$, $z=5.528$, $p<.001$). In TC self-esteem negatively correlated with autonomy frustration, ($r(38)=-0.430$, $p<.01$), and competence frustration, ($r(38)=-0.379$, $p<.05$). In FC, self-esteem positively correlated with autonomy satisfaction ($r(38)=0.316$, $p<.05$), and competence satisfaction ($r(38)=0.429$, $p<.01$).

Conclusions FC better fulfils students' basic psychological needs, specifically needs for autonomy and competence, and self-esteem compared to TC. Collaborative work, and academic scaffolding, contributes to behavioural engagement of students in the learning process. FC with the main focus on students' active involvement may better meet millennials' needs. Implementing validated questionnaires to measure students' psychological needs should become a regular practice in medical schools, specifically during the process of curriculum redesign.

Keywords Self-determination theory, Rosenberg self-esteem theory, Flipped classroom, Competence, Autonomy, Relatedness

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Introduction

Despite a large body of literature, current knowledge is unexpectedly scarce when it comes to analysing the effect of flipped learning on self-esteem and basic psychological needs, such as autonomy, relatedness and competence [1, 2]. Learning is often regarded as a social process [3]. Moreover, social learning might occur in different contexts, from formal workplace training to informal online communities and social networks [4]. It allows students to learn not only from experts but also from their peers. Previous research showed that modification of the learning environment towards a more student-centred approach enhances positive student relationships with peers and faculty [5]. However, learning is a complex process that along with cognitive elements involves motivation, and meta-motivational skills [6]. Several studies showed the positive effect of the student-centred approach on internal student motivation, which among other variables, proved to be a strong predictor of academic performance and general well-being (e.g., self-esteem) [7, 8]. The scarce evidence on medical students hasn't examined the underlying causes that might potentiate these effects [9]. Therefore, the aim of the study was to explore the effect of a relatively new methodology of teaching on basic psychological needs and self-esteem among medical students.

Background of the study

Due to increasing pressure for Higher Education institutions to meet the conceptual needs of the time, medical schools are transforming their curriculum to promote interaction between students and their peers, as well as with faculty [10].

One of these active learning setups –flipped learning also known as Flipped Classroom (FC) - received many accolades as an approach that best reflects students' needs [11] and became popular among faculty and students [12]. FC was found to be effective in developing skills needed to function effectively in the 21st century. Among them are the ability to work in groups [13], apply knowledge in practice [14–17], and analyse and synthesise information [18, 19].

Numerous studies investigated the impact of FC on a particular set of dimensions, mostly overall motivation and cognitive learning outcomes [20, 21]. To illustrate a few research examples, Hew and Lo in their meta-analysis of 28 comparative studies demonstrated FC was more effective in improving learning performance in comparison to a lecture-based traditional classroom (TC) [22]. In the context of medical education, Chowdhury et al. reported that in FC students “feel more engaged and active in the learning process.” [23]. Additionally, Lundin et al. showed that most studies are related to local context and research is “quite scattered”, while systematic

evidence based on empirical data is still limited [24]. Nevertheless, in a number of critical appraisals of FC, concluded that students in FC may learn more than in TC [25, 26]; FC is more beneficial to learning higher cognition skills [27]; learners are more engaged in FC, however, satisfaction largely depended on how teachers prepared instructions [28].

Some research works explored FC impact on students' motivation and satisfaction. For example, Aksoy and Pasli Gurdogan reported that FC significantly benefited students' knowledge and motivation by measuring their self-efficacy and lower scores in test anxiety [29]. Finally, Sergis, Sampson and Pelliccione explored whether FC contributed to enhancing students' basic psychological needs satisfaction and showed promising results [30]. However, the study was performed in the context of K-12 education.

Despite a large body of publications, the current knowledge is unexpectedly scarce, when it comes to analysing the effect of FC on basic psychological needs, satisfaction of which can be the underlying cause for the positive impact of flipped learning on cognitive and meta-cognitive skills. According to self-determination theory (SDT), a learning environment that fosters basic psychological needs will facilitate autonomous or internal motivation, needed for engagement in the learning process and overall improvement in academic performance [31, 32]. On the contrary, thwarting of those needs can devitalize learning process resulting in maladaptive functioning and procrastination among students [33, 34].

SDT is a theory that highlights the significance of inner “needs” development among individuals for personality development, behavioural self-regulation, and performance in a certain situation [35].

The theory implies that an individual's psychological well-being is closely related to the fulfilment of basic psychological needs, such as the need for *Autonomy, Relatedness, and Competence* [36].

Need for autonomy

It is the expression of the self and fosters the ability to act in alignment with the individual's values. Teaching that supports autonomy makes students feel free as opposed to controlling teaching style or behaviour [37, 38]. Moreover, it stimulates intrinsic motivation and is associated with deep learning and better performance [39].

Need for relatedness

The need refers to the inner desire to feel related or connected to others. It highlights the importance of being valued in a society and the need to feel cared for and supported by others. The need is satisfied when individuals experience affiliation with significant others and thus may develop trusted relationships [40].

Need for competence

In accordance with SDT when individuals don't feel capable it can affect their motivation to pursue whatever activities they are involved in. On the contrary, the experience of mastery and the ability to do things leads to satisfaction and well-being [41]. This existing positive link between competence and greater well-being indicates that it is a precondition for psychological health and personal growth through mastering the environment [42].

SDT also evaluates how contextual factors affect individuals' needs satisfaction. Hence, it can be stated that need satisfaction is to be expected to shift along with the changes in the environment or perception of those changes [43, 44].

Summing up, SDT suggests that when three basic psychological needs are satisfied, individuals are more likely to experience greater well-being [45, 46]. On the contrary, when these needs are not met, individuals may experience negative consequences such as poor well-being and psychological distress [47, 48]. Besides, the theory argues that all three needs are universal in the way that their relationship with well-being and optimal functioning shall remain robust regardless of the cultural context [49, 50].

Therefore, finding the answers to what lies behind increased satisfaction and overall motivation in FC from the perspective of SDT, as a theoretical framework of our research, could provide new valuable data.

There is also the research gap on the possible effect of FC on students' well-being which can be further divided into academic well-being and general well-being, such as self-esteem [51]. Although the definition of self-esteem is inconsistent, it can be figuratively defined as an "underground foundation" of a skyscraper building [52]. According to Rosenberg's theory of self-esteem, individuals may experience negative or positive attitudes toward themselves and their perception of their thoughts and feelings [53]. Various studies have shown that low self-esteem may have a detrimental effect on motivation and learning [54, 55]. Self-esteem can fluctuate among medical students as they tend to experience long-standing stress [56, 57]. Baumeister et al. reported that high self-esteem has a positive impact on students' motivation, and academic achievement [58]. In addition, it was also demonstrated that the authoritarian style of management of individuals promotes silence, obedience, and acceptance of information with no critical approach, and therefore may contribute to low self-esteem [59]. Conversely, education that involves active participation of students, and life skill training improves the feeling of self-esteem [60]. Research has found that learning engagement is closely related to academic performance and has a positive correlation with self-esteem [61]. Moreover, students with low self-esteem do not consider themselves competent

unlike those with high self-esteem showing resilience towards academic failures [62].

Epstein also showed that self-esteem is one of the important factors for learning, motivation and confidence that may result in academic improvements and performance [63]. In the context of self-esteem, little is known whether FC benefits our students or puts them at a disadvantage [64]. Individuals can be classified as introverts and extraverts in terms of the way they interact with each other [65]. In the discussion-emphasised approach, verbal contribution, as an engagement marker, is highly rewarded by teachers; however, Reeve and Lee demonstrated that along with verbal engagement, behavioural and emotional constructs should not be underestimated [66]. Several studies demonstrated that introverts are prone to have lower self-esteem in comparison to more socially engaged students [67, 68]. This may indicate that quiet students might experience difficulties through coursework which implies active participation. As a consequence, some students felt overshadowed by more vocal participants and found it hard to benefit from the learning activities [69]. Thus, exploring the effect of FC on self-esteem in comparison to conventional lecture-based learning environment from the perspective of Rosenberg theory of self-esteem, as a theoretical framework of our research, can provide useful information to better meet students' needs.

Research purpose and questions

The purpose of this research is to analyse the effect of FC on students' basic psychological needs: *Autonomy, Relatedness and Competence* and its association with *Self-esteem*.

Particularly, we aimed to find the answers to the following questions:

- Q1** Does FC have a positive effect on fulfilling students' basic psychological needs in comparison to their prior experience with TC?
- Q2** Does FC have a positive effect on students' *Self-esteem* in comparison to their prior experience with a TC?
- Q3** Does satisfaction of basic psychological needs positively correlate with *Self-esteem* in the context of FC?

Methodology

Participants

This was a quasi-experimental quantitative observational research with an experimental group of undergraduate medical students. Randomisation per se was not performed as we were dealing with the existing tutorial group. The inclusion criteria for the study are the international medical students ($N=40$) in their third year of

taking a 12-week course of Internal Medicine in the Department of Faculty Therapy, for whom English was a second language. The exclusion criteria for our research were individuals who met the inclusion criteria however were on their fourth year of taking the course. The mean age of the students was 21.68 years ($SD=1.25$), and the majority of students were from China, Iran, and Bahrain. The study is based on previously collected anonymised data and all respondents gave informed consent. The Institutional Review Board's Health Professions Education committee of the Gulf Medical University approved the research protocol - reference number IRB-COM-MHPE-STD-64-APRIL-2023.

Procedure

FC methodology was designed and implemented for the first time at the University. The lessons were held weekly for three consecutive months. For the initial six weeks of the experimental study, the students were taught in TC, and for the last six weeks, the same group of students attended FC. Two online questionnaires were used to tap into satisfaction of students' basic psychological needs and self-esteem at the end of TC and after exposure to FC. The group was taught by the same professor practitioner. However, in TC lectures were delivered by different faculty members.

Questionnaires

To collect data concerning three dimensions of Self-Determination Theory, students were asked to complete an English version of the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS-Domain-specific measures), specified for training, before and after the exposure to FC [70]. The scale consists of 24 affirmative statements (items) grouped in six subscales measuring both satisfaction and frustration of basic psychological needs. Examples of the statements are: "I felt a sense of choice and freedom in the things I thought and did," "I had doubts about whether I could apply the proposed strategies," "I had the impression that the other participants had less respect for my opinion," "I experienced a good bond with the other participants," "I felt like a failure because of the opinion I had of the mistakes I made." The answers are rated on a 5-point Likert scale from 1 - *Absolutely Wrong* to 5 - *Completely True* and tap into both satisfaction and frustration with the feelings of *Autonomy*, *Relatedness* and *Competence*. To measure students' self-esteem, all students were asked to complete the Rosenberg scale in the same timeframe as BPNSFS-Domain-specific [71]. Although the original scale consists of 10 items, the data used in our study contains only five negatively (reversed) worded items to tap into the negative dimension of self-image [72]. Examples of the items are: "I do not have much to be proud of," "I

wish I could have more respect for myself," "All in all, I am inclined to feel that I am a failure." The answers were rated on a 5-point Likert scale from 1 - *Strongly Agree* to 5 - *Strongly Disagree*. The higher the scores the higher self-esteem. Full versions of both questionnaires are presented in the section "Additional materials."

Educational design and delivery

Educational design in the TC and FC environment was created with the highest level of similarity to minimise biases. Both TC and FC consisted of three stages (Fig. 1). The main difference referred mainly to the way the learning materials were delivered in *Stage 1*, and the time students spent in the classroom during *Stage 2*. In TC, the learning content was distributed during face-to-face classroom sessions, in which the lecturer presented the new material. Whereas in FC, learning activities included "home-based" sessions prior to face-to-face classroom sessions. In TC, the distribution of contact time was shorter in *Stage 2* compared to FC, as the students spent the time by attending a face-to-face lecture in *Stage 1*. In FC, the distribution of contact time in *Stage 2* was longer as the lecture time was added to the group learning in class.

Statistical analysis

The analyses were performed using IBM SPSS Statistics, Base edition. Descriptive statistics of the items, such as means and standard deviations among the variables were checked. For the distribution of the scores, the values of skewness and kurtosis were measured. Considering the relatively small size of the sample, the Shapiro-Wilk test was used to evaluate the normality of assumption. Non-parametric Wilcoxon signed-rank test was applied to compare differences in means of the variables within a group before and after the exposure to FC. Cronbach's alpha reliability test with values >0.7 is typically accepted as satisfactory [73]; and the validity Spearman's rho correlation test was measured for *Autonomy*, *Relatedness* and *Competence* subscales before and after the exposure to FC. Correlation analysis was implemented to define the relations between self-esteem and basic psychological needs autonomy in both FC and TC.

Cohen's d_z was calculated to measure the effect size.

Results

Among 40 international students, 40% were males and 60% females. The mean age of the participants was 21.68 years (range=20–25 years, $SD=1.25$).

Descriptive statistics of the 24 items of The Basic Psychological Need Satisfaction and Frustration Scale and 5 items of the Rosenberg self-esteem scale were evaluated. To compute normality, the Shapiro-Wilk statistics test for skewness and kurtosis was performed, which identified

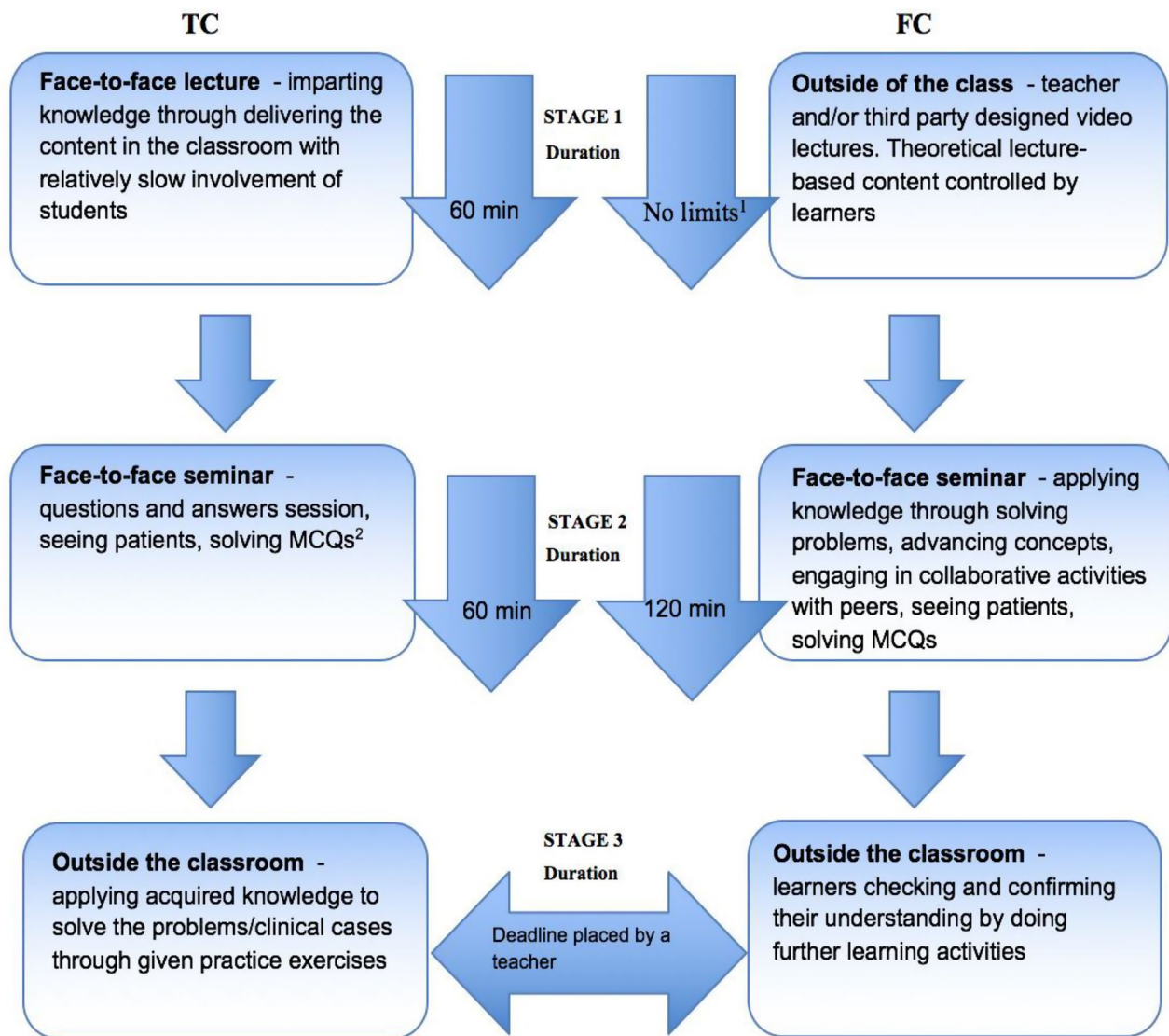


Fig. 1 Educational design of FC and TC. ¹In general students had no time limits for the class preparation, however deadlines were placed to help students prioritise their tasks before face-to-face seminars; ²MCQs – multiple-choice questions

that across the sample most items violated the assumption of normality. For that reason, to assess and validate the measurement structure of a set of observed variables a Factor Loading Analysis was conducted.

Taking into consideration the eigenvalue criteria (>1.0), two factors have been retained in a factor-loading analysis involving 8 autonomy items. In particular, four autonomy satisfaction items tend to load on one factor, and four autonomy frustration items tend to load on another one (Table 1). Eigenvalues for these two retained factors were 2.67 and 1.39, and they explained 50.80% of the variance.

An analogous 2-factor pattern was seen for the 8 relatedness items, the 8 competence items, and the 5 Rosenberg self-esteem items (Table 2) explaining 40.39% of the variance of relatedness, 42.44% of the variance of

competence, and 63.50% of the variance of self-esteem. The extraction of commonalities was above >0.5 for both scales (for SPSS factor loading 0.5 or higher is considered as a rule of thumb) for all variables, so that all items were retained.

To measure internal consistency between items Cronbach's Alpha was measured. To avoid negative alpha, positively and negatively worded questions were not mixed. Negatively worded items were reversed, with the following calculation of the sum score of five items of the Rosenberg self-esteem scale.

The Cronbach's alpha for the whole sample was 0.72 for autonomy, 0.75 for relatedness and 0.70 for competence in TC, and were slightly higher in FC: 0.73, 0.79, 0.75, respectively. The Cronbach's alpha for the Rosenberg self-esteem scale was 0.73 both in TC and FC.

Item	Autonomy		Relatedness		Competence		R ²	Mean	SD
	S	F	S	F	S	F			
<i>Autonomy satisfaction</i>									
1. I felt a sense of choice and freedom in the things I thought and did	.839						.739	3.05	.904
6. I felt like the suggestions given reflected what I want myself	.719						.680	3.30	.966
13. I felt like the way the training was delivered reflected how I wanted myself	.719						.600	2.68	1.12
22. I felt what was told really interested me	.713						.775	3.50	.816
<i>Autonomy frustration</i>									
3. I felt forced to do things I would not choose to do		.689					.507	3.17	1.15
10. I felt obligated to think and act in a certain way		.848					.722	3.50	.847
16. I felt pressured to think and act in a certain way		.687					.536	3.25	.926
19. Most exercises and tasks I did felt like "I had to"		.718					.649	3.52	.960
<i>Relatedness satisfaction</i>									
5. I felt close and connected with the other participants			.702				.620	3.58	1.23
11. I felt connected with the other participants			.850				.722	3.30	1.11
18. I experienced a good bond with the other participants			.822				.675	2.95	1.21
24. I felt that I belonged to the group of participants			.906				.820	3.72	1.13
<i>Relatedness frustration</i>									
2. I felt excluded from the group of participants				.637			.506	2.25	1.03
8. I had the impression that the other participants had less respect for my opinion				.563			.517	2.77	1.31
14. I felt that the relationships with the other participants were just superficial				.848			.720	3.02	1.20
21. I felt other participants were rather cold and distant towards me				.747			.558	2.47	1.26
<i>Competence satisfaction</i>									
9. I felt confident that I could apply the proposed strategies well					.658		.567	3.02	.800
12. I felt competent to achieve the proposed goals					.704		.512	3.57	.844
15. I felt capable at applying the proposed strategies into practice					.817		.687	3.12	.966
20. I felt that I could successfully complete the exercises and tasks					.795		.650	3.42	1.03
<i>Competence frustration</i>									
4. I had doubts about whether I could apply the proposed strategies					.643		.555	3.20	1.06
7. I felt insecure about my abilities to put the proposed strategies into practice					.841		.769	3.65	.921
17. I felt disappointed with how I handled the exercise and tasks					.831		.745	3.22	1.20
23. I felt like a failure because of the opinion I had of the mistakes I made					.795		.643	3.42	1.25

S - satisfaction, F - frustration, R² - extraction, SD - standard deviation

Table 1 BPNSFS items factor loadings, communalities/extractions, means, standard deviations of 6-factors factor loading analysis

Table 2 Rosenberg items factor loadings, communalities/extractions, means, standard deviations of 2-factors factor loading analysis

Item	Factor loading	R ²	Mean	SD
I think I am not good at all	0.795	0.625	3.02	0.861
0.861 I don't have much to be proud of	0.778	0.634	2.87	0.607
I certainly feel useless at Times	0.749	0.672	2.95	0.814
I wish I could have more respect for myself	0.813	0.683	2.60	0.777
All in all, I am inclined to feel that I am a failure	0.809	0.661	3.22	0.659

R² - extraction, SD - standard deviation

The study's first aim was to examine the effect of FC on fulfilling students' need for *Autonomy, Relatedness and Competence* in comparison to their prior experience with a TC. As a preliminary step, descriptive statistics and cumulative mean comparison (mean as a central tendency) of BPNSFS-Domain-specific subscales and self-esteem between TC and FC were performed (Table 3). Autonomy satisfaction was significantly higher in FC ($n=40, z=5.520, p<.001, \text{Cohen's } d_z = 0.9$), and the same tendency was seen for competence satisfaction in FC ($n=40, z=5.122, p<.001, \text{Cohen's } d_z = 0.98$). Although the central tendency of cumulative mean for Relatedness

Table 3 Descriptive and cumulative mean comparison of BPNSFS subscales and self-esteem between TC and FC

	Traditional Classroom Mean (SD)	Flipped Classroom Mean (SD)	p-value
Satisfaction			
0.861 I Autonomy	3.13 (0.53)	4.61 (0.45)	<0.001*
Relatedness	3.38 (1.02)	3.61 (0.98)	0.211
Competence	3.29 (0.54)	4.23 (0.44)	<0.001*
Frustration			
Autonomy	3.36 (0.72)	1.76 (0.54)	<0.001*
Relatedness	2.63 (0.91)	1.83 (0.70)	<0.001*
Competence	3.38 (0.70)	2.14 (0.57)	<0.001*
Self-esteem	2.9 (0.44)	4.1 (0.28)	<0.001*

* statistically significant p-value at the 0.05 level

satisfaction was slightly higher in FC (3.61 vs. 3.38), it wasn't statistically different. As for the frustration of all three needs, a statistical difference was observed for all three subscales between TC and FC. In FC, autonomy ($n=40, z=-5.370, p<.001, \text{Cohen's } d_z = 0.9$), relatedness ($n=40, z=4.187, p<.001, \text{Cohen's } d_z = 0.89$), and competence ($n=40, z=-5.323, p<.001, \text{Cohen's } d_z = 0.98$) frustration was significantly lower.

The study's second aim was to examine the effect of FC methodology on students' *Self-esteem* in comparison to

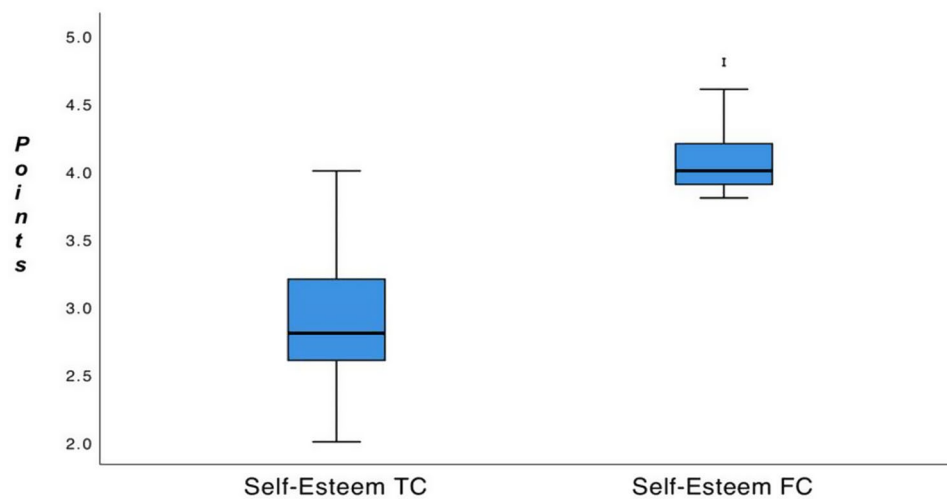


Fig. 2 Comparison of students' Self-Esteem in TC and FC settings. Self-esteem has been found significantly higher among students in FC setting

Table 4 Correlation analysis for study variables in TC

	1	2	3	4	5	6	7
1. <i>Autonomy Satisfaction</i>	1.00						
2. <i>Relatednes Satisfaction</i>	0.271	1.00					
3. <i>Competene Satisfaction</i>	0.471**	0.292	1.00				
4. <i>Autonomy Frustration</i>	-0.024	-0.309	-0.214	1.00			
5. <i>Relatednes Frustration</i>	-0.112	-0.740**	-0.113	0.353*	1.00		
6. <i>Competene Frustration</i>	-0.020	-0.448**	-0.328*	0.382**	0.343*	1.00	
7. <i>Self-esteem</i>	0.061	0.051	0.210	-0.430**	-0.188	-0.379*	1.00

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

their prior experience with a traditional classroom (TC) environment. A descriptive and cumulative mean comparison of self-esteem between TC and FC is presented in Table 3. Self-esteem was significantly higher in FC in comparison with TC ($n=40$, $z=5.528$, $p<.001$). Figure 2 graphically displays a box plot analysis of self-esteem in TC and FC settings. 50% of participants in TC would range their self-esteem between 2.6 and 3.3, whereas in FC between 3.9 and 4.3. The median of self-esteem was 2.8 for TC, and 4.0 for FC.

The study's third aim was to evaluate whether satisfaction of *Autonomy, Relatedness and Competence* positively correlated with Self-esteem in the context of FC methodology versus TC. Nonparametric Spearman's correlations were obtained for all the variables in TC and FC. In TC, self-esteem negatively correlated with autonomy frustration, ($r(38)=-0.430$, $p<.01$), and competence frustration, ($r(38)=-0.379$, $p<.05$) (Table 4). The correlation between autonomy, relatedness, competence satisfaction and self-esteem were not significant ($p>.05$). Competence satisfaction positively correlated with autonomy satisfaction ($r(38)=0.471$, $p<.01$).

In FC, self-esteem positively correlated with autonomy satisfaction ($r(38)=0.316$, $p<.05$) (Table 5), and competence satisfaction ($r(38)=0.429$, $p<.01$). The correlation with autonomy, relatedness, competence frustration in FC was not significant ($p>.05$). Competence satisfaction positively correlated with autonomy satisfaction ($r(38)=0.471$, $p<.01$).

Discussion

Millennials are considered to be tech-savvy and often prefer to acquire knowledge in real-life settings by making mistakes without the fear of being judged, which can be seen as a major characteristics of FC [74]. Therefore, it was worthwhile examining how a relatively new methodology with a focus on a student-centred approach would fulfil students' "self-determination" needs in comparison to TC. The findings of our research demonstrated a consistent pattern. Specifically, students' needs for autonomy and competence were significantly higher in the FC setting. Autonomy satisfaction in FC was supposedly achieved through collaborative work, which quite often was led by the students under the supervision of their

Table 5 Correlation analysis for study variables in FC

	1	2	3	4	5	6	7
1. <i>Autonomy Satisfaction</i>	1.00						
2. <i>Relatedness Satisfaction</i>	0.372*	1.00					
3. <i>Competence Satisfaction</i>	0.090	0.063	1.00				
4. <i>Autonomy Frustration</i>	-0.148	-0.131	-0.073	1.00			
5. <i>Relatedness Frustration</i>	-0.111	-0.634**	-0.017	0.313*	1.00		
6. <i>Competence Frustration</i>	-0.129	-0.117	-0.017	0.437**	0.194	1.00	
7. <i>Self-esteem</i>	0.316*	0.139	0.429**	0.016	-0.233	0.096	1.00

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

teaching professor. It is also argued that instructional and academic scaffolding provided by a teacher along with the hands-on activities contribute to the enhanced feeling of competence, which makes them feel more confident and most importantly not afraid of making mistakes in the classroom [75]. Although both TC and FC shared identical teaching instructions during face-to-face classroom sessions, students in TC experienced more lack of autonomy. Peer interaction, as well as peer-professor interaction, is not always supported during the lecture. Moreover, all the lectures were delivered early in the morning and “not everyone is a morning bird” [68, 76].

In terms of relatedness satisfaction, a statistically significant difference between FC and TC wasn't found. This may be because relatedness is a much larger construct and can be linked to maladaptive social and interpersonal interactions [77]. Moreover, it should be noted that the group of students was quite heterogeneous with different cultural backgrounds from Iran, China and South Africa to Bahrain, Mozambique and Brazil. While in Western cultures, positive social interactions with a certain level of openness are preferable, diverse Eastern cultures may have social skills specifically rooted in the way of upbringing, and practised societal norms [78]. However, it is important to note that relatedness frustration was significantly lower in the FC environment. This may indicate that students felt more secure and perceived less threat from the positive and flexible environment of FC. Teachers should consider specific constraints while dealing with students from diverse cultural contexts. Teachers should also organise their classroom sessions to be more encouraging of social and academic interaction with other students.

The second aim of the study was to evaluate whether FC fulfilled students' self-esteem. Self-esteem is one of the key factors that influences academic achievement [79]. It is also closely related to academic performance through the affective domain [80]. Therefore, examining the effect of FC on self-esteem was considered valuable, as it provides empirical evidence that can be taken

into consideration by universities in their curriculum design. Self-esteem along with other constructs such as motivation and sufficient feedback are still undervalued factors in curriculum development [81]. The findings of our research again demonstrated a persistent pattern. In particular, self-esteem was significantly higher in the FC environment, which can be explained by emotional and behavioural engagement in more extensive collaborative work. This suggests that teachers should set up a socially supportive environment that will help promote the personal worth of the students. Active student involvement, and collaborative concepts implemented in FC can teach students important skills, such as understanding that there are different personalities in groups, and showing a respectful attitude toward each other. All these skills help build up socially desirable behaviour to enhance self-esteem. Apart from academic achievement, behaving socially at university can lead to other advantages in life. The third aim of the study was to examine the correlation between needs satisfaction and self-esteem. Our results indicate that autonomy and competence satisfaction positively correlated with self-esteem in the FC environment. On the contrary, self-esteem negatively correlated with autonomy frustration and competence frustration in the TC. It was observed that relatedness satisfaction/frustration didn't correlate with self-esteem in both TC and FC. The socio-cultural context of the study may have contributed to the results, which can be explored further. Together these results underline the possible role of the learning environment in the satisfaction/frustration of the basic psychological needs of students which in turn correlated with self-esteem. The learning environment is a multifaceted term; however, it can be broadly described as an environment “in which students' learning process is embedded.” To further this idea, we address the role of a teacher as a leading factor in creating a high-quality lesson aimed at developing critical thinking with the importance of effective instructions, active student involvement and feedback.

Limitations and future perspectives

The following limitations should be taken into consideration, when the results of our study are evaluated. First, it should be noted that it was a one-group non-randomised pre-test-post-test design quasi-experiment, in which outcomes have been measured two times: once before and then after the exposure to a flipped learning environment. Second, there wasn't a control group in the research which would allow the use of more complex statistical analysis, such as a multivariate analysis of variance. The correlation analysis used in the study doesn't conclude cause-effect of the findings. Another limitation is the student-teacher familiarity effect among our participants. Basic psychological needs and self-esteem may change over the course of study, specifically when students are taught by the same teacher [82]. This can be the case of another limitation, such as biasing effects on teacher's likability, and these factors should be considered in future research.

Another limitation of our research is the universality of SDT which does not explain cultural and individual differences in the way students get their needs satisfied. Again, this may require more exploration in future research. It should be also noted that although we investigated students with diverse cultural backgrounds in our research, the representation of cultural populations was limited and therefore we were unable to evaluate cultural markers, such as values of independence, freedom, openness and trust. Hence, the generalizability of the findings to the broader audience should be made with caution.

Practical application

FC with the main focus on students' active involvement in class discussion may better meet millennials' needs. On microlevel, implementing new methodology of teaching may have a positive impact on students' self-esteem, self-regulation and personal growth. Putting into practice validated questionnaires to measure students' psychological constructs should become a regular practice in medical schools, specifically during the process of curriculum planning and redesign. Regardless of the existing trend in education with student-centred approach, it is the faculty who play a pivotal role in providing students with the quality education. Hence, on macrolevel, university administrators and leadership should not underestimate the importance of faculty development and the role of teachers' evaluation to improve the quality of teaching and integrity of teachers. Therefore, faculty leadership should implement best practices of *Health Professions Education Development* to prepare faculty for the positive change in affective, intellectual, and social aspects of academic life.

Conclusion

The present research found the positive role of FC in the satisfaction of basic psychological needs, namely, autonomy and competence and its correlation with self-esteem for students from diverse cultural backgrounds. These findings highlight the significance of the needs satisfaction in a more flexible and socially friendly learning environment as a pivotal factor in enhancing students' self-esteem.

Abbreviations

BPNSFS	Basic Psychological Need Satisfaction and Frustration Scale
F	Frustration
FC	Flipped classroom
S	Satisfaction
SD	Standard deviation
SDT	Self-determination theory
TC	Traditional classroom

Supplementary Information

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Supplementary Material 1

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Author contributions

Dr. E. A. made substantial contribution to the conception, design, analysis, and interpretation of data. Professor D.T. made substantial contribution to the conception, design, revision of the paper, and have approved the submitted version. All authors reviewed the manuscript.

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Data availability

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study is based on previously collected anonymised data and all respondents gave informed consent. The Institutional Review Board's Health Professions Education committee of the Gulf Medical University approved the research protocol - reference number IRB-COM-MHPE-STD-64-APRIL-2023.

Consent for publication

Each author agreed with the content and gave consent to submit and publish the work.

Competing interests

We declare that we have no known competing financial interests or personal relationship that could have appeared to influence the work reported in this paper.

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