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Original Article

Motivational component profiles in learning embryology: A comparative study between first and final year medical students

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Abstract
Background: As a part of the "triangulation approach" for remodeling teaching-learning pedagogy related to embryology, we conceived the idea of comparing the motivational component profiles of first-year and final-year students, who might have realized the salience of learning embryology after seeing remarkable cases of congenital malformations.
Methods: We used an observational study design for assessing the interrelation of motivational component profiles between both cohorts using the Science Motivation Questionnaire II (SMQ II)1. Of the total sample size of 150 first-year students, 126 agreed to participate, and similarly, out of 150 final-year students, 105 had consented to participation ['convenience' model of sampling]. The measures of central tendency, i.e., mean and standard deviation, were calculated for each item, and the Mann-Whitney test was utilized to compare the mean score of each motivational component.
Results: Our results indicate that the overall motivational profile for learning embryology differs among first and final-year students. The mean intrinsic motivation and self-determination scores were slightly higher in the first-year cohort, whereas self-efficacy scores were slightly higher in the final-year cohort. This information integrates students' levels and types of motivation into the planning, delivery, and evaluation of medical education.
Conclusion: Despite being one of the key components of self-regulated learning, motivational component profiles remain unaddressed in contemporary medical education owing to their abstractness and subjectivity in terms of documentation. The current study helped us envisage the difference in motivational component profiles toward learning embryology in cross-section. It also senses the need for incorporating motivational short courses in undergraduate curricula, especially in remediation programs.

Introduction

The medical educators of the contemporary era levy increased weightage on the self-regulated dimension of learning and it can be broadly defined as the process by which students tend to control their behaviors and affect in congruence with the academic environment especially while involved in goal-directed activities.[1,2] If we consider learning as a goal-directed activity, the 'successes' of the activity shall be defined by the degree of self-regulation and strategy adopted by the students in achieving the desired outcome despite the learning challenges and difficulty of the subject.[3] One of the key stakeholders of self-regulated learning is the orientation of motivation and its ability to influence the individual's learning outcomes.[4] Motivation, being a multi-faceted abstract construct, can be simplified as the numerous reasons enabling an individual to perform a specified activity. For example, a medical student shall learn a subject either due to the perception that the knowledge gained in this process would be helpful in future clinical practice, or because of the genuine interest in the subject per se, or because of the mere reason for passing the examinations. Of these, the first two notions might result in high-quality learning compared to the third one which tends to make the learning process superficial. Indeed, the successful outcome of a classroom depends upon the extent to which diverse orientations of student motivations are nourished. The self-determination theory of *Deci and Ryan*[5] has classified the motivation components into intrinsic and extrinsic. Intrinsic motivation is the extent to which a student can imbibe and assimilate the provided knowledge on his/her own and is largely affected by

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the level of competence and autonomous inclination towards a particular subject.[6] Intrinsically motivated students learn out of their personal choice for the enjoyment associated with it rather than because of external pressurizing factors.[7] It has been observed that students with elevated intrinsic motivational profiles select effective learning strategies and perform higher quality learning when compared to their peers who are remarkably not motivated.[8] On the other hand, extrinsic motivation is associated with external rewards, such as grades for completing assignments and prizes for topping examinations. Compared to the intrinsic component, the extrinsic component ranges across the continuum. It starts from external regulation where students learn for the mere sake of reward/punishment and then progresses to introjected regulation where the learning is based on internal reward/punishment. Subsequently, it reached a stage of integrated regulation where students become highly motivated to do a particular task i.e. intrinsically motivated.[9] Consider a student who passively attends a lecture for the mere purpose of attendance (state of external regulation), subsequently perceives that missing a class makes him intrinsically lacking something (state of introjected regulation), and finally attends the class only out of his /her autonomy (state of integrated regulation). With the overcrowding of the curriculum, we need to view the process of learning under the lens of motivation to ascertain the quality of teaching-learning programs and this has more weightage in the earlier years of medical education when students metamorphose to a wider scale of education.

In the existing preclinical curriculum, a major pedagogical conundrum is making students, who have not been exposed to clinical settings, understand the core vitality of embryology.[10] Centuries of rote learning and information overload without much linking to real-life practice is one reason why embryology can be considered one of the muddiest areas for students.[11] Simultaneous changes and transient structures observed during human development can not be understood to the fullest unless students exhibit a noticeable degree of motivation. This was evident in one of our previous studies[12] where 39.3% (48/122) students felt that they could not comprehend the sequence of events and 27.9% (34/122) students felt that they had difficulties in visualizing the learned content. As embryology demands constant attention and imagination as well, unless a student has a high degree of intrinsic motivation, he/she tends to ignore the subject, as such.

Remodeling the teaching-learning pedagogy of a particular subject mandates a "triangulation approach". Explicit changes in teaching methodologies could be tried with their effectiveness being ascertained. More importantly, implicit views regarding motivation, beliefs, and values about the particular subject of concern. Third, the utility of the subject in developing the student as a competent health professional. After pursuing an exhaustive literature search, we found that studies related to the implicit views of students regarding embryology teaching have not been conducted.[13-15] Especially, studies about motivational components have neither concentrated on pre-clinical subjects nor measured the difference in the level of motivation in students across years.[16] Going by the principle that, if properly understood as to why and to what extent students value or devalue certain medical subjects, teachers would have a much easier task when implementing the needed changes to maximize the learning potential of a subject.[17]

Conceptualizing the potential, the question we had deciphered is to compare the motivational component profiles of first-year and final-year students. These component profiles include (1) Intrinsic motivation (IM), (2) Career motivation (CM), (3) Grade motivation (GM), (4) Self-determination (SD) and (5) Self-efficacy (SE). Students learn embryology during the first year of medical education and their orientation toward the subject might be different from the final-year students, who have seen noticeable cases of congenital malformations. Furthermore, there might be a difference in the components among the two cohorts because the effect of each component on enabling students' motivation to learn or not learn embryology shall not be equivalent.[16] The concept of motivational component profiles has not been much studied in the field of undergraduate medical education. Especially, first-year medical students often regard learning embryology as one of the most challenging tasks. The current study would also help us document the perceived relevance of embryology in the existing medical curriculum from two dimensions i.e. students who are currently learning embryology and those who are on the verge of completing their undergraduate medical education.

Materials and Methods

After obtaining clearance from the Institutional Research and Ethics Committee (JSAC/64/2018/272; IEC/JIP/2018/513) we obtained informed consent from the first and final-year students separately after explaining the objectives of the study and mentioning their roles in it. Both cohorts belonged to the same institute and have been taught similarly. We opted for the "convenience" method of sampling and therefore the inclusion criteria were all the first and final-year students who consented to participate in the study process. Of the total sample size of 150 first-year students, 126 agreed to participate, and similarly, out of 150 final-year students, 105 consented to participate. We ensured the fact that the participation is voluntary and this would not fetch them any direct/indirect incentive. As the study aims to compare the motivation component profiles in the whole batch, the measures of central tendency seldom get affected by a small number of students who had not expressed their interest in participating.

Study design and instrument used

We used an observational study design to assess the interrelation of motivational component profiles between both cohorts. For assessing the motivational component profiles, we used the Science Motivation Questionnaire II (SMQ II) which is a pre-tested one developed by Glynn et al.[18] The original questionnaire consisted of 25 items and they were categorized under five subgroups: intrinsic motivation, grade motivation, career motivation, self-determination, and self-efficacy. Since our area of concern is specified as embryology, we replaced the word 'science' in the questionnaire with 'embryology', and in a few places, the purpose also was specified according to the context. We cyclically analyzed the items and removed those that were repetitive in one way or another and ambiguous ones. A few items were reframed in terms of language and complexity according to the settings and comprehensive ability of the students. The final version had 22 items and students were blinded to the category they belonged to. We gave the items to the postgraduate residents of our department for ascertaining the feasibility and after the compilation of pilot responses, they were included in the final format. Similarly, we performed pilot validation of the questionnaire which has to be administered to the final year students. Since the final year, students did not have to encounter the examinations, the questions about grade motivation (four items such as, "Getting good marks in embryology is important for me", "I always think about the marks I am going to get in embryology, etc) and two items belonging to self-efficacy and self-determination sub-categories (two items such as, "I believe I can earn good marks in embryology" and "I am confident that I will do well on embryology tests") were removed and final draft consisted of 16 items. All the items were positive and thus the need for negative scoring was nullified. The items of both questionnaires were randomly shuffled so that students would not recognize the pattern of the particular motivational component. Students were instructed to read the items, comprehend their exact meaning, and rate them on a five-point Likert scale which ranged from 1-5 (1 = strongly disagree to 5 = strongly agree). In addition, we attempted to document the percipience of final-year students regarding the relevance of embryology in the undergraduate curriculum, and for that, we adopted a few items from a previous study[19] and others from our previous study.[12] We piloted the items and the final format was validated by a group of post-graduate students before being administered to the final-year students.

Statistical analysis

The measures of central tendency i.e. mean and standard deviation were calculated for each item. The overall mean for each motivational component was also assessed and depicted as an average value out of 5. Mann-Whitney test was utilized for comparing the mean score of each motivational component. All statistical analyses were two-tailed and values of *P* less than 0.05 were considered to be statistically significant. The statistical analysis was performed using Microsoft Excel®.

Results

The compilation of data revealed that the mean age of first-year students was 17.53 ± 0.79 years and that of final-year students was 22.17 ± 0.93 years. The mean scores of each item, both for first and final-year students, were tabulated and compiled in Table 1. The overall mean score of each motivational component profile has been calculated in Table 2. The perception of final-year students regarding the role of embryology in the undergraduate curriculum has been shown in Table 3.

Discussion

In the era of self-directed learning, the "desired optimal learning" of the students depends on the motivation continuum, which could indirectly affect the students' self-regulatory profiles.[20] Research about self-directed learning has outlined the fact that behavioral/affective outcomes tend to get increasingly positive when a student progresses from the lowest to the highest rung of motivation.[21] The primary aim of this study is to figure out the differences in motivational component profiles among first and final-year students and generate objectified evidence for motivation as such. The component profiles that we have studied include (1) IM, (2) CM, (3) GM, (4) SD and (5) SE.

To achieve this, we have used the pre-tested science motivation questionnaire II to accurately decipher the components in an objectified manner.[18] Another study used the same questionnaire to assess the difference in motivational component profiles while learning histology among students belonging to different health sciences curricula.[22] In contrast, we tried to measure the difference in the level of motivation across years (first and final year). Embryology, a complex subset of anatomy, holds significant clinical relevance when addressing congenital diseases in children. (i.e. in pediatrics) and this helped us hypothesize the retrospective gain in motivation in students in learning embryology. We did not consider gender as a valid determinant of motivational levels and thus ignored it from the panel of personal variables.

In the current study, we observed the mean intrinsic motivation scores (3.77 ± 0.82 vs. 3.12 ± 0.46) and mean self-determination scores (3.63 ± 1.32 vs. 3.13 ± 0.53) were slightly higher in the first-year cohort compared to final year cohort. The mean career motivation scores were almost similar in both groups (3.05 ± 1.07 vs. 2.94 ± 0.79). The mean self-efficacy scores were slightly higher in the final-year cohort (3.99 ± 0.91) compared to the first-year cohort (3.54 ± 1.27). As the final year, students need not appear in any examinations related to embryology, comparing grade motivation might not serve any purpose.

The top three responses following the discrete analysis of items answered by first-year students were "I wish

Table 1. Comparison of the motivational component profiles of first and final-year medical students

Items	Mean ± SD	Mean ± SD	*P* value
I feel that the embryology I am learning is relevant to my life (IM)	4.06 ± 0.92	3.72 ± 0.85	0.0039
Learning embryology is interesting (IM)	3.53 ± 1.13	2.78 ± 0.66	<0.0001
I am curious to learn about discoveries in embryology (IM)	3.84 ± 0.47	3.12 ± 0.53	<0.0001
I enjoy learning embryology (IM)	3.68 ± 0.53	NA	NA
I wish to do better than other students in embryology (GM)	4.18 ± 0.89	NA	NA
Getting good marks in embryology is important for me (GM)	3.74 ± 1.18	NA	NA
Scoring high on embryology tests and practical matters to me a lot (GM)	3. 29 ± 1.35	NA	NA
I always think about the marks I am going to get in embryology (GM)	3.16 ± 1.28	NA	NA
My career will involve embryology in some form (CM)	2.88 ± 1.16	2.72 ± 0.92	0.2535
I will use the embryology knowledge to solve the cases in my career (CM)	2.66 ± 1.23	3.38 ± 1.21	<0.0001
Learning embryology will help me get a good job (CM)	3.24 ± 0.97	2.66 ± 0.26	<0.0001
Learning embryology makes the overall study more meaningful (CM)	3.17 ± 0.84	2.87 ± 1.32	0.0374
I feel learning embryology will benefit me in my future career (CM)	3.32 ± 1.32	3.09 ± 0.82	0.1218
I am confident I will do well in embryology labs and practical (SE)	4.01 ± 0.85	3.21 ± 1.41	<0.0001
I believe I can master embryology knowledge (SE)	3.43 ± 1.06	3.86 ± 1.41	0.0088
I am confident that I will do well on embryology tests (SE)	3. 81 ± 0.79		
I believe I can earn good marks in embryology (SE)	2.92 ± 1.31		
I prepare well for embryology tests and practical (SD)	3.36 ± 0.69	3.21 ± 1.41	0.2936
I put enough effort into learning embryology (SD)	3.49 ± 0. 57	3.41 ± 1.15	0.4931
I use strategies to learn embryology well (SD)	3.22 ± 0.83	3.21 ± 0.89	0.9298
I study hard to learn embryology (SD)	4.13 ± 1.12	3.17 ± 0.82	<0.0001
I spend a lot of time learning embryology (SD)	3.96 ± 0. 47	2.66 ± 0.72	<0.0001

IM, Intrinsic motivation; CM, career motivation; GM, grade motivation; SD, self-determination; SE, self-efficacy.

Table 2. Comparison of motivational component profiles between first and final-year students

Motivation component profiles	First-year students	Final year students	*P* value
Intrinsic motivation	3.77 ± 0.82	3.12 ± 0.46	<0.0001
Grade motivation	3.59 ± 0.67	Not applicable	
Career motivation	3.05 ± 1.07	2.94 ± 0.79	0.3833
Self-determination	3.63 ± 1.32	3.13 ± 0.53	0.0003
Self-efficacy	3.54 ± 1.27	3.99 ± 0.91	0.0027

to do better than other students in embryology" (grade motivation; 4.18 ± 0.89); "I study hard to learn embryology (self-determination; 4.13 ± 1.12) and "I feel that the embryology I am learning is relevant to my life (intrinsic motivation; 4.06 ± 0.92). The items receiving the lowest responses were: "I will use the embryology knowledge for solving the cases in my career (career motivation; 2.66 ± 1.23), "My career will involve embryology in some forms (career motivation; 2.88 ± 1.16), and "I believe I can get good marks in embryology (self-efficacy; 2.92 ± 1.31). In essence, on one hand, first-year students have adequate intrinsic motivation and self-determination in learning a difficult domain such as embryology, and on the other hand, they neither realize the significance of it in terms of their career nor feel confident about their potential in mastering it.[23] In contrast, the statement 'I am confident that I can do well in embryology-related questions' received the highest response from final-year students. (e.g.: in pediatrics) (self-efficacy; 4.12 ± 1.35) and the item receiving the lowest response was: "I think learning embryology would help me get a good job (career motivation; 2.66 ± 0.26). Though final-year students were highly self-efficacious in mastering concepts of embryology up to a level of application in clinical cases, they are neither intrinsically motivated nor feel it important for their career.[24]

In the current study, we have not correlated the motivational component profiles with the final scores of the summative assessment. Over the years, we have observed that students tend to prepare for examinations only in terms of selected high-yield areas and that would not exactly correlate with the level of understanding of the subject per se. However, we feel that grade motivation scores would be a plausible correlate with the examination scores as students who harness the high level of it are likely strategic learners.[25] As a matter of completion, we wished to document the attitudes/perceptions of students regarding the role of embryology in the contemporary undergraduate curriculum, and the items were grounded on the veteran *Thurstone and Chave* attitude protocol.[26] We could perceive certain opinions based on maximum responses such as, "Embryology is of benefit only to certain specialties and it needs to be modernized to fit contemporary needs". This could be correlated with lower levels of intrinsic motivation and career motivation scores

Table 3. Perception of the relevance of embryology in medical education for final-year students

Items	Mean ± SD
Embryology is a useful tool for satisfactory medical practice and is clinically relevant	3.85 ± 1.21
Embryology is of benefit only to certain specialties	4.42 ± 0.28
Embryology is of some use in the clinics, but its importance is exaggerated	4.26 ± 1.07
Embryology is so old-fashioned and redundant that has no role in contemporary practice	2.35 ± 0.91
Embryology is time wasted in the medical curriculum	1.94 ± 0.27
Embryological terminology develops the vocabulary of medicine	2.46 ± 1.17
Embryology needs to be modernized if it is going to be useful in medicine	4.19 ± 0.87
Every doctor should have good knowledge of embryology	4.09 ± 0.63
It is not possible to make a reasonable diagnosis without embryology knowledge	3.27 ± 0.42
Medicine is incomplete without embryology	2.87 ± 0.63
Most medical conditions do not require a great knowledge of embryology	3.82 ± 0.57
Only limited embryology knowledge is enough for satisfactory medical practice	3.17 ± 0.78

of final-year students.

A comparison of motivational component profiles between two cohorts (Table 2) illustrates certain spot findings: (1) The profile of intrinsic motivation tends to decline across time and this is more pronounced in specified subject domains such as embryology[27,28]; (2) When specified subjects get decoupled from the aura of examinations grade motivation gets leveled out and unless students recognize the domain to be crucial for further year subjects, their extrinsic motivation also begins to flatter; (3) Findings about self-determination and self-efficacy can be understood based on the pursuit of mastery goal orientation and affective perception of students about the subject plays a role in determining the quantum of academic effort[29]; (4) Scores of self-determination could be correlated with the self-regulated learning activity of students. The increased scores in first-year students might be due to the need to meticulously learn it when compared to the final year cohort; (5) Increased self-efficacy scores in the final year cohort might be a pseudo-perception because of the lack of specified examinations and fear of examination along with the difficulty of the subject would have resulted in lower scores among the first-year cohort.

The results of the study also help us conceptualize the way students envisage a particular subject along with the degree of motivational intent toward it. By this, faculty could modify the conventional teaching strategies, incorporate a significant number of clinical details in their lectures, and re-emphasize students' pertinence of understanding the concepts. For an optimally motivating learning environment, instructors should sense three basic psychological needs of the students namely: autonomy (choice-making), competence (ability to master), and relatedness (sensing the relevance).[30] A student can select between completely ignoring the subject if he/she feels that it either could not be mastered or it is not relevant to his future career. Over here, the compendium of motivation component profiles, rendered by educational activities, plays a catalytic role and eventually makes learning a meaningful endeavor. Thus, it is pertinent to ascertain the motivational component profiles of students towards each subject and titrate the pedagogies accordingly.

Limitations

The current study was conducted among first and final-year students belonging to a single institute therefore, the results could not be extrapolated to other educational settings. Similarly, the motivational component profiles vary based on the subject and the implication of the study solely confines to 'embryology' alone. Secondly, we could not measure the degree of motivation at the baseline level i.e. at the point of entry of students. The cross-sectional observational design of the study measures the perceptions at a single point and elements of variability can not be ruled out. Finally, the slightly lower response rate of final-year students might have affected the results and this fact needs to be considered while analyzing the results.

Conclusion

Despite minor shortcomings, the current study helped us envisage the difference in motivational component profiles toward learning embryology in cross-section. While filling out the questionnaire, students had meta-cognitively sensed the elements of motivation and this might affect their future self-directed iterative process. When compared to novice learners, mature learners have different motivational components and instructors should be aware of this fact while designing their pedagogies. Since understanding motivational component profiles has been an ignored area in undergraduate medical education, our study accentuates the difference in motivational component profiles between first and final-year medical students. The current study also senses the need for incorporating motivational short courses in undergraduate curricula, especially in remediation programs. In short, the concept of motivation should be made more explicit and objectified in places, especially when handling challenging subjects.

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Authors' Contribution

Conceptualization: Dinesh Kumar V.
Data Curation: Raveendranath V.
Methodology: Dinesh Kumar V and Raveendranath V.
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Supervision: Raveendranath V, Niranjan Biswal.
Writing–original draft: Dinesh Kumar V.
Writing–review and editing: Raveendranath V.

Competing Interests

The authors declare no conflict of interests.

Ethical Approval

The project has been approved by the Institute Ethics Committee, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India (Ethical committee number: JIP/IEC/2018/513).

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