

# A Cross-sectional Study Investigating Learning Approaches in Undergraduate Medical Education

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## Research article

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# Abstract

**Objective** The primary objective of this proof-of-concept cross-sectional study was to identify a framework for appraising the learning-approaches of undergraduate medical students in a competency based medical curriculum and correlating the results with teaching-approaches, as well as academic performance. The study was pursued at MBRU, which is a medical school in the Middle East with an undergraduate entry medical program. **Results** Our framework was blueprinted using the Approaches and Study Skills Inventory for Students (ASSIST) questionnaire, to which we made some modifications such that the overall cogency of the questionnaire wasn't affected. Initial results with modified ASSIST at MBRU showed that most of our students adopted Deep or Strategic-learning approaches. This observation is in line with other studies in the literature, which shows that modified ASSIST is a suitable tool for mapping generic learning approaches with teaching approaches. Further, based on the insights from our initial results following the implementation of modified ASSIST, we have considered specific pedagogical strategies, in practice at MBRU, which cater to the generic learning approaches of majority of our undergraduate medical students. These pedagogical approaches, A. Feynman's Technique; and B. Blended learning strategies, if implemented suitably in a curriculum will transform "Surface-learners" to "Deep/Strategic-learners".

## Background

Pedagogy in medicine is transforming from the classical "sage on the stage" to more engaging approaches [1, 2]. In fact, many medical schools have now adopted competency-based learner-centred approaches to teaching to spur active learning [3]. The effectiveness of such learner-centred pedagogical strategies will be augmented if they are fittingly mapped, with generic learning approaches adopted by medical students in a given cohort. This implementation is pivotal for medical schools in the Middle East, which admit students from diverse high-school curricula, based on matriculation scores, and experience high dropouts [4]. This proof-of-concept study is aimed at identifying a framework for appraising the learning approaches of undergraduate medical students in a competency based medical curriculum and correlating the results with the availed teaching-approaches as well as academic performance.

## STUDY LANDSCAPE

The study was conducted at Mohammed Bin Rashid University of Medicine and Health Sciences (MBRU). MBRU is a new medical school with an undergraduate entry medical program, in which the curriculum is founded on a competency-based model and spans six-years. The curriculum is divided into 3 phases (Figure: 1)[1].

Each phase of the curriculum includes integrated courses and builds on the preceding one, such that the curriculum is "spiral" (Figure: 1) [5]. The school has a diverse student population, drawing students from more than 19 countries across the globe.

# Methods

## Ethical Considerations

The study was approved MBRU-Institutional Review Board (MBRU-IRB) (Approval No. MBRU-IRB-SRP2018-048). Participation was voluntary, with a declaration of informed consent. The study spanned between January and September of 2018.

## Participants

The study population comprised 84 undergraduate medical students (belonging to Year-2 or 3) enrolled in the MBBS-program at MBRU. A purposive sampling method was applied [6], whereby candidates were eligible to participate based on their status as an undergraduate medical student in MBRU. Year-1 students were excluded from the study, as the short-period of time in medical school was insufficient to assess their learning approach.

## Evaluation of Learning and Teaching Approaches

Our study employed the Approaches and Study Skills Inventory for Students (ASSIST) questionnaire to evaluate the predominant learning and teaching approaches, among the participants (Table: 1). This questionnaire was developed by Entwistle [7], for university students' conceptualizations of learning, approaches to studying, and preferences for different types of instructional methods.

Available research on ASSIST has identified three primary approaches to studying: Deep, Strategic, and Surface (Figure: 2). Construct validity has been supported by several studies which have linked approach to learning to academic performance [8]. Deep and Strategic approaches usually are related to greater success, while Surface approaches may put students at risk for poor academic performance. As a result, curriculum design and pedagogy that improve Deep and Strategic approaches may be beneficial to improving performance outcomes.

In the present study we effected a modified version of the ASSIST questionnaire. The initially published ASSIST questionnaire consists of 3 different sections designated A, B, and C. All three sections consist of items with a Likert scale rating for response. As shown in (Table: 2), in the proposed research the 66 items have been reduced to 41 items (Sections B and C). We modified the questionnaire to include a smaller number of questions, while maintaining an equal number of questions across the learning approaches. In the modified ASSIST, an additional 4 items were added. These items recorded the demographics of the participants, i.e. age, sex, year of study in the MBBS program, and high-school education of the participant.

The last 8 items of the modified ASSIST enquired about preferred teaching approach. They measured whether students preferred a deep or a surface teaching approach.

## Study Variables

The key aim of this study was to identify the predominant learning approaches among undergraduate medical students. We also investigated the correlations between different teaching and learning approaches, as well as, correlations between learning approaches and different demographic factors such as age, gender, year of study and high-school curriculum. Additionally, the correlations between learning approaches and perceived academic performance were also investigated. All of these variables were collected and tabulated as questionnaire results in an encrypted spreadsheet. All variables were numerical continuous variables.

### Statistical Analyses

The questionnaire response file was converted to a spreadsheet and the questions for each approach were reorganized into adjacent columns, with the value of each response in the respective row. The average-score for each approach was calculated for each participant by taking the average of all responses recorded for a certain approach. The predominant learning approach for each participant was chosen as the highest score per learning approach. Descriptive statistics were utilized to describe the demographics of the study population. In order to identify whether a significant difference existed between the mean scores for predominant learning approaches, paired t-tests [9], were used.

The Spearman correlation coefficient [10], was calculated for Likert-scale variables to compare if students prefer the teaching approach that matches their learning approach. This was done by analysing correlations between learning approach and preferred teaching approach, as well as a correlation between learning approach and perceived academic performance. The Spearman correlation analysis was conducted utilizing the average scores for each learning and teaching approach and scale scores for perceived academic performance as data values. Ordered logistic regression was used to analyse the effect of predominant learning approach on perception of academic performance, controlling for age, gender, and cohort. The level of significance (p-value) considered was 0.05. Data was analysed using STATA, version 15.1. [11].

## **Results**

### Participants

Sixty-four (76%) responses were received. Details of exclusion at various stages of data analysis are shown in Figure: 3.

### Learning Approaches

The distribution of the predominant learning approaches among the 60 students is shown in Figure: 4A.

The two highest scored items in ASSIST were, (A) Question 6 (Table: 1), for Deep-learning approach (score,  $s=4.43$ ) and (B) Question 5 (Table: 1), for Strategic-learning approach ( $s=4.4$ ). Question 10 (Table: 2), concerning Surface-learning approach, scored lowest ( $s = 2.3$ ).

### Teaching Approaches

The results for preferred teaching approaches are shown in Figure: 4B. Five students were excluded from the analysis, as they ranked equally for both Deep-teaching and Surface-teaching approaches. Of the 55 students, majority preferred Surface-teaching Approach Figure: 4B.

Next, we correlated the students' preferred teaching approaches with learning approaches (Figure: 4C). Here, Question 38 in ASSIST (Table: 1) concerning the surface-teaching approach, assessing information delivery/dissemination, had the highest score ( $s = 4.5$ ). On the other hand, Question 39 in ASSIST (Table: 1) pertaining to the deep-learning approach, appraising learner understanding, had the lowest score ( $s = 2.9$ ).

### Paired t – tests

Paired t-tests were conducted to identify any significant differences between the average scores of each learning approach. Statistically significant difference was observed between deep-learning (Mean (M)= 4.02, Standard Deviation (SD) = 0.554) and surface-learning (M= 3.52, SD=0.638) approaches ( $t(60) = 4.30, p < 0.001$ ). Significant difference between the deep-learning and strategic-learning (M=3.46, SD = 0.676) approaches ( $t(60) = 6.11, p < 0.001$ ) was also witnessed. No statistically significant difference between strategic-learning and surface-learning approaches ( $t(60) = -0.37, p = 0.71$ ) was found.

### Spearman Correlation

A Spearman correlation was conducted to determine if students' preferred teaching-approaches match their learning-approach (Table: 3). Sixty students were included in this analysis. Deep-learners ( $R = 0.46, p < 0.001$ ) and Surface-learners ( $R = 0.49, p < 0.001$ ), were found to prefer their respective teaching approaches.

Strategic-learning scores failed to exhibit correlation with Deep-teaching scores ( $R = 0.22, p = 0.09$ ) or Surface-teaching scores ( $R = 0.06, p = 0.67$ ). A positive correlation between Deep-learners and Strategic-learners ( $R = 0.36, p = 0.005$ ) was found, whereas a negative correlation between Deep-learners and Surface-learners ( $R = -0.30, p = 0.021$ ) was observed.

Next, the association between learning approach and academic performance was also studied (Table: 4). Only Strategic-learners had a significant positive correlation with perceived academic performance ( $R = 0.54, p < 0.001$ ).

### Ordered Logistic Regression

Ordered logistic regression was used to study the effect of predominant learning approach on self-perception of academic performance (Table: 5). In this analysis, the dependent variable academic performance had multiple levels (1-9). Results suggest that Surface-learners are more likely to score themselves 1.69 points less than Deep-learners on their self-perceptions of academic performance

(Estimate: -1.69; 95% CI: -2.88, -0.51;  $p=0.005$ ). However, Strategic-learners were no different than deep-learners when scoring their self-perceptions of academic performance (Estimate: 0.74; 95% CI: -0.64, 2.12;  $p=0.30$ ). Details of the regression are presented in Table: 5.

## Discussion

Our study using a modified ASSIST questionnaire (Table: 1) presents a tool for mapping the synchronicity between learning approaches and teaching approaches in undergraduate medical education, especially in locales where the student population is diverse with dissimilar academic foundation/backgrounds.

Through a modified ASSIST questionnaire we found that the Deep-learning approach was the predominant learning approach in our students, a trend that has been observed in other similar studies [12, 13]. Competency-based medical education has most likely impelled the integration of problem-solving and analytical thinking in the “typical medical curriculum” of today. Additionally, correlation analysis between the three learning approaches indicated a positive correlation between Strategic-learning and Deep-learning items, but a negative correlation between Strategic-learning and Surface-learning items. This indicates that Strategic-learners can adapt to Deep-learning approaches, but Deep-learners and Surface-learners cannot adapt to each-others’ learning approaches. This finding in part supports the earlier observations of Ramsden, in which it was seen that strategic-learners employed “cues and clues” about assessment to engage both surface- and deep-learning strategies to achieve positive outcomes [14].

The 3P (**P**resage, **P**rocess and **P**roduct) teaching and learning model of Biggs and Moore, suggests that learning approach of a student is tempered and mitigated by: (A) teaching context; (B) meta-learning processes and; (C) outcomes of learning, where factors associated with teaching context play a vital role (Figure: 5) [15]. Accordingly, one of the aims of delivering a curriculum is to promote the “transformation” of “Surface/Deep-learners to Strategic-learners”. This can effectively be achieved through the concerted and prudent use of active learning techniques [16, 17]. Additionally, to provide the right milieu for this “transformation,” teaching strategies should promote and foster self-directed learning through mental models such as the Feynman technique (Figure: 6); encourage collaboration; informally assess students; integrate technology in the learning process and; disseminate lessons with flexible learning paths.

One of the challenges of this study is that although most of our students are Deep/Strategic-learners, they prefer the surface-teaching approaches. This may be attributed to the fact that at MBRU, diverse blended learning strategies are employed (Figure: 7), insufficiently examined by the items in the modified ASSIST. In line, the students most likely have indicated their responses based on their reflections in the didactic sessions.

Logistic regression showed that surface learners are more likely to view themselves as inferior academically when compared to deep learners. Does this affect their academic performance in the long-

run? A study by Stringer et al, in school children showed that self-perceptions of academic competence account for significant variance in academic performance. However, neither the academic self-perceptions at the beginning of the study nor changes in self-perceptions over time predicted changes in academic performance [18]. Little is known in the niche of medical education in this regard, and therefore further research is warranted to address this gap.

## Conclusions

We present a comprehensive tool designed using the framework of ASSIST to correlate learning approaches with teaching approaches. Initial results are similar to other studies in the literature. However, ASSIST is a self-reporting apparatus, and therefore may not always reveal the true approach to learning of students, especially if they responded in a way that they believed would have been the approved answers. Also, how learning approaches are predisposed in a multidimensional milieu, when resilience and stress-coping strategies of students are also included, is currently unknown. Future research should investigate these facets.

## Abbreviations

**ASSIST:** Approaches and Study Skills Inventory for Students

**MBRU:** Mohammed Bin Rashid University of Medicine and Health Sciences

**IRB:** Institutional Review Board

**3P:** Presage, Process and Product

## Declarations

- ***Ethics Approval and Consent to Participate:*** The Mohammed Bin Rashid University of Medicine and Health Sciences-Institutional Review board reviewed the present study (Application number: MBRU-IRB-SRP2018-048) and provided an exempt status. Further clarification can be obtained from the MBRU-IRB at [irb@mbru.ac.ae](mailto:irb@mbru.ac.ae)

The study spanned between January and September of 2018.

- ***Consent for Publication:*** Not Applicable
- ***Competing interest declaration:*** YB is the recipient of funding from Pfizer, Amgen and the Paragon Group to conduct medical education activities in the form of continuing professional development

(CPD) and continued medical education (CME) activities. However, these funds haven't been used in this study depicted in the manuscript. **Other authors declare no competing interest.**

- **Funding.** No Funding was obtained for this study.
- **Author Contributions:** **AA** obtained IRB approval for the study, implemented the ASSIST questionnaire, curated the data and prepared the initial manuscript draft; **WW** analyzed the curated data using different statistical tools; **FAAR** and **CT** proof-read the manuscript and provided YB with constructive and practical inputs; **DD** helped in study design and provided logistical support; **YB** put-forward the initial design of the study, drafted the final version of the manuscript and explored the statistical data in the light of different learning theories.
- **Acknowledgment.** **YB** will like to thank Dr. Aida Azar, the course director of Student Research project. Data depicted in this manuscript was collected by **AA** to fulfill the requirements of her thesis submitted as part of the course requirement.

### Availability of Data and Materials

- The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author (YB) on reasonable request.

### Authors' information

- **AA** is a fourth-year medical student at MBRU. She has basic science research experience as a student intern at the Queens University of Belfast and the Mayo Clinic. She has received awards in the region, for her work in medical education. AA's interest in medical education is particularly focused on the different approaches to learning, and the factors influencing them specifically resilience and stress-coping strategies; and on these lines, she is at present working on a research project with YB.
- **WW** is a first-year medical student at Dr. Kiran C. Patel College of Allopathic Medicine. He earned his bachelor's degree in Economics with Honors at the University of Illinois at Chicago in 2016; his senior capstone focused on health policy and economics. He then completed his master's degree in biomedical science at Rosalind Franklin University of Medicine and Science in 2017. WW's vast background in health economics, statistics, and medical sciences, along with his drive to become a

physician-scientist, earned him a position as a research assistant at the Neuro-Informatics lab at Mayo Clinic. Since then, WW has published several scientific articles focused on surgical outcomes and spine surgery.

- **FAAR** is a Lecturer of Prosthodontics at HBCDM, UAE involved in teaching postgraduate dental students. She is an Alumnus of Shiraz University, Iran and Boston University Institute of Dental Research and Education, UAE. She has a keen interest in health profession education research, focusing mostly on evaluating learners' perceptions of their educational environments. She is currently working with YB on a study in syllogism with DREEM.
- **CT** is a Learning Designer with expertise in the fields of healthcare simulation and learning and teaching enhancement through technology-enabled learning. He is also experienced in both project planning and operationalization of medical simulation and digital learning services in European and Middle Eastern Hospital and University environments.
- **DD** is a Professor Emeritus at the University of Toronto; Visiting Professor, at MBRU. A family physician and a prominent figure in continuing education in Canada and the US, his rigorous, outcome-based focus on CME has garnered grants totaling several million dollars, and publication of roughly 150 peer-reviewed papers, dozens of abstracts, book chapters, and three major books.
- **YB** was awarded his PhD by The National University of Singapore, following which he was an NIH-fellow at The Scripps Research Institute, La Jolla, USA; and Alexander Von Humboldt fellow at the Max-Planck Institute for Biophysical Chemistry, Germany. He is currently, an Associate Professor of Biochemistry and with clinical research, is involved in teaching medical students, curriculum and course-design and delineation of student assessment policies. His research in medical education is primarily focused on epistemology, ethnography, delineation of strategies for integration and contextualization of basic sciences in the medical curriculum to inform clinical practice and Pierre Bourdieu's multifaceted concept of habitus with the aim to understand the relation between collective and individual trajectories of medical students as they navigate complex evolutions in undergraduate medical education.

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## Tables

Table: 1 – Modified ASSIST Questionnaire

Item no.	Item	1	2	3	4	5
Approaches to Studying						
1	I organise my study time carefully to make the best use of it.					
2	I find I have to concentrate on just memorising a good deal of what I have to learn					
3	Often, I feel I'm drowning in the sheer amount of material we're having to cope with					
4	I look at the evidence carefully and try to reach my own conclusion about what I'm studying					
5	It's important for me to feel that I'm doing as well as I can on my courses*					
6	I try to relate ideas I come across to those in other topics or other courses whenever possible					
7	I tend to read very little beyond what is actually required to pass					
8	Regularly I find myself thinking about ideas from lectures when I'm doing other things					
9	I think I'm quite systematic and organised when it comes to revising for exams					
10	Much of what I'm studying makes little sense: it's like unrelated bits and pieces					
11	When I'm working on a new topic, I try to see in my own mind how all the ideas fit together.					
12	I often worry about whether I'll ever be able to cope with the work properly					
13	Often I find myself questioning things I hear in lectures or read in books					
14	I concentrate on learning just those bits of information I have to know to pass					

15	I find that studying academic topics can be quite exciting at times					
16	I keep in mind who is going to mark an assignment and what they're likely to be looking for.					
17	I work steadily through the term or semester, rather than leave it all until the last minute					
18	I'm not really sure what's important in lectures so I try to get down all I can.					
19	Ideas in course books or articles often set me off on long chains of thought of my own					
20	Before starting work on an assignment or exam question, I think first how best to tackle it					
21	I often seem to panic if I get behind with my work.					
22	When I read, I examine the details carefully to see how they fit in with what's being said.					
23	I put a lot of effort into studying because I'm determined to do well.					
24	I gear my studying closely to just what seems to be required for assignments and exams					
25	Some of the ideas I come across on the course I find really gripping.					
26	I usually plan out my week's work in advance, either on paper or in my head					
27	I keep an eye open for what lecturers seem to think is important and concentrate on that					
28	I generally make good use of my time during the day					
29	I often have trouble in making sense of the things I have to remember					
30	When I finish a piece of work, I check it through to see if it really meets the requirements					
31	It's important for me to be able to follow the argument, or to see the reason behind things					

32	I like to be told precisely what to do in essays or other assignments					
33	I sometimes get 'hooked' on academic topics and feel I would like to keep on studying them.					
Preferences for different types of course and teaching						
34	lecturers who tell us exactly what to put down in our notes					
35	lecturers who encourage us to think for ourselves and show us how they themselves think					
36	exams which allow me to show that I've thought about the course material for myself					
37	exams or tests which need only the material provided in our lecture notes					
38	courses in which it's made very clear which books we should read or refer to*					
39	courses where we're encouraged to read around the subject a lot for ourselves					
40	books which challenge you and provide explanations which go beyond the lectures					
41	books which give you definite facts and information which can easily be learned					
Academic Progress		1				9
42	Finally, how well do you think you have been doing in your assessed work overall, so far?  Please rate yourself objectively, based on the grades you have been obtaining					

Table 2: Modifications introduced in ASSIST questionnaire

Section	Content	Scale	Modification(s)
A	“What is Learning?” Conceptions of Learning	Likert Scale (1-5)	Removed (a-f)
B	Approaches to studying	Likert Scale (1-5)	33/52 questions included, 11 per learning approach.
C	Preferences for different types of course and teaching	Likert Scale (1-5) *	No modifications (9 total questions).
Additional Section	Demographics	Continuous	Age; Gender; Year of Study; Previous High School

Table: 3 – Spearman correlation to compare if students’ preferred teaching-approaches match their learning-approach

Key: Correlation P-value	Average Strategic Score	Average Surface Score	Average Deep Score	Average Surface Teaching Score	Average Deep Teaching Score
Average Strategic Score	1.0000				
Average Surface Score	-0.0761 0.5632	1.0000			
Average Deep Score	0.3587 0.0049*	-0.2975 0.0210*	1.0000		
Average Surface Teaching Score	0.0555 0.6737	0.4885 0.0001*	0.0370 0.7791	1.0000	
Average Deep Teaching Score	0.2194 0.0921	-0.5547 0.0000*	0.4571 0.0002*	-0.3499 0.0061	1.0000

*\*Statistically Significant (p<0.05)*

Table: 4 – Correlation Among Average Learning Approaches Scores and Academic Performance

Key: Correlation P-value	Average Strategic Score	Average Surface Score	Average Deep Score	Academic Performance
Academic Performance	0.5437 0.0001*	-0.2486 0.0599	0.2339 0.0772	1.0000

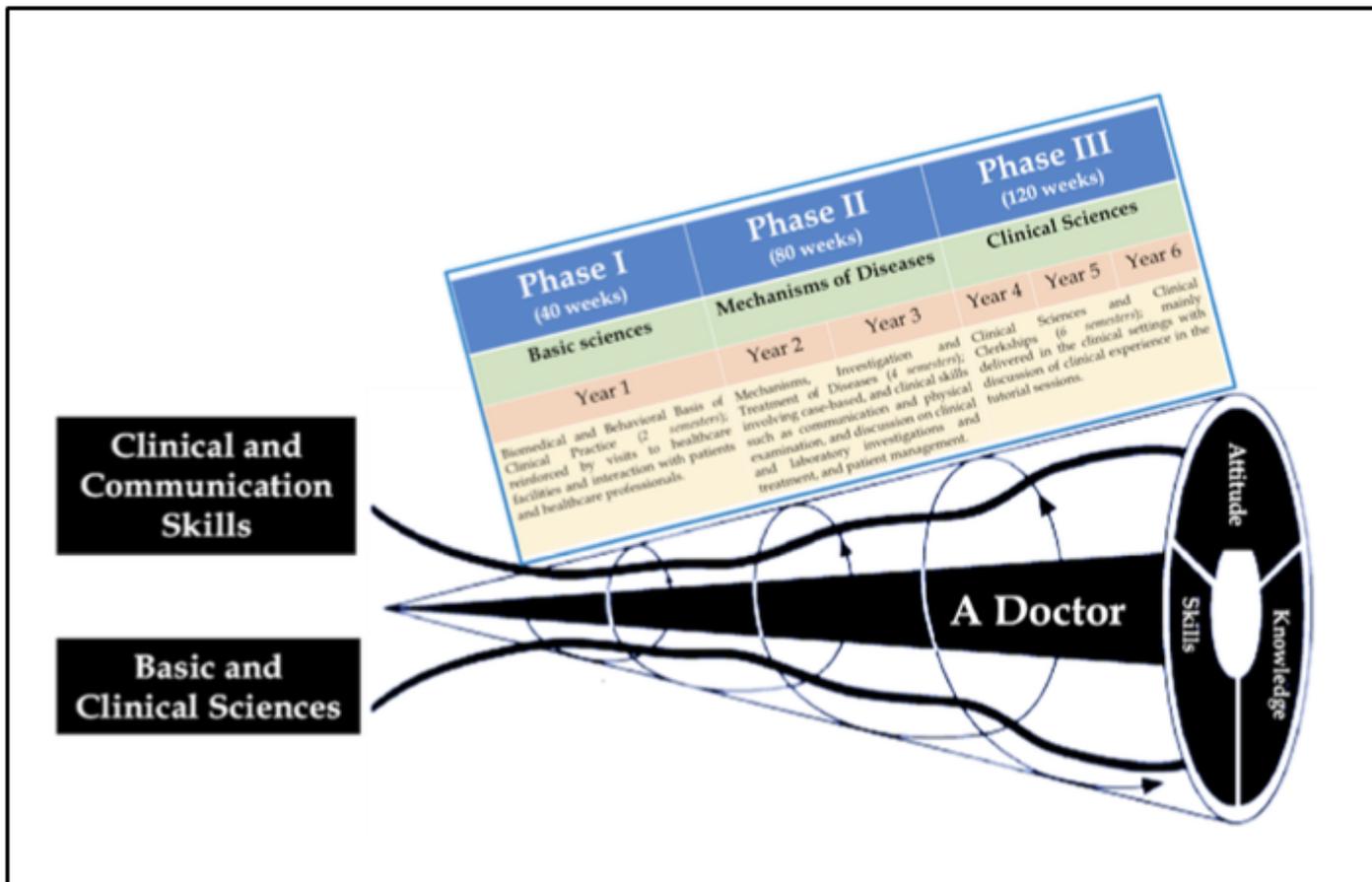
*\*Statistically significant (p<0.05)*

Table: 5 – Ordered Logistic Regression: Effect of Predominant Learning Approach on Perception of Academic Performance

Outcome: Academic Performance Score	Estimate (95%CI)	P-Value
Age (years)	0.17 (-0.32, 0.65)	0.50
Gender		
Female	base	
Male	0.02 (-1.01, 1.06)	0.96
Batch (Year of Graduation)		
Year 2	base	
Year 3	-0.10 (-1.14, 0.94)	0.85
Learning Approach		
Deep	base	
Strategic	0.74 (-0.64, 2.12)	0.30
Surface	-1.69 (-2.88, -0.51)	0.005*

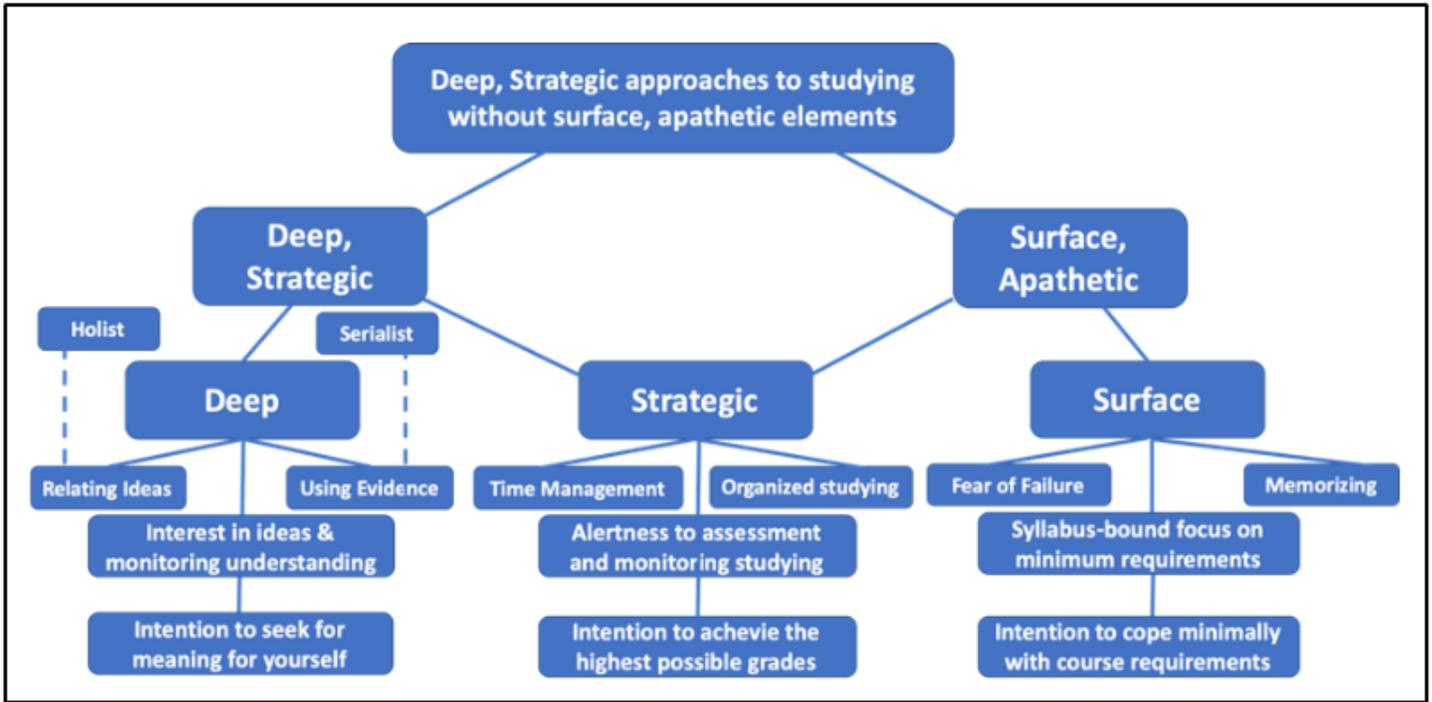
*\*Statistically Significant (p<0.05)*

## Figures



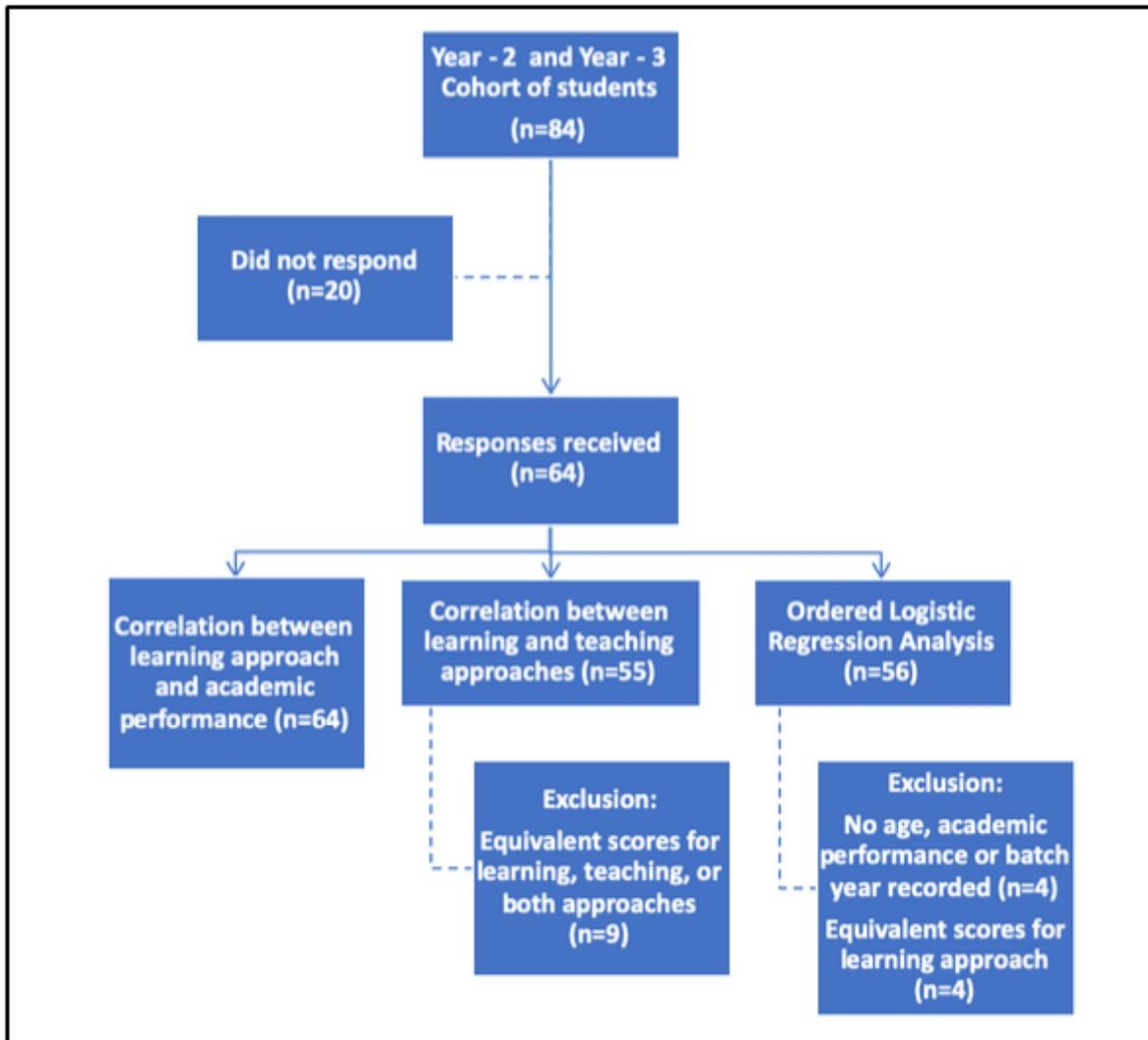
**Figure 1**

The undergraduate medical curriculum at Mohammed Bin Rashid University of Medicine and Health Sciences (MBRU). The curriculum is divided into three phases and spans over six years. (Note: Each phase of the undergraduate medical curriculum includes integrated courses and builds on the preceding one, such that the curriculum is a “spiral,” and the students repeat the study of a subject, each time at a higher level of difficulty and in greater depth.)



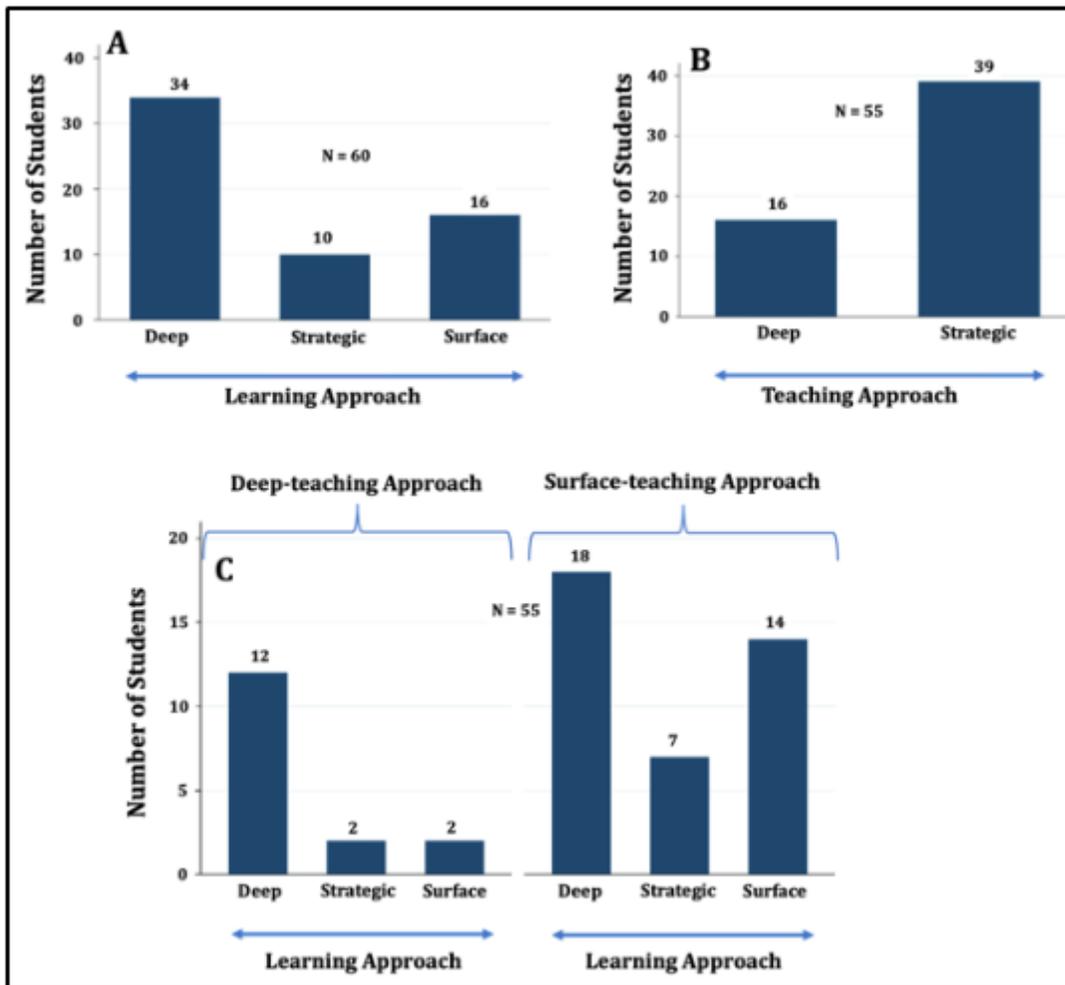
**Figure 2**

Conceptual mapping of components of effective studying from ASSIST. (Note: Redrawn with permission from Entwistle et al)



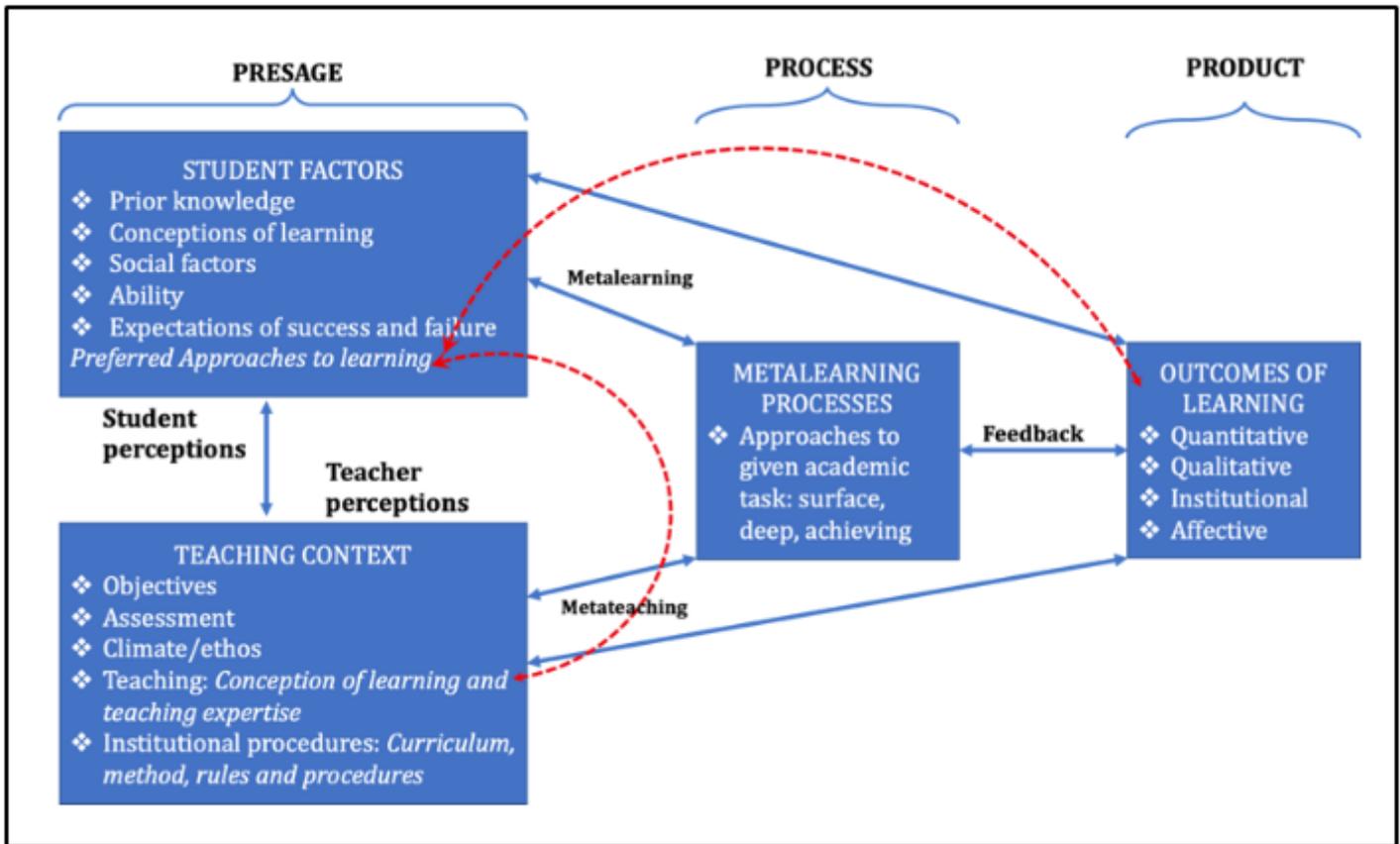
**Figure 3**

Details of exclusion at various stages of data analysis.



**Figure 4**

A. Predominant Learning Approaches Among MBRU Students; B. Predominant Teaching Approaches Among MBRU Students; C. Frequency of Predominant Learning Approaches, Classified by Predominant Teaching Approaches.



**Figure 5**

The 3P Model of Teaching and Learning. The model describes the factors which influence whether a student will take strategic, deep or a surface-learning approach. The model shows how student factors interact with the teaching context during the learning activities and lead to the attainment, or non-attainment, of the learning outcomes. They argue that the instructor is responsible for the design and structure of the learning environment and that the student is responsible for engaging appropriately with the activities. In line it is important that we map the students' learning approaches with their preferred teaching approach, which has been pursued in this study (indicated by the red dotted lines).

## THE FEYNMAN TECHNIQUE

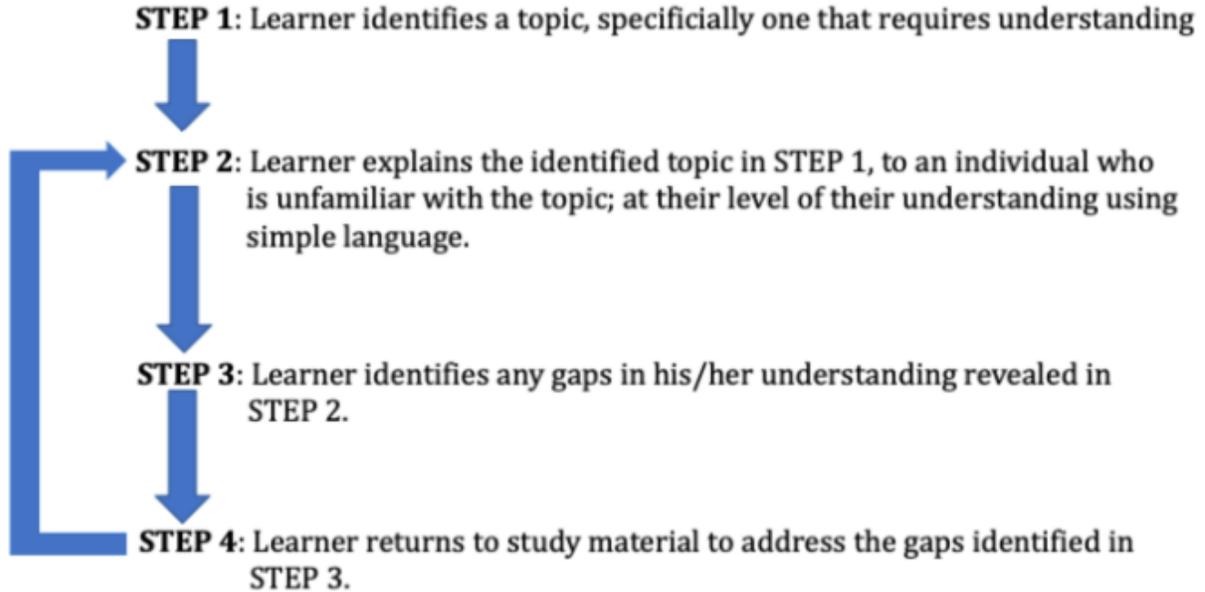
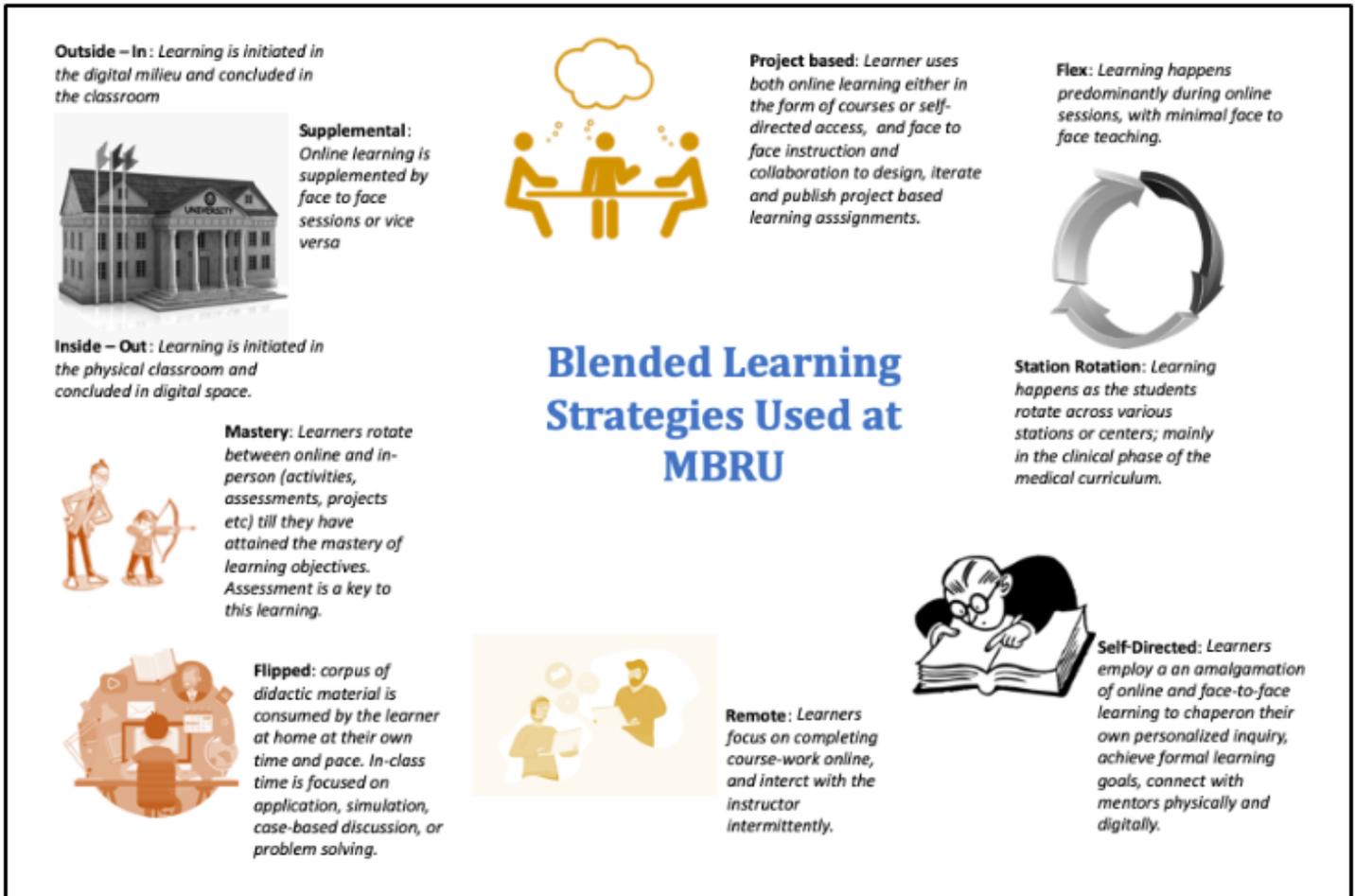


Figure 6

The Feynman Technique. The Feynman Technique is a mental model that was coined by Nobel-prize winning physicist Richard Feynman. Known as the "Great Explainer," Feynman was celebrated for his capability to lucidly demonstrate dense topics like quantum physics for practically anybody. The Feynman Technique is laid out clearly in James Gleick's 1993 biography, "Genius: The Life and Science of Richard Feynman." In the book, Gleick elaborates on this method, which is attributed to be the key to Feynman's extraordinary success in his exams at Princeton University (Note: This technique has been used successfully by one of the authors in disseminating complex concepts in Biochemistry with success, where it was discovered that the technique stimulates self-learning in students with success (Banerjee et al. unpublished results). The technique is presented here such that readers can effectively adapt during their own teaching.)



**Figure 7**

The different Blended Learning Strategies in practice at MBRU. These strategies couldn't be assessed using modified ASSIST questionnaire, which is one of the limitations of the ASSIST questionnaire and will be addressed in the future studies. (Note: These strategies are presented such that readers can integrate them in their pedagogy.)