RESEARCH ARTICLE

Threshold concepts encountered by second year medical students in a Basic Health Science module; a qualitative study

Memoona Mansoor,[1] Ali Tayyab,[2] Syed Shoaib Shah,[3] Rehmah Sarfraz[4]

Abstract

Objective: To explore threshold concepts in a Basic Health Sciences module.

Method: The qualitative study was conducted at the Islamabad Medical and Dental College, Islamabad, Pakistan, in March 2019, and comprised students and faculty members in the gastrointestinal tract module of spiral I of the integrated modular curriculum in Basic Health Sciences. Data on student experiences was collected using semi-structured interviews with open-ended questions. The data was coded and themes were identified by the researchers independently. A thematic matrix was produced, cross-referencing data relating to troublesome areas identified by the students against the threshold concept criteria. The identified themes were discussed among the researchers to reach consensus. Only the identified themes were taken as the expected threshold concepts in the gastrointestinal tract module.

Results: Of the 18 subjects, 14(77.8%) were students and 4(22.2%) were facilitators. There were 8 areas identified by the students as troublesome in the module; development of gastrointestinal tract, anatomical relations, electron transport chain, histology of gastrointestinal tract mucosa, peritoneal disposition, anal canal and ischioanal fossae, peristalsis, and absorption across gastrointestinal tract mucosa. Only development of gastrointestinal tract appeared to cross-match with all the criteria outlined for threshold concepts. The troublesome areas identified by the teachers were development of gastrointestinal tract, peritoneal disposition, anatomical relations, absorption across gastrointestinal tract and peristalsis.

Conclusion: Development of gastrointestinal tract was found to be the threshold concept in the system-based integrated module of gastrointestinal tract. Most of the students found their previous knowledge inadequate in learning concepts of the module.

Keywords: Threshold concepts, Gastrointestinal tract, Integrated curriculum, Basic health sciences.

(JPMA 72: 901; 2022) **DOI: https://doi.org/10.47391/JPMA.3348**

Introduction

Since the introduction of the threshold concepts framework by Meyer and Land in 2002, extensive research has been done in this area in diverse professions, including economics, engineering, literature, accounting, arts and mathematics.[1] A number of studies in health sciences have been reported, but the field has remained underexplored.

Threshold concepts are distinct ideas inevitable for meaningful learning of a discipline or content area. They are difficult to comprehend and assimilate, but once understood they alter the perspective of the learners toward that specific field.[2] Threshold concepts are 'transformative' because, once learned, they change the viewpoint of students, 'integrative' as they reveal inter-relationship of previously known information resulting in a more refined understanding, 'irreversible' because these cannot be unlearned once acquired, 'troublesome' due to their overwhelming difficulty for the learners, 'liminal' for the reason they cause ambiguity, bounded by being discipline-specific, 're-constitutive' because repeated de-construction and re-construction of knowledge occur in the process of overcoming them, and 'discursive' because these enable the learners to communicate in the language of the subject.[1]

Researchers agree that identifying threshold concepts can inform medical curricula because it helps us discover limitations of curricular design and structure. Such shortcomings can be weakness of instruction, wasting of curricular time, communication gap between students and faculty and lack of meaningful formative feedback to the learner.[3-5] Threshold concept framework is also valuable in recognising when and how students need assistance, direction or challenge for learning.[6] Students' background knowledge of a content area may affect assimilation of threshold concepts in that field.[1] Studies recommend revisiting of spiral curricula in the light of identified threshold concepts.[5]

[1,4]Department of Medical Education, [2]Department of Ophthalmology, [3]Department of Forensic Medicine, Islamabad Medical and Dental College, Islamabad, Pakistan.

Correspondence: Memoona Mansoor.

Email: memoona.mansoor@imdcollege.edu.pk

Most of the studies targeting threshold concepts in medical education have been done in Europe, the United States and Australia, focussing on identifying threshold concepts in either clinical subjects or soft disciplines, including ethics, professionalism and professional identity formation.[3,7,8] Several studies are carried out without direct student involvement in identifying the threshold concepts.[9]

Robust curricular reforms are under way in Pakistan with an obvious drive to adopt and implement an integrated curriculum in Basic Health Sciences. Identifying threshold concepts in medical education thus demands particular attention because such initiatives can guide the curricular goals and decision-making. The current study was planned to determine threshold concepts in gastrointestinal tract (GIT) module of second year undergraduate medical programme in Pakistan.

Subjects and Methods

The qualitative study was conducted at the Islamabad Medical and Dental College (IMDC), Islamabad, Pakistan, in March 2019. After approval was obtained from the institutional ethics review board, the sample was raised using purposive sampling technique. Those included were students of second year of the medical undergraduate programme and faculty members of Basic Health Sciences regardless of age and gender. The faculty members were instructors with at least two-year experience of facilitating academic sessions in small group discussions (SGDs) and laboratory classes, and were also involved in the planning of academic activities and assessments.

The curriculum at the study institution is at level 7 (correlation) of Harden's integration ladder.[10] At this level, integrated instruction is done along with subject-based teaching to give a holistic picture to the students. The curriculum for the first three years is organised in two spirals with horizontal integration of pre-clinical subjects. Spiral I spans first two years of learning with horizontal integration of Anatomy, Physiology and Biochemistry, spiral II covers third year with the integration of Pathology, Pharmacology and Forensic Medicine. Each spiral is divided in blocks and each block has two or more system-based integrated modules. GIT module was selected for the identification of threshold concepts due to student feedback from previous year and also because of the fact that second year medical students are more familiar with the system of teaching and more confident with the use of terms etc. It was module VI in spiral I. It dealt with Anatomy, Applied Physiology and biochemistry. It was organised around five themes based on clinical conditions related to anterior abdominal wall and GIT. SGD was the most frequently relied upon method of instruction, followed by large-group sessions to cover patients with hernia, achlasia, peptic ulcer, intestinal obstruction, and chronic liver disease.

Qualitative approach of phenomenology was adopted because the idea was to explore the experiences of students while facing and overcoming challenging concepts in this particular module.[11] These experiences were explored with the help of an interview guide with a standardised script. The questions were developed after literature search and all questions of the interview were open-ended.[7] Seven questions were designed for the students, and nine for the faculty. Interviews were conducted after the conclusion of the GIT module. A written informed consent was obtained before the interview and a brief introduction of the threshold concepts was given to the participants. All interviews were face-to-face and lasted 12-15 minutes each, and were recorded with the permission of the participants. There were no repeat interviews. All interviews were conducted in the conference room of the Department of Medical Education (DME) by the principal investigator who had an active role in curriculum planning and faculty development activities, while her non-involvement in active teaching reduced the element of bias and pre-suppositions.

All the interviews were conducted bilingually in English and Urdu. The audio files were transcribed first by the interviewer. The conversation/ sentences in Urdu were translated into English while transcribing. The transcribed data was then reviewed by the other researchers one by one who suggested corrections/modifications which were done with consensus. Manual coding and thematic analysis was done for data analysis.

The team identified the troublesome areas from the answers to question number 1. Grouped them under similar themes; coded and themed each answer verbatim to identify the criteria of threshold concept it apparently expressed; and produced a matrix cross-referencing data related to troublesome areas with data meeting particular threshold concepts criteria.

The identified themes were discussed among the researchers to reach consensus. Troublesome concepts which appeared to have all the six criteria of being re-constitutive, liminal, integrative, discursive, transformative and irreversible were taken as threshold concepts in the GIT module.

Results

Of the 100 eligible students approached 14(14%) agreed

Table-1: Cross-referencing of troublesome concepts with threshold concept criteria.

	Troublesome area	Re-constitutive	Liminal	Discursive	Integrative	Transformative	Irreversible
1	Development of GIT	2	2	2	1	2	3
2	Structural/anatomical relations	0	1	3	0	0	0
3	Electron transport chain	1	0	2	2	2	2
4	Histology of GI mucosa	0	1	1	0	1	2
5	Mesentery and peritoneal disposition	1	0	1	0	1	1
6	Anal canal and ischio-anal fossa	1	1	0	0	0	0
7	Peristalsis	1	0	1	0	1	1
8	Absorption across GIT	1	0	1	0	1	1

Table-2: Development of gastrointestinal tract (GIT) as a threshold concept.

Question 1 Troublesome concepts	Question 2 Why do you think that/those concepts were difficult to comprehend? Re-constitutive	Question 3 How did you manage the conflict between your previous knowledge and previous ideas Liminal	Question 4 How did you overcome the encountered difficulties? Discursive	Question 5 How much did your previous knowledge help you in learning? Integrative	Question 6 What were the 'Aha' moments which changed your previous idea? Transformative	Question 7 How did you make sure that the concepts have been fully understood and internalized? Irreversible
Development of GIT	"I was unable to link gross anatomy and embryology. I think it was because when I study I make a picture in my mind of what I am studying so…. I was unable to make a picture of what was happening. This was the difficult thing.	"To learn that in detail was quite different and beyond I could imagine. I get disturbed how and why is it happening like that".	"I ask my sister who is a doctor that can she briefly explain me I also discuss with my friends so basically it is the discussion with different people that helps		"When I understood the development of stomach and its rotation it was an Aha moment for me. The picture that I had already made was not actually like this and I was like "Oho! It was not like this, it's this" and it changed my understanding.	"I discussed it with my sister and she corrected me where I was wrong and she acknowledged me what was correct.
		Quite honestly I do get stressed out that I don't know this so how I am supposed to understand things that are going to happen next to because things in embryology are interlinked. So I do get stressed out but I kind of cope with it by I watch videos from u-tube. I need a visual image of everything especially in embryo that's happening	I think of watching about videos or discussing with friends because it helps, or just correlating it with diagram and everything, but I do believe that……	Last year we studied the development of trachea that helped me to correlate with the development of esophagus a lot and from there it became easy for me that it is just one pattern that is happening. That helped me a lot.	Yes…when I watched the video, it wasn't really like my understanding and I got it so this is how "stomach rotation" it is happening in foetal life.	It was discussion with a couple of friends, I asked if I was right or wrong and that was the things which actually made me confident.
	Whatever is taught in small group discussions we are making picture of it in our brain (imagination) that this is how it would appear"	In (before) SGD I feel that I know everything but when other students discuss during an SGD I feel that no my learning is very deficient.				I asked my colleagues to quiz me.

Table-3: Faculty responses to the questionnaire on threshold concepts of gastrointestinal tract (GIT).

Interview Questions	Faculty 1	Faculty 2	Faculty 3	Faculty 4
1 What were /was the most difficult concepts in your opinion for the students in this module?(Troublesome)	1. Embryology of GIT • Folding of embryo 2. Peritoneal disposition They did not have any idea of folding of embryo and how does the yolk sac enter the embryo""	1. Relations of stomach 2. Peritoneal disposition • Concepts of greater and lesser sac/greater and lesser omentum • Difference between parietal and visceral peritoneum "They found the concept of lesser and greater sacs difficult" "They got an idea of relations of stomach after I taught them with the help of models"	1. Disposition of peritoneum • Mesentery • Intra and extra- peritoneal organs 2. Development of GIT "Students were unable to link embryological development with the positioning of GIT in abdominal cavity"	1. Relations of stomach and other organs 2. Absorption across GIT and Mixing and propulsion of food
2 How did you identify that students are in the phase of confusion and ambiguity?	"I asked questions after the lecture and got an idea that students who had poor foundational knowledge of embryology were unable to correlate things"	"They were able to recall that lesser sac is behind the stomach but were confused and unable to identify it on models and specimen"	"Whenever I asked any question during group discussion and when I marked their tests"	While facilitating SGDs when I came across their ideas
3 Why do you think those concepts were difficult for students to grasp? (re-constitutive)	"Because they had limited background knowledge"	"They used their imagination reading the book unless they have seen specimens they can't have clear concepts" "Students with better understanding told me that they have seen videos on you-tube"	"Cadaver dissection is helpful in learning these concepts, models are not that helpful."	It seemed they were unable to extract relevant information from the resource material , the book they study (Guyton and Hall), is detailed and it is not easy for novices to get it right initially "
4 What steps you had taken to help the students understand those concepts? (liminal)	"I try to revise previous concepts with the help of pictures and summarization and then move forward to talk about new content"	"I showed them specimens and models and recommended dissection videos"	"I tried to give them the concept of peritoneum as a balloon but it did not do much"	"I recommended them number of resources like books and animated videos. I also gave them short answer questions for practice."
5 Did you struggle with the comprehension of the same concepts when you studied?	"We were never taught embryology the way we are teaching, neither had we had any concept of that."	Yes "We used to observe cadavers and specimen and did not have good quality models"	Yes "At that time we just memorized things without understanding. When I started teaching I tried to understand…."	I don't remember
6 How did you overcome those difficulties? (discursive)	"By studying in groups, open discussion benefitted me"	"We did not have videos at that time and used run after our seniors and professors who could teach us on specimen"	"I did dissections and it really paid off".	"We studied in groups all friends to understand that and it was useful that lot of things were clarified".
7 To what extent did your previous knowledge help you in facilitating learning those concepts?(integrative)	"It helped a lot, I would make my lecture presentations, emphasizing the areas challenging for me"	A lot	"60-70 percent, my concepts were refined when as a teacher I thought how should I make students understand and guide"	"It helped me much because teaching is the best way of learning"
8 Describe any new approach /concept you have developed in GIT module. (Transformative)	"During our days there were no videos, these are good in understanding certain stuff especially embryology"		-----	Nothing I have noticed or applied

Contd. on Next Page >>>

Contd. from Previous Page >>>

Interview Questions	Faculty 1	Faculty 2	Faculty 3	Faculty 4
9 How did you make sure that concepts have been assimilated by the students?	"By feedback and asking questions about previously learnt content, take surprise quiz at times"	"I ask questions during small group discussion and students have to relate to the models/specimens while discussing, it gives me an idea"	"During group discussion I get an idea of their concepts, secondly by marking tests".	"I ask students who are passive to summarize the discussion which gives me an idea how much they have gained".

to participate, while, of the seven faculty members, 4(57%) participated. Among the students, there were 10(71.4%) females and 4(28.6%) males with overall age range 19-21years. Among the faculty members, there were 3(75%) females and 1(25%) male with overall age range 27-30 years.

Interviews with the students led to 20 broad troublesome areas. From among them, 8(40%) areas were declared troublesome by the researchers after grouping them together in multiple discussion sessions. The troublesome areas were development of GIT, anatomical relations, electron transport chain, histology of GIT mucosa, peritoneal disposition, anal canal and ischioanal fossae, peristalsis, and absorption across GIT mucosa. Only development of GIT appeared to cross-match with all the criteria outlined for threshold concepts (Table-1). The observation was based on the relevant verbatim answers of the students (Table-2).

The troublesome areas identified by the faculty members were development of GIT, peritoneal disposition, anatomical relations, absorption across GIT and peristalsis (Table-3).

Faculty response was varied about the reason of troublesomeness of these concepts. The reasons they recognised included limited background knowledge, inability to do cadaveric dissection and content overload.

On the whole it seemed that the students found the threshold concepts related to the discipline of anatomy difficult to visualise and imagine, and there was much new knowledge to handle. However, one threshold concept related to Biochemical aspect was attributed to the external factor of limited preparation time, and one related to Physiology was attributed to information overload. The faculty members, too, identified that limited background knowledge and inability to visualise the development of gut on their own could be the reason of troublesomeness of these concepts.

Students described that mostly they handled the troublesome concepts by discussing with peers or some faculty member and by watching videos. The teachers explained that they facilitated the students through the phase of liminality by making them visualise things in a better way with the help of different techniques, videos, cadavers and specimens.

For most of the troublesome areas, the students found their previous knowledge inadequate in understanding, except for electron transport chain for which they believed their background knowledge helped them with the understanding. For development of GIT, only one out of three students thought that the previous knowledge was useful. Another interesting aspect was that students finding ischioanal fossae as a troublesome concept clearly said that they were unable to correlate the knowledge because it was related to something they had yet to study. This was because the module Reproduction is in succession of the GIT module. The faculty was of the view that although background knowledge of the students was not enough to understand the difficult concepts, but while preparing to teach, their own previous knowledge helped them a lot in identifying areas of emphasis and choosing instructional tools.

The teachers could not identify any new approach they developed during teaching this module. Students assessed their learning of troublesome concepts by discussing it with peers, seniors and facilitators. Similarly, the faculty assessed assimilation of content by learners by asking questions and marking their tests.

Discussion

A total of eight areas were identified by the students as troublesome in the system-based module of GIT in spiral I of the integrated curriculum at the study institution. Most of these concepts recognised by the students matched with the ones identified by their facilitators. Development of GIT was found to be the threshold concept for this module because of having all the characteristics of the threshold concept framework.

So far, most of the studies done in identifying threshold concepts have been discipline-specific done in traditional curricula and or clinical subjects. Despite extensive search of different databases, inlcluding PubMed, ERIC and CINAHL, we could not find any study done in a system-based modular curriculum to compare the findings of the

current study with. A system-based curriculum is designed for correlating structure and function with the disease for better understanding and practice of medical knowledge and has the same aim as the idea of threshold concepts.

Kramer and Soley, while seeking perceptions of medical students about difficult concepts in a traditional course of Anatomy, observed that 30% of their students had difficulty in understanding omenta, mesenteries and peritoneal sac, and more than 49% faced problem with comprehension of body cavities, mesenteries and rotation of gut.[12] Although the study targeted the subject of Anatomy only and the focus was not on threshold concepts, but only on the identification of troublesome areas, the findings are interestingly similar to the ones in the current study which was done in an integrated module of GIT. We used structured interviews compared to the survey approach by Kramer and Soley, yet the troublesome concepts identified in the specific areas were similar.[12]

Horrigan explored threshold concepts in Physiology across different modules in Biomedical Sciences and the role of laboratory class in learning these concepts. The investigator did one-on-one interviews with students and faculty to identify the threshold concepts. In GI Physiology, the threshold concept identified by the teachers was absorption across GI membrane.[13] In the current study, absorption as well as peristalsis were identified as threshold concepts by one of the students and one member of the teaching staff. However, Horrigan had some interesting observations behind the troublesome nature of these threshold concepts. He observed that their foundations lay in premedical subjects, like Chemistry and Physics which were not relatable to individual experiences and were difficult to integrate. Interestingly, students and faculty members in the current study were unable to pinpoint the intellectual reason behind their threshold concepts and attributed the troublesomeness of their threshold concepts to external factors, like inadequate time for preparation, content overload and unavailability of physical aids.

Loertscher et al. identified threshold concepts in Biochemistry involving both students and experts, and came up with a list of five major threshold concepts in the subject. They observed that these concepts were interconnected with foundational biochemical ideas and constituted a conceptual network.[14] The threshold concept of electron transport chain identified by students in the current study can easily fit in the categories 'steady state' and 'free energy' identified in the earlier study. They identified the threshold concept in the whole of Biochemistry in five phases and used focus group discussions (FGDs) and workshops for the purpose, while the current study did it in a limited duration module with a questionnaire already structured according to threshold concept framework. We share their belief that in planning instructional strategies for future, these threshold concepts will help focus on specific areas, like visual literacy skills, to facilitate student learning.[14] They intended a reorganisation and realignment of undergraduate Biochemistry courses in the light of their findings which was exactly the aim while planning the current study. The current finding of electron transport chain as troublesome for students is verified by Forni et al. who tried different methods of instruction for teaching electron transport chain to medical students.[15] They tried board games to teach this concept to first year medical students and got an encouraging response from the qualitative feedback of the students. We observed that the students struggled by consulting more books for clarification of the concept.

One of the two challenges detected by Barradell and Peseta in the identification of threshold concepts in their review was disagreement among the study participants about threshold concept in a particular discipline.[4] Contrary to this finding, students and teacher in the current study broadly agreed to the three threshold concepts identified in the GI module, which surprisingly were related to the single discipline of Anatomy.

Moeller and Fawns explored threshold concepts in learning electroencephalography (EEG), and acknowledged that taking experts only as participants was a limitation to their study because experts may not be able to comprehend why a concept is troublesome for the students.[7] Evgeniou and Loizou had similar suggestion that experts might differ in their opinion of troublesome concepts they faced as beginners.[16] In contrast, most of our students were of the view that they had limited previous knowledge of the concepts they found troublesome. This idea was verified by the observation of their teachers as well. It was also observed that teachers found these concepts challenging for themselves during their own student life too.

Some students did identify their 'AHA!' moments for the troublesome concepts they had; some seemed still stuck in the liminal phase and had no transformative moments regarding their difficult concepts. This was a valuable insight and allowed us to examine those content areas of the GI module meticulously to come up with suggestions for future improvements.

The current study has its limitations, as it was done with a single cohort in one institution. As such, the findings cannot be generalised. The same module can be explored in other medical schools following the same curriculum or may be in the same school with different group of students to validate the current results. The average response to interviews both by faculty and students was very low.

Conclusion

Development of GIT was found to be the threshold concept in the system-based integrated module of GIT. Most of the students found their previous knowledge inadequate in learning concepts of the module.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

References

1. Land R. Threshold concepts and troublesome knowledge (1): Linkages to ways of thinking and practising within the disciplines. 2003.
2. Collett T, Neve H, Steven N. Using audio diaries to identify threshold concepts in'softer'disciplines: a focus on medical education. Practice and Evidence of Scholarship of Teaching and Learning in Higher Education Special Issue: Threshold Concepts and Conceptual Difficulty.2017;12:99-117
3. Neve H, Wearn A, Collett T. What are threshold concepts and how can they inform medical education? Med Teach 2016; 38: 850-3.
4. Barradell S, Peseta T. Putting threshold concepts to work in health sciences: insights for curriculum design from a qualitative research synthesis. Teach High Educ 2017; 22: 349-72.
5. Hyde S, Flatau A, Wilson D. Integrating threshold concepts with reflective practice: Discussing a theory-based approach for curriculum refinement in dental education. Eur J Dent Educ 2018; 22: e687-97.
6. Egnew T, Lewis PR, Meyers KR, Phillips WR. The Suffering Medical Students Attribute to Their Undergraduate Medical Education. Fam Med 2018; 50: 296-9.
7. Moeller JJ, Fawns T. Insights into teaching a complex skill: Threshold concepts and troublesome knowledge in electroencephalography (EEG). Med Teach 2018; 40: 387-94.
8. Neve H. Learning to become a primary care professional: insights from threshold concept theory. Educ Prim Care 2019; 30: 5-8.
9. Neve H, Lloyd H, Collett T. Understanding students' experiences of professionalism learning: a 'threshold'approach. Teach High Educ 2017; 22: 92-108.
10. Harden RM. The integration ladder: a tool for curriculum planning and evaluation. Med Educ 2000; 34: 551-7.
11. Tavakol M, Sandars J. Quantitative and qualitative methods in medical education research: AMEE Guide No 90: Part II. Med Teach 2014; 36: 838-48.
12. Kramer B, Soley JT. Medical student perception of problem topics in anatomy. East Afr Med J 2002; 79: 408-14.
13. Horrigan LA. Tackling the threshold concepts in physiology: What is the role of the laboratory class? Adv Physiol Educ 2018; 42: 507-15.
14. Loertscher J, Green D, Lewis JE, Lin S, Minderhout V. Identification of threshold concepts for biochemistry. CBE Life Sci Educ 2014; 13: 516-28.
15. Forni MF, Garcia-Neto W, Kowaltowski AJ, Marson GA. An active-learning methodology for teaching oxidative phosphorylation. Med Educ 2017; 51: 1169-70.
16. Evgeniou E, Loizou P. The theoretical base of e-learning and its role in surgical education. J Surg Educ 2012; 69: 665-9.