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An Educational Experiment in Parasitology Implemented on Preclinical Medical Students in Discipline-Based and Integrated Programs at AFCM

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Abstract

Introduction: Parasitology is taught in Egyptian medical schools in the pre-clinical stage. Commentary stations are intensively used as a student-centered learning strategy that relies on designed questions to assimilate target knowledge through case-solving skills. Class instructor is mandatory for guiding students through different stations. Aim: The study was performed undertaken to assess students' perception of the tool. Subjects and Methods: A comparative, cross-sectional study was implemented on preclinical medical students who studied parasitology in discipline-based and integrated programs at AFCM. For data collection, a questionnaire was proposed and converted into an online survey using Google online survey Forms. Statistical analysis used: To evaluate the validity, KMO and Barlett's tests of Sphericity were used while Cronbach's alpha was used for reliability. A p-value < 0.05 was regarded as statistically significant. Results: A total of 200 students answered the questionnaire including 84 from discipline-based program (42%) and 116 from integrated program (58%). The data collection tool demonstrated a validity of 0.778 and reliability of 0.754, with p-value < 0.001. More than 50% of the study group strongly agreed with the method to trigger knowledge assimilation while 48% endorsed it for deep learning. The facilitator role of the instructor was appreciated and not considered as a passive knowledge transmitter. Comparing students from both programs, there was no significant difference regarding perception of the method. Notably, 6+1 students significantly preferred applying bonuses and penalties to motivate their performance compared with 5+2 candidates, (p-value 0.036). Conclusion: Commentary stations with a class instructor were found to trigger knowledge assimilation and stimulate deep learning in parasitology education for both discipline based and integrated program medical students.

Keywords: Commentary stations, knowledge assimilation, deep learning, facilitator, clinical vignette

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Introduction

Basic sciences were traditionally taught in Egypt medical schools isolated from the clinical setting (step 1 of the integration ladder of Harden, 2000). This resulted in graduating generations of practitioners who do not clearly understand the relevance of what they have been taught in basic sciences to their work as physicians.

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They did not know how to use the huge amount of pre-clinical knowledge recalled in their clinical practice after being registered in national healthcare systems. A typical example of an isolated basic science taught to medical students in their pre-clinical phase is Parasitology.

The National Authority for Quality Assurance and Accreditation of Education (NAQAAE) in Egypt has issued the 1st edition of the National Academic Reference Standards (NARS) in Medicine (2009). It stated that medical students must integrate basic biomedical science with clinical care (6.1) and put a meaningful diagnostic formulation (6.4).

The era of the application of integrated curricula in medical schools' education has begun. This raises the mandate of reforming the methodology of teaching and learning basic sciences to be in a clinical context [1, 2, 3, 4, 5].

The National Authority for Quality Assurance and Accreditation of Education (NAQAAE) in Egypt has issued the 2nd edition of the National Academic Reference Standards (NARS) in Medicine (2017). One of the important educational strategies required according to the NARS is that the medical school must ensure "early clinical exposure". A second important strategy is contemporary medical education which recognizes the integration of basic and clinical disciplines as good practice in medical education. NAQAAE and the Supreme Council of Egyptian Universities (SCU) necessitate that all faculties of medicine apply some degree of integration beginning from step 5 to step 11 on the integration ladder [6].

Student engagement has become fundamental for the efforts to enhance teaching and learning. The term student engagement has been increasingly prominent in higher education as an indicator of student and institutional success and quality [7]. Researchers deduced that learning and high academic performance begin with student engagement [8]. The methodology of providing commentary stations was found to engage students more effectively than a traditional practical class and focused their attention on generic/transferrable skills that are required to excel during basic science studies [9].

Our hypothesis is that by providing carefully formulated commentary stations with valid and accurate questions and evaluations, the acquisition of knowledge, engagement, critical thinking, and problem-solving skills of the students will improve.

In this context, we inquired how undergraduate AFCM medical students in 3rd preclinical year perceive formulated commentary stations as a learning tool in medical Parasitology both in discipline-based and integrated programs. The implementation of commentary stations in practical parasitology classes might overcome the challenge of limited time to conduct a satisfactory parasitology curriculum for medical students under the pressure of heavily loaded curricula.

The aim of the current study is to explore the perception of undergraduate preclinical medical students "in both discipline-based and integrated curricula" of commentary stations as a learning tool to study medical parasitology in a clinical context.

Subjects and Methods

A comparative, cross-sectional study was conducted on the students who studied medical parasitology in discipline-based and integrated programs in the Department of Medical Parasitology, Armed Forces College of Medicine, Cairo, Egypt. Parasitology discipline is taught to 3rd year pre-clinical students both in discipline based and integrated curricula at AFCM. In the discipline-based curriculum, parasitology was distributed all through the academic year. In the integrated curriculum, parasitology was only taught in one module entitled "Infectious Diseases". A batch from the discipline-based program (Year 2018) and another batch from the integrated program (Year 2023) were included in the study. Of note, all involved subjects were in the same age group during implementation of the tool. Commentary stations were introduced as a learning tool along with the implementation of the medical parasitology curriculum, during practical classes.

Inclusion criteria involved AFCM students who finished the course of parasitology in both the discipline-based and integrated curricula. Exclusion criteria included students who haven't terminated the parasitology course yet.

Steps for preparation and implementation of commentary stations.

1-<u>Correlation with NARS and the related course specification</u>.

Fulfilling the National Academic Reference Standards (NARS), published in years 2009 for discipline-based curricula, the intended learning outcomes number 3.1 and 6.4 were adopted for implementation in teaching parasitology discipline, to be in clinical context. Then

in year 2017, the National Authority of Quality Assurance and Accreditation in Education (NAQAAE) issued the 2nd edition of NARS (2017). The key competency numbers 1.6. (Selection of appropriate investigations), 1.8. (Applying knowledge for clinical reasoning), 1.10 (Integrating given data to put a meaningful diagnostic formulation), 4.5 (Identifying parasite pathogenesis), 4.8 (Interpreting common diagnostic modalities), and 1.13 (Using evidence-based medicine in management decisions) were selected for implementation in parasitology in the modular program. The medical parasitology curriculum was validated to accommodate the educational strategies of NARS that stated, "The Medical school must ensure early clinical exposure".

2-<u>Determination of intended learning objectives (ILOs)</u>

ILOs that can prepare the students for clinical enrolment by letting them see patients both on paper and in selected relevant videos. Examples for ILOs:

a- Identify the main characteristic features of medically important parasitic stages presented in class. (3.1 = NARS 2009 & 4.8 = NARS 2017).

b- Relate the presented parasitic specimens to clinical/laboratory/ epidemiologic setting through the provided commentary stations. (6.4 = NARS 2009 & 1.8, 1.10, 4.8 = NARS 2017).

Noting that ILOs were applied in a stepwise pattern, i.e. ILO (a) was covered in the step of brainstorming using pre-class assessment. Thereafter, ILO (b) was covered in the commentary station.

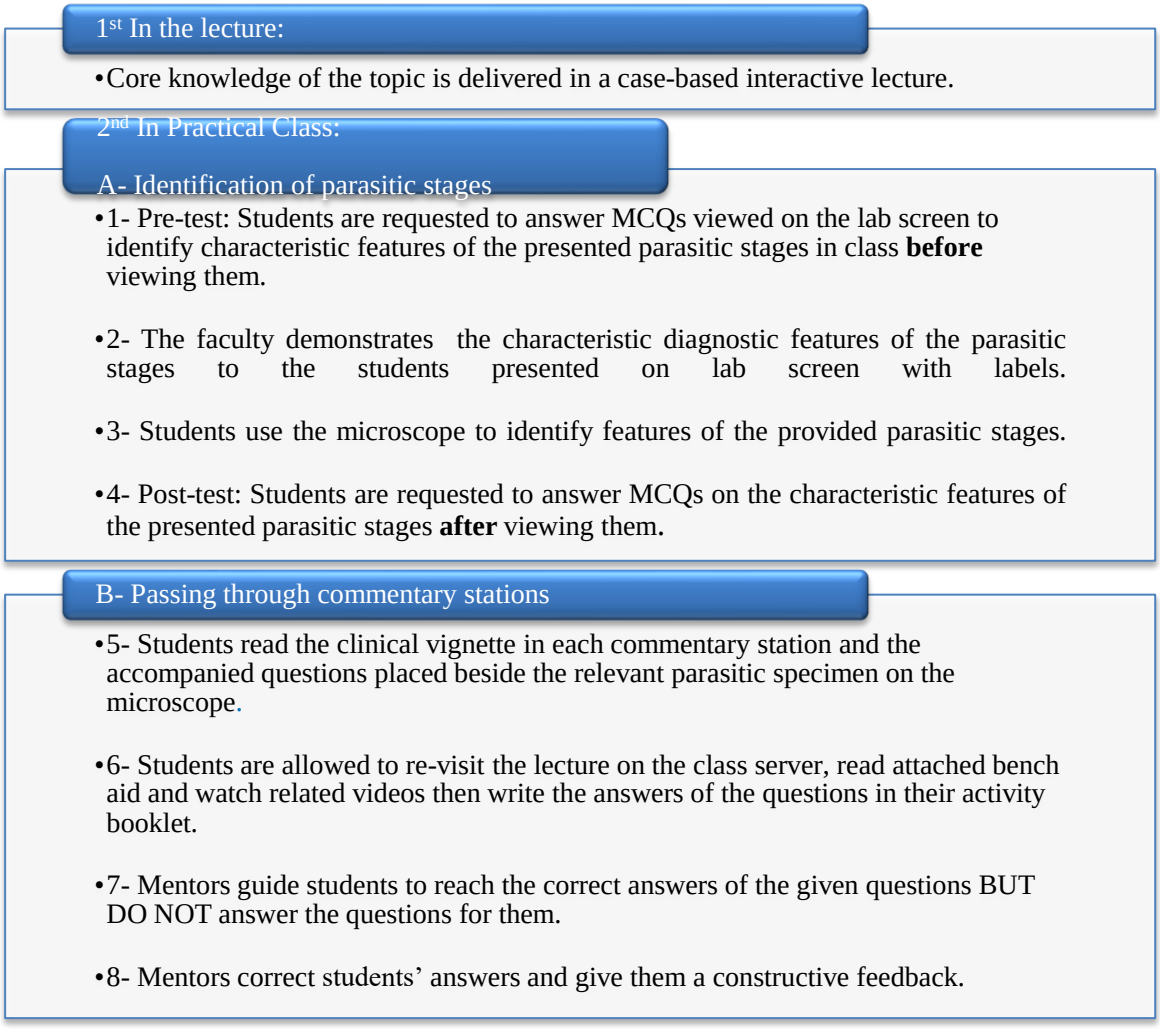


Fig. 1 Steps of learning medical parasitology at AFCM

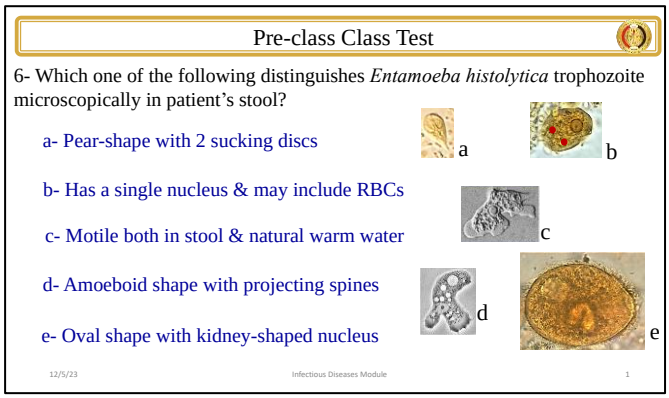
3- <u>Preliminary preparation of the student for the application of commentary stations in learning. Fig1</u>

a. First, students were given the core knowledge of each of the scheduled topics through a formulated case-based interactive lecture. To induce critical thinking, a clinical vignette was conducted at the beginning of the lecture. The clinical problem converted passive didactic lecturing into active mental activity [10]. This is a must for learning, as recommended by cognitive theory. It has been shown that retention of knowledge is increased by active learning [11]. Students were randomly picked to answer questions to ensure their engagement in the lecture [12,13].
b. Second, a designed pre/post practical class assessment was used to execute the training activities on how to identify the parasitic stages provided microscopically or by the naked eye for large parasites.

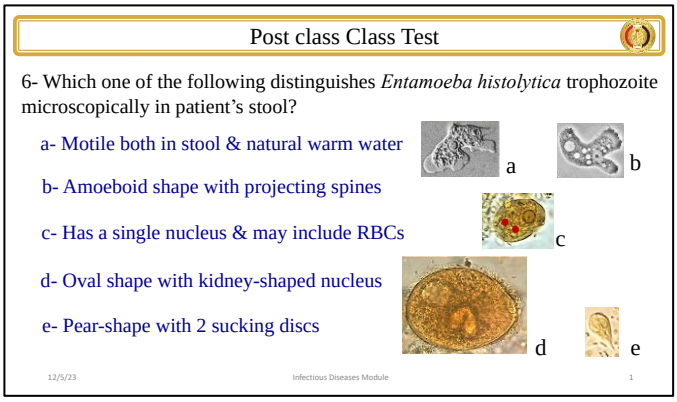
In the pre-class assessment, the brainstorming approach was utilized as the key to working through a question [15], attached example (1.a). At the beginning of the class, students were instructed to answer MCQs to determine the most characteristic features of the parasitic stages provided in class before viewing them.

Student questioning is an important learning strategy to assess their learning needs to achieve curricular objectives [14].

To test knowledge acquisition, a post-test was conducted, attached example (1.b). Instructors were able to use this feedback to style them in in-class activities and teaching to resolve the most common points of student confusion [16, 17].



Example (1.a)



Example (1.b)

4- Implementation of commentary stations. Fig 1

a- Each commentary station was based on a clinical vignette that was formulated to relate the presented parasitic specimen to a clinical/laboratory/epidemiologic setting, attached example (1.c). This was conducted to prepare the students for clinical reasoning [18]. Being in the preclinical phase, student performance was identified on items with clinical stem, and the percentage of students who correctly answered each item was determined [19].

Student's instructions:
- Read the provided commentary.
- Use the microscope to examine the provided permanently preserved slide specimen then answer the following questions.

Clinical history:

A 30-year-old man has strong desire to defecate with little or no stool passes out. He also has pain & spasm at the anus. The demonstrated specimen is microscopically recovered in his stool specimen.

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Task

a) **Focus & identify** the demonstrated specimen on the microscope. (Write its full name & developmental stage)

b) **What** is the remarkable finding detected in the patient stool by naked eye examination? And what is the medical term given to his symptoms?

c) **Where** does the causative parasite exist in the patient's body? **Can** the causative pathogen appear in other sites of infected patient's body? Justify your answer.

d) **Predict** one complication this patient is likely to develop if prompt treatment is neglected.

Example (1.c)

b- Video supplements of real patients having parasitic infections were selected and projected in class. This allowed students to acquire theoretical material, visualize, and solve professional situations better. This was used to promote active learning and approach technology while studying medical parasitology discipline [20, 21].

c- Evaluation was done using scoring points and descriptive rubrics (correctly grasped the concept, partially grasped the concept, did not grasp the concept). This was used as a grading tool to ensure the validity and reliability of commentary stations during the practical classes. This also assured fairness among students [22]. Students in the integrated system had only their activities in class documented in their portfolios and their active sharing is evaluated by marks.

d- The current educational experiment considered the framework of gifted students. This was applied on all students who joined 6+1 and 5+2 program. In 6+1 program students, bonuses were in the form of extra day leave. For 5+2 program students, extra marks were given in their portfolio. Gifted students were defined as subjects who were acknowledged for performance that was higher than that of their classmates. On the other hand, 6+1 students who had unlikely behaviour were punished by preventing them from taking leave. The 5+2 students were punished by losing marks. That is how enthusiasm, motivation, and competition among students studying medical parasitology discipline and the acquisition of information were triggered [23].

A questionnaire was prepared to get feedback from the students on the application of commentary station methodology in learning medical parasitology. The questionnaire was developed after a comprehensive review of the prior studies which comprises items that evaluate the perception of medical students in relation to the "applicability of the method in knowledge assimilation (item 1, 2, and 3)" and "interpersonal relationships and their impact on the in-class activities (item 4, 5, and 6)" and was based on a 5-point scale (Table 1).

The questionnaire was converted into an electronic format through Google Forms. The link was communicated to a batch of students who studied Parasitology in the 5+2 program and another batch of students who studied parasitology in the 6+1 program.

Table 1 The questionnaire used for data collection.

1	**2**	**3**	**4**	**5**
Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Applicability of the method in knowledge retrieval & assimilation				
No.	**Question**			**Student choice**
1	The applied learning methodology is engaging to the topics presented in class.			
2	The applied learning methodology is excellent to be used in other courses taught in pre-clinical years.			
3	I think that with this methodology I will achieve a deeper level of learning i.e., I will not forget the material easily over time.			
Interpersonal relationships and their impact on the in-class activities				
No.	**Question**			**Student choice**

4	I think that the discussion between the instructor and student provided tools to approach the correct answers.	
5	Bonus and penalties motivate me to make effort during performing assignments requested in practical class.	
6	I think that I will do better in exams by learning with the applied learning methodology.	

Statistical methods

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, NY, USA). Data were summarized using frequency (count) and relative frequency (percentage) for categorical data. For comparing categorical data, a Chi-square (X^2) test was performed. An Exact test was used instead when the expected frequency was less than 5. The questionnaire was analysed for its validity using the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity and Reliability using Cronbach's alpha. P-values less than 0.05 were considered statistically significant [24].

Results:

1- Questionnaire Validity and Reliability

At the outset, the validity and reliability of the questionnaire as a tool of student perception were explored. Estimation of validity using the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity revealed a value of 0.778. Moreover, Bartlett's test of sphericity revealed statistical significance ($p < 0.001$), which determines that the variables are significantly correlated (Table 2). Moreover, based on Cronbach's alpha the value of reliability (0.754) showed an appropriate values range (p-value <0.001) (Table 3). Hence, this output yielded the relevance of the obtained data for the analysis of the currently applied method of learning.

Table 2 Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity

KMO and Bartlett's Test[a]				
	Cronbach's Alpha	95% Confidence Interval		0.778
		Lower Bound	Upper Bound	
Value	0.754	0.697	0.803	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.				

a. Based on correlations

Table 3 Cronbach 's alpha for reliability

Bartlett's Test of Sphericity	Approx. Chi-Square	514.265
	Df	15
	P value	< 0.001

2-<u>Quantitative analysis of the questionnaire responses</u>

Two hundred responses were gathered which were satisfactory for statistical analysis. Results revealed that 58% (n=116) of the participating students studied parasitology in the 5+2 program and 42% (n=84) of the participating students studied parasitology in the 6+1 program (Fig N).

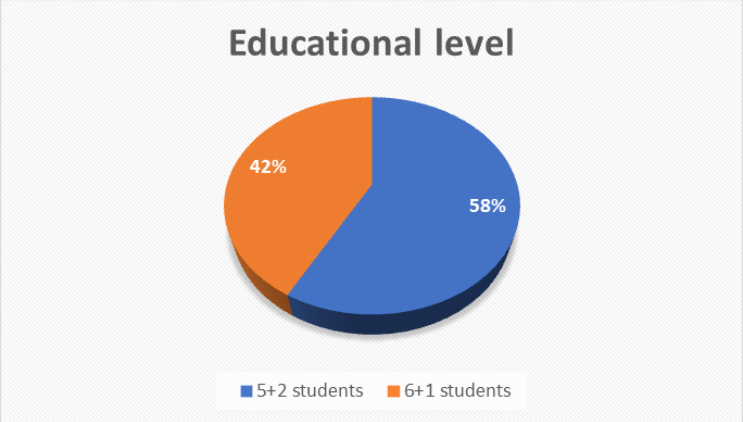

Fig. 2 Distribution of students in the 5+2 and 6+1 programs

In the whole study population, more than half of the students (>50%) strongly agreed with the currently investigated method as a tool for knowledge retrieval (items 1, 2, and 3). Regarding items that evaluate interpersonal relationships and their impact on in-class activities, the percentage of students who recommended the method in deep learning (item 3) was the largest (86.5% agree and strongly agree) among all study participants. In addition, most of the students showed a preference for the facilitator role of the instructor rather than passively introducing the answers to questions provided in the training set (item 4) (67% agree and strongly agree). Further details are shown in Table 4.

The data collected revealed that there were no significant differences in the perception of the students to the method of learning, between 5+2 or 6+1 programs (p-value >0.05) Table 5. Nevertheless, (The statistical test used was chi square test and Exact test was used instead when the expected frequency is less than 5)

the item that evaluates the impact of "bonuses and penalties on motivating performance" showed a higher value of agreement in students studied in 6+1 compared with 5+2 programs (p-value = 0.036). The statistical test used was chi square test and Exact test was used instead when the expected frequency is less than 5. In addition, comparing students who attended 5+2 versus those who were in the 6+1 program, most of the latter group determined the applicability of the currently applied method in the retrieval of knowledge and selected "strongly agreed" in percentages exceeding 55% in items 1,2, and 3.

Table 4 Frequencies of responses to the questionnaire items in the whole study population (n=200).

Questionnaire item	Response	Counts	%
Applicability of the method in knowledge retrieval & assimilation			
1- The applied learning methodology is relevant to the topics presented in class.	Strongly agree	117	58.5%
	Agree	72	36.0%
	Neutral	10	5.0%
	Disagree	1	0.5%
2- The applied learning methodology is excellent to be used in other courses taught in pre-clinical years.	Strongly agree	112	56.0%
	Agree	75	37.5%
	Neutral	12	6.0%

	Disagree	1	0.5%
3- I think that with this methodology I will achieve a deeper level of learning i.e., I will not forget the material easily over time.	Strongly agree	97	48.5%
	Agree	76	38.0%
	Neutral	23	11.5%
	Disagree	4	2.0%
Interpersonal relationships and their impact on the in-class activities			
4- I think that the instructor should not answer questions raised in class. He only guides me to get the answer. This makes learning sticky.	Strongly agree	71	35.5%
	Agree	63	31.5%
	Neutral	41	20.5%
	Disagree	20	10.0%
	Strongly disagree	5	2.5%
5- Bonus and penalties motivate me to make effort during performing assignments requested in practical class.	Strongly agree	83	41.5%
	Agree	66	33.0%
	Neutral	32	16.0%
	Disagree	13	6.5%
	Strongly disagree	6	3.0%
6- I think that I will do better in exams by learning with the applied learning methodology.	Strongly agree	112	56.0%
	Agree	67	33.5%
	Neutral	20	10.0%
	Disagree	1	0.5%

Table 5 Responses to the items in students who studied in 5+2 versus 6+1 programs

Questionnaire item	Response	5+2 program n=116		6+1 program n=84		X^2	P value
		Count	%	Count	%		
Applicability of the method in knowledge retrieval & assimilation							
1-The applied learning methodology is relevant to the topics presented in class.	Strongly agree	60	51.70%	57	67.90%	6.444	0.068
	Agree	47	40.50%	25	29.80%		
	Neutral	8	6.90%	2	2.40%		
	Disagree	1	0.90%	0	0.00%		
2- The applied learning methodology is excellent to be used in other courses taught in pre-clinical years.	Strongly agree	62	53.40%	50	59.50%	1.538	0.785
	Agree	45	38.80%	30	35.70%		
	Neutral	8	6.90%	4	4.80%		
	Disagree	1	0.90%	0	0.00%		
3- I think that with this methodology I will achieve a deeper level of learning i.e., I will not forget the material easily over time.	Strongly agree	52	44.80%	45	53.60%	5.181	0.15
	Agree	43	37.10%	33	39.30%		
	Neutral	18	15.50%	5	6.00%		

	Disagree	3	2.60%	1	1.20%		
Interpersonal relationships and their impact on the in-class activities							
4- I think that the instructor should not answer questions raised in class. He only guides me to get the answer. This makes learning sticky.	Strongly agree	36	31.00%	35	41.70%	4.515	0.362
	Agree	41	35.30%	22	26.20%		
	Neutral	25	21.60%	16	19.00%		
	Disagree	10	8.60%	10	11.90%		
	Strongly disagree	4	3.40%	1	1.20%		
5- Bonus and penalties motivate me to make effort during performing assignments requested in practical class.	Strongly agree	38	32.80%	45	53.60%	10.17	0.036
	Agree	41	35.30%	25	29.80%		
	Neutral	23	19.80%	9	10.70%		
	Disagree	10	8.60%	3	3.60%		
	Strongly disagree	4	3.40%	2	2.40%		
6- I think that I will do better in exams by learning with the applied learning methodology.	Strongly agree	58	50.00%	54	64.30%	4.732	0.161
	Agree	43	37.1%	24	28.6%		
	Neutral	14	12.1%	6	7.1%		
	Disagree	1	0.9%	0	0.0%		

Discussion

Parasitology discipline has been traditionally taught in Egyptian medical schools from the biological perspective much more than from the medical perspective. This has resulted in a misconception among the great majority of medical students as well as medical graduates and medical school authorities about the significance of educating parasitology discipline in medical schools. Many voices started to rise demanding the removal of this discipline from undergraduate medical curricula and giving just flakes of information on common parasitic infections during the clinical phase. These voices have been raised more and more with the implementation of the curricula of the 5+2 program and the reduced timeline given to students studying medicine. Hence, this study involved students who have been enrolled in both 5+2 and 6+1 programs and inspected their perceptions of the currently implemented method of education in Parasitology.

In the current study, we assessed the performance of the implemented educational tool through a valid and reliable questionnaire. The usefulness of this tool was formerly validated through a study by Nasser et al. (2021) [25]. Thus, the used tool was demonstrated to be valid, and reliable and no items were removed. Boparai et al. (2018) deduced that a valid questionnaire is necessary to collect useful data that can serve to understand the objectives of a study. In addition, the same authors determined that validated questionnaires prevent improper analysis, increase the weight of a study, and have the power to generalize their results [26].

In the current study, most students nominated the implemented tool of education to increase knowledge assimilation. This agreed with Donker et al. (2022) who speculated that applying relevant questions improves the students' capabilities to preserve acquired knowledge rather than recall questions [27]. Also, Schmidt and Mamede (2020) concluded that instructional methods in medical education e.g., practical examples and mixed practice are helpful to elaborate discussion, reduce the cognitive load, and support the retrieval practice of knowledge [28]. It is worth mentioning that in endemic regions, introducing long-lived information in medical parasitology is of particular importance. For example, intestinal parasitic infections represent a significant public health alert in

developing countries including Egypt [29, 30, 31, 32, 33, 34, 35]. Also, several zoonotic parasitic infections are present in Egypt and neighboring countries, such as soil-transmitted nematode infections, hydatidosis, filarial infections, schistosomiasis, fascioliasis, and leishmaniasis [36]. Another example is the ticks which are important arthropod vectors that transmit pathogens to humans and animals. Owing to favorable climatic and environmental conditions, along with animal importation from neighboring countries, ticks, and tick-borne diseases (TBDs) are widespread in Egyptian localities [37]. This necessitates providing a deep dive into parasitic infections in undergraduate medical school curricula and highlights the necessity to reform parasitology lectures and practical classes into a clinical context.

In the current study, most students in both 5+2 and 6+1 programs recommended the method to trigger deep learning. To bridge the gap between basic sciences and clinical sciences taught in medical schools, basic sciences should be delivered to medical students in an applied form in a clinical context. Commentary stations are delivered as a learning tool where real-life problems are presented. This proved an interesting means to approach the topics of parasitology discipline and worked well. The students must move across the stations in the classroom and complete the given activities with different levels of difficulty. So, these learning stations were found to inspire students' autonomy, critical thinking, collaboration, and engagement [38].

In the current study, the whole study group emphasized the facilitator role of the instructor rather than a passive transmitter of information. Using commentary stations in education has urged the faculty to transform their teaching method from the traditional didactic to the facilitator style. This has influenced students' maturation and engagement with their profession. Richer et al. (2021) deduced that educators who act as facilitators exhibit distinctive professional identities of higher self-efficacy, satisfaction, and creative views about learning and apply efficient teaching strategies [39].

In the current study, most of the students who attended the 6+1 program determined the applicability of the implemented method as has been shown in the results of items (1, 2, and 3) of the questionnaire. This may reflect their prerequisites and eagerness for integration while being engaged in the discipline program of 6+1. This may reflect the continual challenge that students in 6+1 have to get rid of the molecular or sub-molecular level of information and their continual willingness to receive an outpatient education (Densen, 2011) [40].

In the current study, the inductive learning methodology was presumed to induce relevance to the topics presented in class (the first item in the questionnaire). Similarly, Asberger et al. (2021) determined that a lack of relevance in knowledge is an important factor that leads to educational misunderstanding and influences students' cognitive ability [41]. In the second item of the questionnaire, the applied learning methodology was determined to be used in other courses taught in pre-clinical years. Thus, we wonder about students' perceptions of collaborations between disciplines to establish a coherent curriculum as required by NARS 2017. Also, in the third item, the responses obtained by the students reflect the retention of knowledge and enhancement of deep learning. Likewise, Jhala and Mathur (2019) determined that case-based learning boosts life-long medical learning [42].

In the fourth item of the questionnaire, both 5+2 and 6+1 students revealed insignificant differences and only a minority of students in both groups recommended the passive role of the instructor. This emphasizes the necessity to prepare the students to cross the bridge from mainly teacher-centered to student-centered learning. Yet, it is worth mentioning that education embraces a vast variety of misconceptions about learning and education, with topics ranging broadly across matters of learning, teaching, and educational policy [43].

In the fifth item, bonuses and penalties implemented in practical classes motivated students to exert effort. Similarly, Sri Andriani Sidin (2020) signified the impact of the implementation of rewards and punishment in teaching to get a positive impact on students' learning [44].

In the sixth item of the questionnaire, the insignificant differences between 5+2 and 6+1 students reflected the positive impact of active learning strategies on the outcome of learning [45, 46, 47].

Conclusion

The currently implemented tool of learning appeared to facilitate knowledge assimilation in a clinical context. In addition, it was recommended to impact interpersonal relationships and in-class activities

to promote deep learning. The current educational experiment highlighted the facilitator role of the instructor rather than being a passive transmitter of knowledge. Comparing students who attended the 6+1 program with those in 5+2, bonuses and penalties and the impact of the tool on deep learning were highly determined by the former group. Therefore, this reflected the enthusiasm of the students in the 6+1 program to be incorporated into relevant clinical vignettes whereas most of the program relied on isolated disciplined unapplied basic sciences.

Conflicts of interests

The authors declare that there were no conflicts of interest.

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