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Exploring the perception and challenges encountered by undergraduate medical students towards the development of self-regulated learning: a mixed method study.

Shaikha Alzaabi, Jeyaseelan Lakshmanan, Mandy Mofatt

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Exploring the perception and challenges encountered by undergraduate medical students towards the development of self-regulated learning: a mixed method study.

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Abstract

Background: Self-regulated learning (SRL) is an essential attribute of future healthcare professionals consisting of four components: planning, monitoring, evaluation, and reflection. There is global consensus on the lack of medical students' ability to self-regulate their learning, however little is known about the challenges they encounter upon attempting to do so. This study aimed to assess the perception of self-regulated learning amongst undergraduate medical students and identify factors that might hinder its development.

Objective: This study was conducted to assess the perception of undergraduate medical students at Mohammed Bin Rashid University (MBRU) towards SRL and explore the challenges they encounter in developing this skillset.

Methods: A mixed method approach was adopted where a 5-Likert-scale questionnaire was used to collect quantitative data on perception of SRL from all undergraduate medical students (n=300) at MBRU. Semi-structured interviews were used qualitatively to explore challenges encountered by students when attempting to regulate learning. Quantitative data obtained underwent frequency, factorial and comparative statistical analysis whilst qualitative data was thematically analysed.

Results: 78 students, 41 pre-clinical and 37 clinical, completed the questionnaire. An overall positive perception of SRL was observed with the highest score of agreement (61.5%) was for eagerness to improve learning. The second highest score of agreement (56.4%) was for pro-actively establishing learning goals while the highest score of disagreement (46%) was for the ability to monitor one's learning. There were no significant differences between the scores of clinical and pre-clinical students for the three main domains identified by factorial analysis of the perception questionnaire: Plan learning (P=0.811), monitor learning (P=0.136) and evaluate learning (P=0.752). The following six themes emerged from thematic analysis of the semi-structured interviews: life-long-learner, evaluation & reflection, learning strategies, personal challenges, curriculum & assessment, and lack of guidance on learning strategies. Furthermore, it was perceived that clinical students displayed a deeper understanding of SRL. Finally, students experimented with a range of learning strategies in an attempt to identify those that were better aligned with their learning needs and fulfilled curricular requirements.

Conclusions: Students seemed to appreciate the value of SRL in preparing them to be competent healthcare professionals but still lacked metacognitive awareness. A number of modifiable barriers including lack of guidance, and a predominant didactic-based curriculum and assessment were identified. It is recommended to monitor medical students' self-regulated learning early in the course of their undergraduate degree and deliver appropriate intervention to stimulate development of this skillset. Clinical Trial: -

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Keywords: Self-regulated learning; undergraduate; medical students; lack of guidance; learning strategies.

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Introduction

Background

Self-Regulated Learning (SRL) is a term that describes students who are metacognitively, motivationally, and behaviorally invested in their own learning process [1]. It constitutes a central pillar of medical education and is a perquisite to a career of life-long-learning with many studies attempting to better understand this skillset [2, 3, 4]. Various models have evolved over the years to illustrate the psychological mechanisms underlying SRL [5] and consensus has been reached on four main 'operational components' aka skillsets: planning/ goal setting, monitoring, evaluation, and reflection [6].

The planning/goal setting skillset is much more complex than simply 'passing the exam'. The process is more often opportunistic and flexible, involving identifying personalised learning goals by the learner, followed by detailed planning on how to achieve them in view of one's academic abilities and available resources [7].

The monitoring component of SRL, described as the extent to which learning has been achieved [8] requires insight throughout the learning process to inform the learner whether a particular learning strategy should be continued, adjusted, or replaced [6]. Finally, the evaluation and reflection skill sets allow learners to assess 'why' they failed to attain a particular goal and 'how' they can redirect efforts to achieve it in the future [8].

SRL and medical education

One of the main objectives of medical education is to prepare students for a lifetime commitment to learning [9]. Therefore, SRL is an exceptionally important skill for healthcare professionals to meet the continued expectations of levels of competency in a rapidly changing world of medicine [10].

Literature has highlighted inadequacies in medical students' self-regulatory mechanisms [11]. This poses the important question of why they lack this skillset in the first place. From a global perspective, it is well known that progression from secondary school to higher education is a challenging period of adjustment. This challenge can be magnified for medical students due to the complexity and breadth of knowledge and skills to be acquired in the curriculum and the consequent cognitive overload and increased rates of emotional burnout [12].

There has been much emphasis on the importance of instructional design to enhance SRL. Recommendations have included the use of teaching methods that cultivate active learning, planning and decision making [13]. Examples of these can be seen in small group teaching, approaches such as problem-based learning (PBL) and team-based learning (TBL) where teachers and students switch roles. This can create a favorable learning environment that motivates students to become more proactive and develop independent learning skills [14].

SRL in the middle east

Previous studies in the middle east [15, 16] have shown that undergraduate medical students who demonstrated higher levels of SRL had better academic performances than their counterparts with lower levels. However, studies on SRL in this part of the world are still few and are yet to explore the individual components of SRL and to what extent, if any, they evolve over the course of a medical degree. It may be that students brought up in exam-oriented school curricula, such as those in the middle east, will not be motivated to develop SRL. This may then be manifested in the drop in their

grades upon commencing academically demanding careers such as medicine, dentistry, or law. Such students have probably been accustomed to much more directed guidance and learning support from teachers, leading to less of a need to develop metacognitive learning strategies [17]. In recent years, much effort has been invested to reform school curricular in the middle east by incorporating more active learning styles and reflective dimensions [18]. Nevertheless, it could be argued that school curricula are still far from ready to enable SRL.

Rational for the study and Research questions

In summary, there is global consensus that medical students' ability to self-regulate their learning is key for a career committed to life-long-learning. However, little is known on the insight and perception of medical students towards SRL. Moreover, modifiable barriers that hinder their development of this skill remain somewhat elusive and opportunities to inform curricular interventions to foster it earlier in their medical careers have not been sufficiently explored. Therefore, this study aimed to better understand the perception of undergraduate medical students towards SRL within the local context in the United Arab Emirates (UAE).

The study attempted to answer the following questions:

1- What is the perception of undergraduate medical students towards self-regulated learning?

2- How does the perception of self-regulated learning and adapted learning strategies differ between clinical and pre-clinical students?

3- What are the challenges encountered by undergraduate medical students that impede the development of self-regulated learning?

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Methods

Context of the Study

The study setting was Mohammed Bin Rashid University of Medicine and Health Sciences within the UAE. The six-year Bachelor of Medicine and Bachelor of Surgery (MBBS) program at the university is composed of three pre-clinical years of basic science teaching followed by three clinical years. Various fundamental courses are delivered during the pre-clinical phase over a duration of two years including: Anatomy, physiology, organic chemistry, history of medicine, pathology pharmacology, research methods and medical terminology. Throughout the clinical years, students rotate across a range of specialties at affiliated hospitals including internal medicine, psychiatry, paediatrics, surgery, emergency medicine, obstetrics and gynecology and family medicine.

Research Design

A mixed-methods approach was adapted with triangulation of quantitative and qualitative data from two sources: students' perception of SRL questionnaire (quantitative) and semi structured interviews (qualitative) (Figure 1). This study was approved by MBRU- Institutional Review Board (Reference # MBRU IRB-2022-96).

Recruitment

Approximately 300 undergraduate medical students across all six cohorts of the MBBS program were recruited to participate in the study. The sampling strategy used was the voluntary response non-probability sampling and recruitment was done via email invitations. The invitation email was sent by the principal investigator before commencing the study providing a brief description of the study and a digital link to complete the questionnaire. The email gave students an option to further participate in the qualitative component of the study, namely the semi-structured interviews. A consent form outlining details on confidentiality and autonomy was attached to the email for the students to sign upon accepting the invitation.

Data Collection

Students' Perception of Self-regulated learning (Quantitative)

A 5-point Likert-type scale (1: strongly disagree, 2: disagree, 3: neutral, 4: agree and 5: strongly

agree) pre-validated questionnaire [19] composed of 10 items was adapted and used to anonymously assess participants' perception of SRL (Table 1). Participants completed the questionnaire online via a Microsoft office link included in the recruitment email together with details on year of study and gender. The data collected via Microsoft Office form was then input into an SPSS database for analysis.

Table 1 Cheng et al (2010) Questionnaire adapted to assess Participants' perception of SRL

1- I am familiar with the concept of self-regulated learning.	☐ Strongly disagree	☐ Disagree	☐ Neutral	☐ Agree	☐ Strongly agree
2- I can pro-actively establish my learning goals.	☐ Strongly disagree	☐ Disagree	☐ Neutral	☐ Agree	☐ Strongly agree
3- I am good at planning my learning time effectively.	☐ Strongly disagree	☐ Disagree	☐ Neutral	☐ Agree	☐ Strongly agree
4- I have a wide range of learning strategies appropriate to my learning needs.	☐ Strongly disagree	☐ Disagree	☐ Neutral	☐ Agree	☐ Strongly agree
5- I know how to find resources for my learning.	☐ Strongly disagree	☐ Disagree	☐ Neutral	☐ Agree	☐ Strongly agree
6- I am able to monitor my own learning process.	☐ Strongly disagree	☐ Disagree	☐ Neutral	☐ Agree	☐ Strongly agree

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7- I can evaluate my own learning outcomes.	☐ Strongly disagree	☐ Disagree	☐ Neutral	☐ Agree	☐ Strongly agree
8- I am eager to constantly improve and excel in my learning.	☐ Strongly disagree	☐ Disagree	☐ Neutral	☐ Agree	☐ Strongly agree
9- I am comfortable expressing my learning needs to others.	☐ Strongly disagree	☐ Disagree	☐ Neutral	☐ Agree	☐ Strongly agree
10- I believe that self-regulated learning will help me in the future.	☐ Strongly disagree	☐ Disagree	☐ Neutral	☐ Agree	☐ Strongly agree

Semi-structured interviews (Qualitative)

Semi-structured interviews were conducted online via the Microsoft teams platform using six guiding questions generated based on existing literature [20, 21] and designed to complement the questionnaire (Table 2). Probing was used to stimulate the interview especially in areas that needed further clarification. Audio-recordings from the interviews were downloaded from Microsoft Team's software and saved into a password protected folder on the principal investigators' laptop. Data was collected by manual transcription of the participants' responses to the guiding questions from the audio files and saved into anonymised word documents labelled with an assigned identification number for each participant in preparation for analysis.

Table 2 Semi-Structured Interviews' guiding Questions

1	What does the term 'self-regulated learning' mean to you?
2	Can you outline some learning strategies you adapt to prepare for theory exams? Practical exams?
3	Do you utilise any technology-enhanced tools to aid your learning? if so, could you name a few
4	If you find difficulty understanding a concept relating to a topic, would you take the time to explore it on your ow account? If so, what resources do you consult?
5	What difficulties/challenges (personal or institution-related) do you face when trying to develop your own learning strategies?

6	In your opinion, what kind of support do students need to be able to self-regulate their own learning?

Statistical Analysis

Students' Perception of Self-regulated learning (Quantitative)

Quantitative analyses of the data, collected using the respective questionnaire, were done using IBM SPSS statistics version 25 (Armonk, NY: IBM Corp.). Cronbach's Alpha and inter-item correlation was used to test the reliability of the questionnaire. Factorial analysis was used to test the construct validity of the questionnaire and classify its items into domains. Comparative analysis of the identified domains was conducted with regards to gender of participants and their phase of study (clinical vs pre-clinical). Finally, a descriptive analysis focused on the frequency distribution of the questionnaire items and the degree of agreement with each. P-value of less than 0.05 was used as the level of significance.

Semi-structured interviews (Qualitative)

Transcribed data from the qualitative component of the study underwent reflexive thematic analysis [22] using the qualitative data analysis software Delve [23]. The analysis proceeded with the following six steps: 1) familiarisation with the data 2) generation of initial codes 3) search for themes 4) review potential themes 5) definition and naming of themes and then 6) production of the report [22]. Familiarization involved transcription of the interviews' audio recording by the main author (SA) to interrogate and better understand the raw data at hand. This was followed by an inductive navigation of the entire transcription to tag selected excerpts of potential meaning and generate the initial set of codes (Figure 2). This step aimed to capture insights within the dataset that were relevant to the research questions. Once the code labels were finalised, codes with shared meaning were clustered into themes and sub-themes each forming a facet of an overarching central concept. Themes were reviewed by the research team and then used to construct a thematic map by SA, outlining the relationship between themes, sub-themes and codes for each of the two components of the study (perception and challenges).

Results

Students' perception of self-regulated learning (Quantitative)

The total number of respondents to the questionnaire was 78 out of approximately 300 (response rate of 26%). Participants were aged between 18 and 25 years old, consisting of 57 (73%) female students and 21 (27%) male students. Out of the 78 participants, 41 (53%) were pre-clinical students and 37 (47%) were clinical students. The questionnaire had a Cronbach's Alpha score of 0.51. The mean inter-item correlation was 0.120. The mean (SD) score of agreement calculated by cross-bonding calculations was 36.76 (±4.46).

Findings from the frequency analysis (Table 3) demonstrated "agreement" being the majority of items' scores. The highest score of agreement was for question 8 "I am eager to constantly improve and excel in my learning" to which 61.5% of the participants strongly agreed. The second highest score of agreement was for question 2 "I can pro-actively establish my learning goals" to which 56.4% of the participants agreed. The majority of the participants agreed that they have a wide range of learning strategies (question 4, 60.2%) and are able to find appropriate resources for learning (question 5, 68%). The highest score of disagreement was for question 6 "I am able to monitor my own learning process" which 46.2% of the participants disagreed with.

Table 3 Frequency Analysis of perception questionnaire

Question	Answer code	%
1- I am familiar with the concept of self-regulated learning.	Strongly Disagree	2.56%
	Disagree	7.70%
	Neutral	12.82%
	Agree	52.56%
	Strongly Agree	24.36
2- I can pro-actively establish my learning goals.	Strongly Disagree	1.28%
	Disagree	3.85%
	Neutral	17.95%
	Agree	56.41%
	Strongly Agree	20.51%
3- I am good at planning my learning time effectively.	Strongly Disagree	3.85%
	Disagree	19.23%
	Neutral	20.51%
	Agree	39.74%
	Strongly Agree	16.67%
4- I have a wide range of learning strategies appropriate to my learning needs.	Strongly Disagree	0.0%
	Disagree	19.23%
	Neutral	20.51%
	Agree	47.44%
	Strongly Agree	12.82%
5- I know how to find resources for my learning.	Strongly Disagree	0.0%
	Disagree	7.69%

	Neutral	24.36%
	Agree	43.59%
	Strongly Agree	24.36%
6- I am able to monitor my own learning process.	Strongly Disagree	14.10%
	Disagree	46.15%
	Neutral	16.67%
	Agree	1.28%
	Strongly Agree	21.80%
7- I can evaluate my own learning outcomes.	Strongly Disagree	0.0%
	Disagree	20.51%
	Neutral	29.49%
	Agree	37.18%
	Strongly Agree	12.82%
8- I am eager to constantly improve and excel in my learning.	Strongly Disagree	0.0%
	Disagree	32.05%
	Neutral	5.13%
	Agree	1.28%
	Strongly Agree	61.54%
9- I am comfortable expressing my learning needs to others.	Strongly Disagree	1.28%
	Disagree	12.82%
	Neutral	20.51%
	Agree	43.59%
	Strongly Agree	21.8%
10- I believe that self-regulated learning will help me in the future.	Strongly Disagree	0.0%
	Disagree	3.85%
	Neutral	8.97%
	Agree	35.90%
	Strongly Agree	51.28%

Domains: Red=Plan; Green=Monitor; Blue=Evaluate

Three domains (plan, monitor and evaluate learning) were confirmed from factorial analysis. The questionnaire items constituting the domains are colour-coded (Table 3) with red for the 'plan' domain, green for 'monitor' and blue for 'evaluate', Further analysis was then done on these domains to compare the extent to which participants were familiar with the individual SRL components (a proxy for identifying any gaps in perception). The scores for each questionnaire item were added according to the following code: strongly agree 5, agree 4, neutral 3, disagree 2, strongly disagree 1. Thereafter, the collective scores from the questions for each domain (ranging from a minimum of 3 to a maximum of 15) were then averaged to obtain a mean score for each domain (SD). Items 1, 2, 3, and 5 constituted the 'plan learning' domain with 90% of the participants responding as agree or strongly agree and a mean (SD) of 15.6 (2.5) suggesting that the majority of the participants agreed. Items 4, 6 and 7 fell into the 'Monitor learning' domain where about 8% of the participants responded as disagree,14% as neutral and 35% as either agree or strongly agree. As for the 'evaluate learning' domain, consisting of items 8, 9 & 10, about 4% of the participants responded as strongly disagree or disagree, 5% responded as neutral and 80% responded as agree or strongly agree. The mean

(SD) for this domain was 12.5 (1.8) suggesting that most of the participants agreed. Therefore, it seems that the majority of the participants had a highly positive perception of the plan and evaluate components but not as much of the monitor component. It appears that Item 6 might have skewed the results in the opposite direction which is in line with findings from the descriptive analysis mentioned earlier.

Results from the comparative analysis using T-test for the three identified domains (Table 4) demonstrated that male participants had very similar mean scores compared to their female counterparts across the three domains. Likewise, the phase of study did not have an effect on scores when clinical and pre-clinical participants were compared.

Table 4 Comparative analysis using t-tests of the three identified domains.

		Monitor learning		
		Mean	Standard Deviation	P Value
Gender				
	Male	10.71	2.24	0.628
	Female	10.42	2.40	
Phase of study				
	Pre-clinical	10.88	2.15	0.136
	Clinical	10.08	2.52	
		Evaluate learning		
		Mean	Standard Deviation	P Value
Gender				
	Male	12.62	2.25	0.905
	Female	12.56	1.75	
Phase of study				
	Pre-clinical	12.51	1.96	0.752
	Clinical	12.65	1.81	

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		Plan learning		
		Mean	Standard Deviation	P Value
Gender				
	Male	16.00	2.86	0.446
	Female	15.49	2.50	
Phase of study				
	Pre-clinical	15.56	2.55	0.811
	Clinical	15.70	2.68	

Thematic analysis of semi-structure interviews (Qualitative)

A total of six participants took part in semi-structured interviews. The interviews were anonymised upon transcription and each participant was given a unique personal identifiers (P1-P6). Four of the participants were clinical students (one in fourth year, one in fifth and two in sixth year) whilst the remaining two were pre-clinical students (one in first year and the other in second). Five of the six participants were female, and the duration of the interviews ranged from fifteen to forty-five minutes. Clinical participants offered more detailed answers to the guiding questions and more than often volunteered examples to elaborate on their ideas. As such, interviews were longer with these participants. Analysis of the data collected from the semi-structured interviews' transcriptions led to generation of six key themes (three relating to perception while the other three to challenges) and six sub-themes (Figure 3).

Theme 1: Life-long learner

Participants recognized a range of essential attributes of a life-long learning healthcare professional including time-management, setting goals, motivation, self-discipline, accountability and maturity. Pre-clinical participants seemed to appreciate the need to have ownership of one's learning while clinical participants had more insight into the necessity of SRL for future healthcare professionals to be able to better care for their patients.

Theme 2: Evaluation & reflection

All of the participants seemed to appreciate the value of reflective practice for a healthcare professional. However, only one of the clinical participants displayed some understanding of the evaluation component of SRL explaining that if objectives were not achieved then it would

be necessary to change the approach to learning.

Theme 3: Learning strategies

Participants sounded ‘elated’ as they described the various learning strategies upon answering guiding question number 2 ‘Can you outline some learning strategies you adapt to prepare for theory exams? Practical exams?’. Creating personalized notes was a unified key strategy amongst all the participants that took on variable forms. On the other hand, collaborative learning through study groups was a favourable strategy amongst most in preparation for their objective structured clinical examination (OSCE) An interesting observation was the heavy dependence of participants on the use of technology-enhanced learning tools (TELTs) to aid their learning. Time management appeared to be a powerful element of a goal-oriented learning strategy. Participants expressed the need to plan and organize their learning in advance to better prepare for their exams, especially clinical participants who expressed the need to shift to more time-efficient learning strategies that were outside their comfort zone upon embarking onto their clerkships.

Theme 4: Personal challenges

Participants were more comfortable seeking help from a fellow peer if they struggled with their studies rather than reaching out to faculty. There seemed to be a general pattern of uncertainty amongst participants with regards to the learning style most appropriate to their level of study within the MBBS program which has caused much fear and anxiety. Pre-clinical participants were particularly overwhelmed by the amount learning material upon commencing the program.

Theme 5: Lack of guidance on learning strategies

Most of the participants mentioned a trial-and-error approach towards developing their learning strategies which they attributed to a lack of guidance and believe resulted in decremental effects on their grades. Furthermore, participants expressed the need for guidance tailored to their learning needs upon commencing the MBBS program.

Theme 6: Curriculum & assessment

With a tone of hesitation, participants mentioned a number of deficiencies in the pre-clinical curriculum structure and assessment. They expressed that it is based on memorization, delivered mostly via traditional didactic teaching, and consequently assessed through recall question exams which left no motivation to develop SRL.

Relationship between Key themes

Some of the key themes were connected either in a cause-and-effect manner or as relatable (Figure 4). The personal challenges reported by the participants such as demotivation, uncertainty about the most appropriate learning style or even being overwhelmed by the learning content seemed to be a direct consequence of the lack of guidance on how to best approach a medical curriculum on a tight timeline. Consequently, participants found themselves in a position where they had to ‘experiment’ with various learning techniques in order to find a few that were useful.

Comparison between clinical and pre-clinical students

Throughout the course of the interviews, the following two main differences were noted between pre-clinical and clinical students:
1) Perception of SRL: although both clinical and pre-clinical participants stated that they are not familiar with the term SRL, the former did seem to have a deeper understanding of the various dimensions involved including reflection and evaluation. On the other hand, pre-clinical participants saw the concept of SRL as an opportunity for them to mature in terms of ownership of their learning process.
2) Learning strategies: the majority of learning strategies adapted by the two groups were common (Table 5). The major discrepancy was that clinical participants utilized question banks to get repetitive exposure to the same learning material (spiral learning) at regular intervals (spaced repetition) while pre-clinical participants used Technology-enhanced Learning Tools (TELTs) to accumulate sufficient notes to be memorized in preparation for their exams which were predominantly recall in nature.

Table 5 Comparison of learning strategies between clinical and pre-clinical students

Phase of study	Pre-clinical	Clinical
Learning strategy	Collaborative learning for OSCE	
	Creating own notes	
	Spaced repetition	
	TELTs- memorisation cards	TELTs- Question banks
	Systematic learning	

*OSCE=Objective Standardised Clinical Examinations; TELT=Technology-Enhanced Learning Tools

Integrated findings

Findings triangulated from the two concurrent data sources (quantitative & qualitative) were included in an iterative process of the joint display analysis (Figure 5). Seven out of the ten items from the SRL perception questionnaire complemented several codes generated from the semi-structured interviews which thereafter fed into the aligning key themes and sub-themes.
The details elicited from the semi-structured interviews aligned to the domains and elaborated the answers to the questionnaire. For instance, a positive answer to item number 4 on the questionnaire 'I have a wide range of learning strategies appropriate to my learning needs' was supplemented with the list of learning techniques outlined by participants during the semi-structed interviews. Another example is a positive answer to item number 8 'I am eager to constantly improve and excel in my learning' which aligned with the list of attributes of a life-long-learner described by the participants during the interviews.

Discussion

In this study, we explored the perception of SRL amongst undergraduate medical students and the challenges they encountered in developing this skillset. The following six themes emerged: lifelong-learner, evaluation & reflection, learning strategies, personal challenges, lack of guidance and curriculum & assessment. Findings from the study have identified a number of modifiable factors that influence medical students' regulation of their learning which might be useful to inform future interventions.

Principle Results

Perception of SRL

In relation to the first research question ' What is the perception of undergraduate medical students towards self-regulated learning?' It was evident from our findings that there was an overall positive appreciation to the value of SRL in preparing students to be competent future healthcare professionals. Three out of the six key themes emerging from the study related to the perception of SRL namely: life-long-learner, evaluation & reflection and learning strategies.
In terms of SRL components [6], the majority of participants were able to identify their own learning needs and set study goals. This aligns well with Knowle's andrological process design for the effective life-long learner theory [24] which highlights the need for learners to identify their objectives and design their learning plans. In contrast however, participants seemed to struggle to monitor the learning process itself, which could be attributed to their inability to make accurate judgments on their performances [25]. Consequently, participants overestimate their abilities, otherwise known as the 'Kruger-Dunning effect' [26] devoting them of the need to monitor their learning.
Most participants viewed 'evaluation & reflection' as the end of a learning journey rather than a step along the way with little insight into its value in guiding improvements for future learning processes. Although reflective practice is embedded into the MBBS curriculum at MBRU through reflective essays and portfolios, participants were still unable to fully comprehend its use beyond fulfilment of curricular requirements highlighting the need for guidance on how to better utilise this complex skill [27].
Although participants adapted 'multimodal' learning strategies [28, 29], their heavy dependence on TELTs was not entirely surprising considering where the current student population fits into the generational ladder. participants explained the need for a trial-and-error approach to experiment with a range of learning strategies before they can settle for a few that would best address their learning needs. Despite being a logical and justified approach to tackle the dense medical curriculum, one could argue that such a process could have been cut short if appropriate guidance and support were provided.

Challenges to developing SRL

The remaining three key themes: personal challenges, lack of guidance on learning strategies and curriculum & assessment answered the third research question 'What are the challenges encountered by undergraduate medical students that impede the development of self-regulated learning?'

participants attributed much of the struggle they experienced in developing self-regulation of their learning to the lack of guidance from faculty on how best to approach the medical curriculum. Contrary to the misconception that SRL is time-sensitive and bound to evolve with time, there is much evidence to support that SRL is in fact a skill to be taught but requires appropriate guidance and support from trained faculty [8, 30, 31].

Our findings have highlighted the negative effect of the traditional didactic pre-clinical curriculum and the consequent cognitive overload on the development of SRL. Moreover, it was evident from our study that the predominant recall-based assessments in the pre-clinical years left no opportunity for self-regulation identifying the need to reconstruct exams to address higher levels of Bloom's taxonomy earlier rather than later in the medical curriculum [32].

Personal challenges reported by our study related mainly to the fear and anxiety caused by participants inability to attain appropriate learning strategies to maintain their expected level of academic performance. It is reasonable to conclude that such anxiety may well be related to and perhaps even a direct consequence of the other challenges identified namely: the traditional didactic curriculum and lack of appropriate guidance on learning.

Comparison between clinical and pre-clinical students

To answer the second research question 'How does the perception of self-regulated learning and adapted learning strategies differ between clinical and pre-clinical students?', it seems that there was no significant difference in the perception of SRL between clinical and pre-clinical participants. Having said that however, clinical participants displayed a deeper insight and a more holistic view of SRL portrayed by their detailed responses and longer interview times. This in turn might reflect a higher level of metacognitive awareness probably acquired from time spent on clinical grounds.

Although most of the learning strategies appeared to be common between clinical and pre-clinical participants, the few differences could be attributed to their different learning needs and nature of examinations. Whereas clinical participants predominantly utilize TELTs in the form of question banks to develop clinical reasonings, pre-clinical participants make use of technology to memorize material for their recall-based exams. Therefore, it is not entirely surprising to hear participants express the need to adjust their learning from predominant memorization pre-clinically to more pattern recognition and knowledge application in the clinical years. This learning adjustment appears to be a logical 'evolution' amongst medical students in view of the transition from the safe learning academic environment to the more complex opportunistic learning on clinical grounds. [33, 20, 34, 4].

Strength and Limitations of the study

One of the strengths of this study is triangulation of data from two sources via a mixed-method approach which adds rigor and enhances the value of findings [35]. An additional quality marker of the study is its ease of replication to a larger scale of the student population.

One limitation to the study is the bias resulting from the loss of objectivity associated with an inside researcher whereby the principal investigator is a faculty that has known, taught and

assessed some of the study participants. To counteract this bias, a possible solution could have been to consider member checking [36]. Another limitation was the selection bias associated with the voluntary response non-probability sampling strategy employed by the study. Finally, due to the small sample size of students participating in the semi-structured interviews, the findings obtained may not be generalizable.

Comparison with prior work

Our findings of participants being able to set study goals, but poor monitoring of their performances is in line with other research in this area [37, 38]. However, some contrary findings were reported [39, 40] where medical students were found to focus appropriately on monitoring but to a lesser extent on planning and goal setting.

The struggle demonstrated by our participants to fully comprehend and utilize the evaluation and reflection component of SRL was echoed in another study [41] and was related to the complexity of this skill requiring continuous guidance and feedback from trained faculty to fully develop.

The observation of a deeper insight of SRL displayed by clinical participants in the study was also seen in a similar study [42] and was attributed to unique opportunities in the clinical environment fostering SRL such as direct patient interaction and clinical team dynamics otherwise not available in the academic setting.

Compared to our findings however, much of the literature reported a wider range of factors influencing students' development of SRL [42, 4, 31] such as: Social background, peer pressure, multitasking and patient interaction. A possible explanation for our limited findings on SRL challenges could have been the open and generic nature of the guiding question used (Table 2). More directive questions may have resulted in deeper descriptions of challenges encountered.

Conclusions

This study aimed to explore the perception of SRL amongst undergraduate medical students at MBRU and the challenges they encountered in developing this skill as well as highlight any difference in response between clinical and pre-clinical students.

Overall, participants had a positive perception of SRL and its value in preparing them to be competent healthcare professionals but were found to exhibit minimal insight into the interplay of the various components constituting this skill. Six key themes emerged from the study namely: lifelong-learner, evaluation & reflection, learning strategies, personal challenges, curriculum & assessment, and lack of guidance on learning strategies. Clinical participants displayed a deeper insight into the dimensions of SRL and only differed in a few learning strategies compared to their pre-clinical counterparts. This difference was allotted both to the variable nature of the assessment between the two phases and the influence of the clinical environment on self-regulation.

Most of the SRL challenges encountered were attributed to 'defects' within the curriculum structure and assessment design in addition to a lack of guidance on suitable strategies for students to approach the dense medical curriculum in a time-efficient manner.

The study findings have identified a number of modifiable factors that influenced medical students' development of SRL. In view of the outcomes, the following two parallel interventions are recommended:

1) Shift away from traditional didactic teaching by incorporating more student-centred instructional design into the medical curriculum.

2) monitor students' SRL from the early years of the MBBS program and provide tailored

guidance by trained faculty on appropriate learning strategies from the early stages of their medical degree. This guidance should also extend into the clinical clerkships to support the evolution of self-regulation during the transition period and beyond.

Further work

In terms of future directions, the plan is to extend this study to other medical schools within the UAE not only to expand the sample size for more reliable analysis but also to explore perceptions and challenges of different student populations. Moreover, it would be interesting to expand the scope of the study to compare the SRL perception and challenges with medical students in a Graduate Entry Doctor of Medicine program. This will provide new insights into the impact of academic maturity and experience on the self-regulatory mechanisms of learning.

Ethical Considerations

This study was approved by MBRU- Institutional Review Board (Reference # MBRU IRB-2022-96). Participation in the study was on voluntary basis with a written consent in accordance with the general regulation of the College of Medicine-Human Research Ethics Committee. The survey, utilized to capture the perception of the students, was anonymous and the transcriptions of the semi-structured interviews were saved on an encrypted file against personal identifiers known only to the principal investigator.

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Conflicts of Interest

The authors declare no conflicts of interest.

Abbreviations

SRL	Self-regulated Learning
MBBS	Bachelor of Medicine and Bachelor of Surgery
MBRU	Mohammed bin Rashid university
OSCE	Objective Structured Clinical Examination
PBL	Problem-based Learning
SPSS	Statistical Package for the Social Sciences
TBL	Team-based Learning
TELTs	Technology Enhanced Learning Tools
UAE	United Arab Emirates

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Supplementary Files

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Figures

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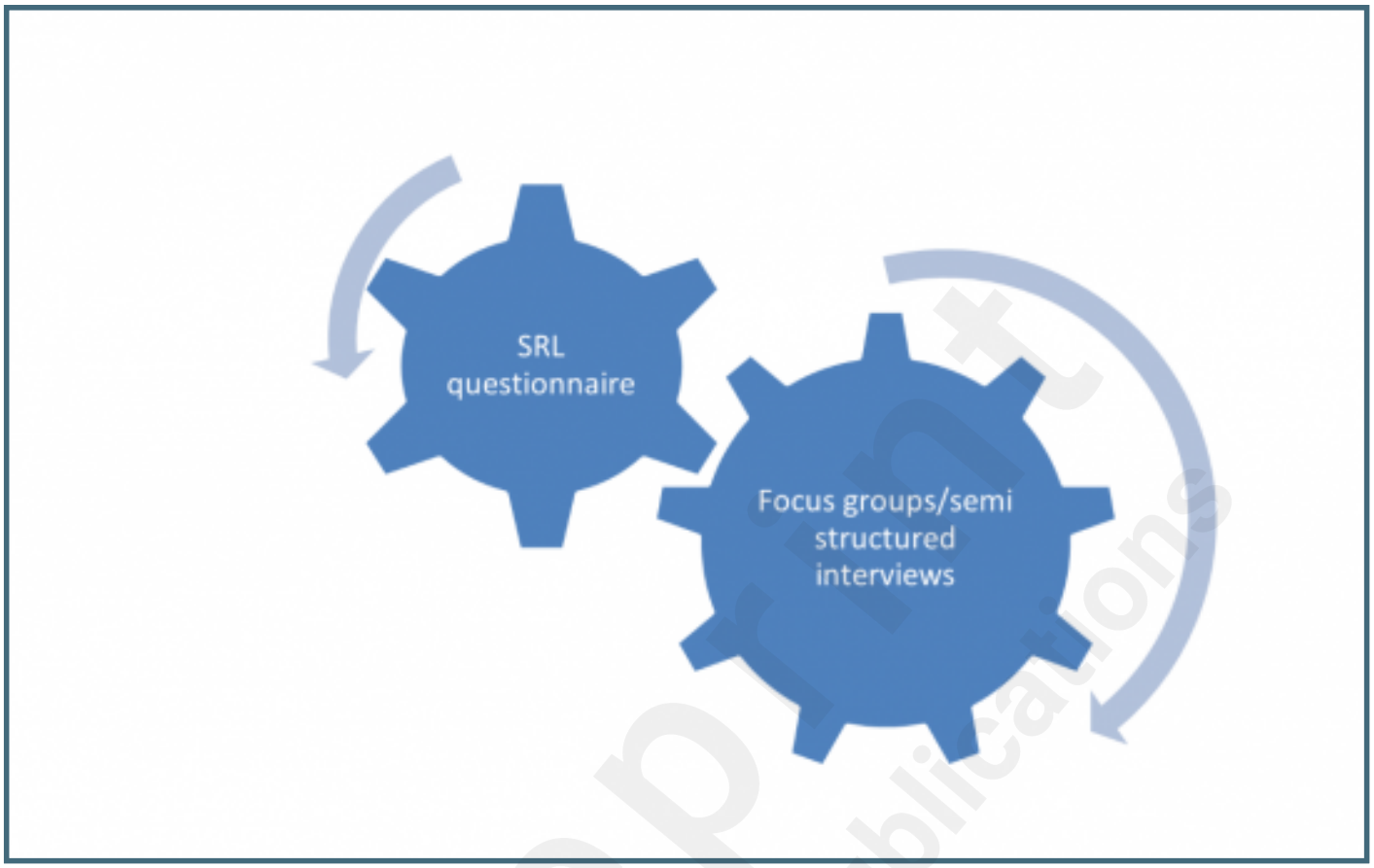
Research design. Data was triangulated from two sources.



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Transcription with codes.

P6 transcription.docx

P6 transcription

pre-clinical student

What does the term 'self-regulated learning' mean to you?

I think as far as I understand means learning at your pace , I would think there may not be a deadline and you are learning at your own time- an interesting definition for a junior student. Sub Q: and have you heard of this term before or are you trying to make sense of it at the moment? No I first heard of the term in your email.

Is there any value of being able to self-regulate your learning as a future healthcare professional?

I think as we grow and mature, we are not only taking control of our own learning but we are also relying less on others unlike school and college. As you develop more in your field you don't need a 24/7 guidance , if you need a specific question answered you can contact the professor. I think this is useful coz' when you are a doctor, you are not just a physician but also a scientist and so we need to develop our own methods and understanding. So basically finding info for our own selves rather than getting it from others and this skill is very important to develop into efficient researchers and clinicians once we graduate inshallah.

SRL is about ownership & control

SRL is about self-discipline and maturity

Can you outline some learning strategies you adapt to prepare for theory exams? Practical exams?

So for theory exams I go through the lecture slides, I don't make notes unless I really need to coz I think that's too much work so I focus mainly on active recall with flashcards and review sessions with my friends, so anything that would force me to think. For practical exam, we are still in y1 we haven't done much yet but for example for anatomy practical's I use complete anatomy which is provided by the university

Group study for exam revision

use of online resources to aid learning

Do you utilize any additional tools to aid your learning? If so, could you name a few.

I mentioned complete anatomy, there is also a flash card system called Anki which I recently tried it out and what I really like about it is that it has a feature that allows you to decide whether you found the flash card hard or easy and accordingly the software will show you the flashcard again after some time – spaced learning- this is useful because it forces you to keep up with your learning and reinforces the difficult topics.

second repetition as a learning strategy

How do you approach a difficult learning topic? What kind of resources do you consult?

So it depends on the subject, if it's a memorisation thing so like if there is something that I dint understand on the lecture slides themselves the first thing I would do is to ask my friend and if its still unclear then I reach out to the professor. The faculty are helpful, but they might take time to reply so my immediate course of action then is to reach out to YouTube.

Group study for exam revision

What difficulties/challenges (personal or institution-related) do you face when trying to develop your own learning strategies?

I think on a personal challenge is that I just came from high school where we were used to be supervised the while time and told what and when to do basically so we rarely get to take control of our own learning. Generally they were very organised but sometime I felt that the class was not that useful and I would rather use the time to study the topic on my own- so here we get a glimpse of the schooling system that fosters spoon feeding and doesn't not allow much of space or an opportunity for SRL-

Sub Q- you have mentioned earlier some learning strategies but can you tell us how you go about developing learning techniques?

Well I think the biggest help which was offered by the university is the buddy system which was very useful. My buddy gave me some resources and advice and reassurance.

In your opinion, what kind of support do students need to be able to develop self-regulated learning?

One thing that would be helpful, is for seniors to share with juniors how they would change their learning approach if they could go back in time- interesting thought- this would help us to start certain useful techniques earlier in our medical degree rather than explore them later at our own pace.

Created with the Delve Qualitative Analysis Tool

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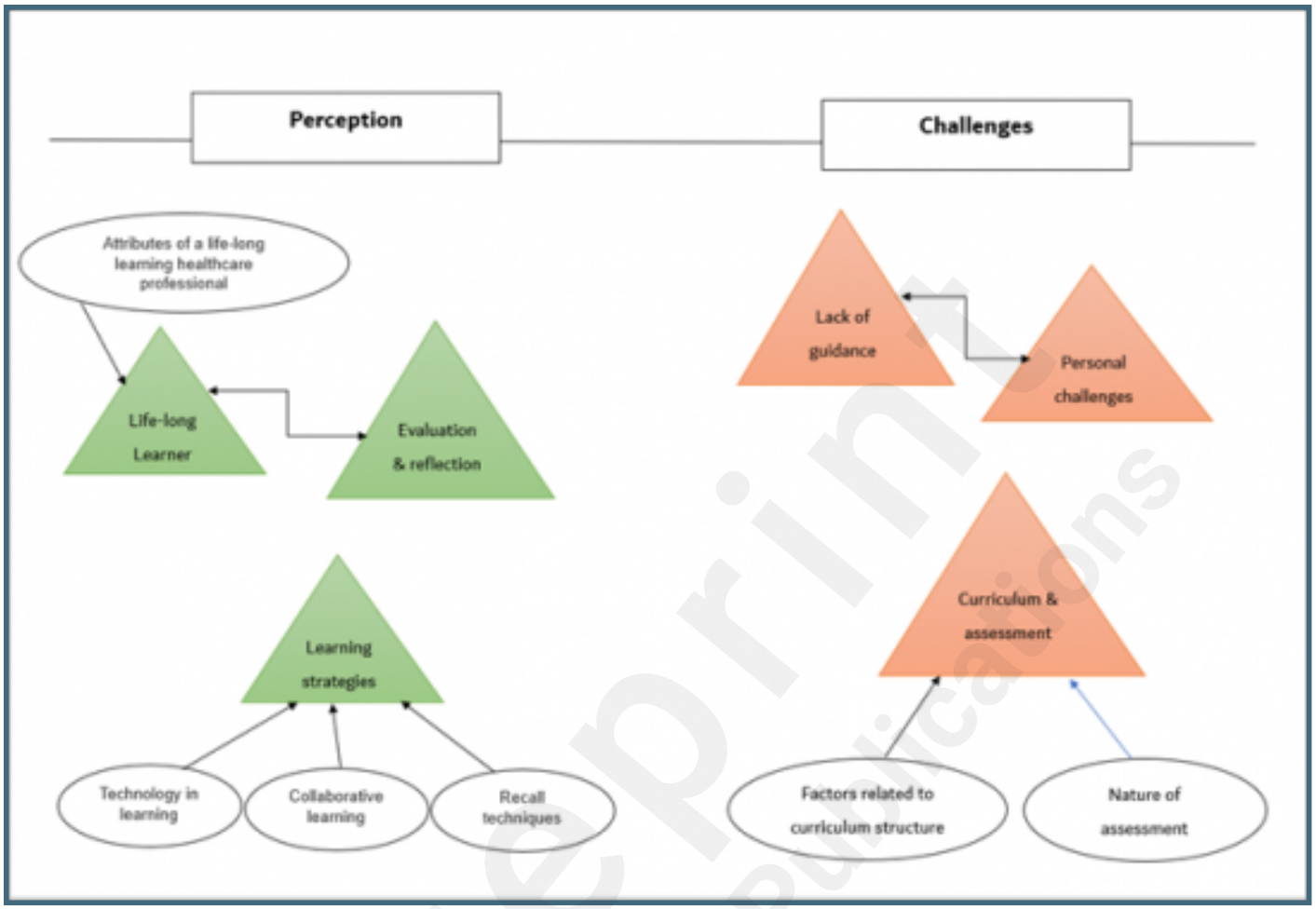
Thematic map.



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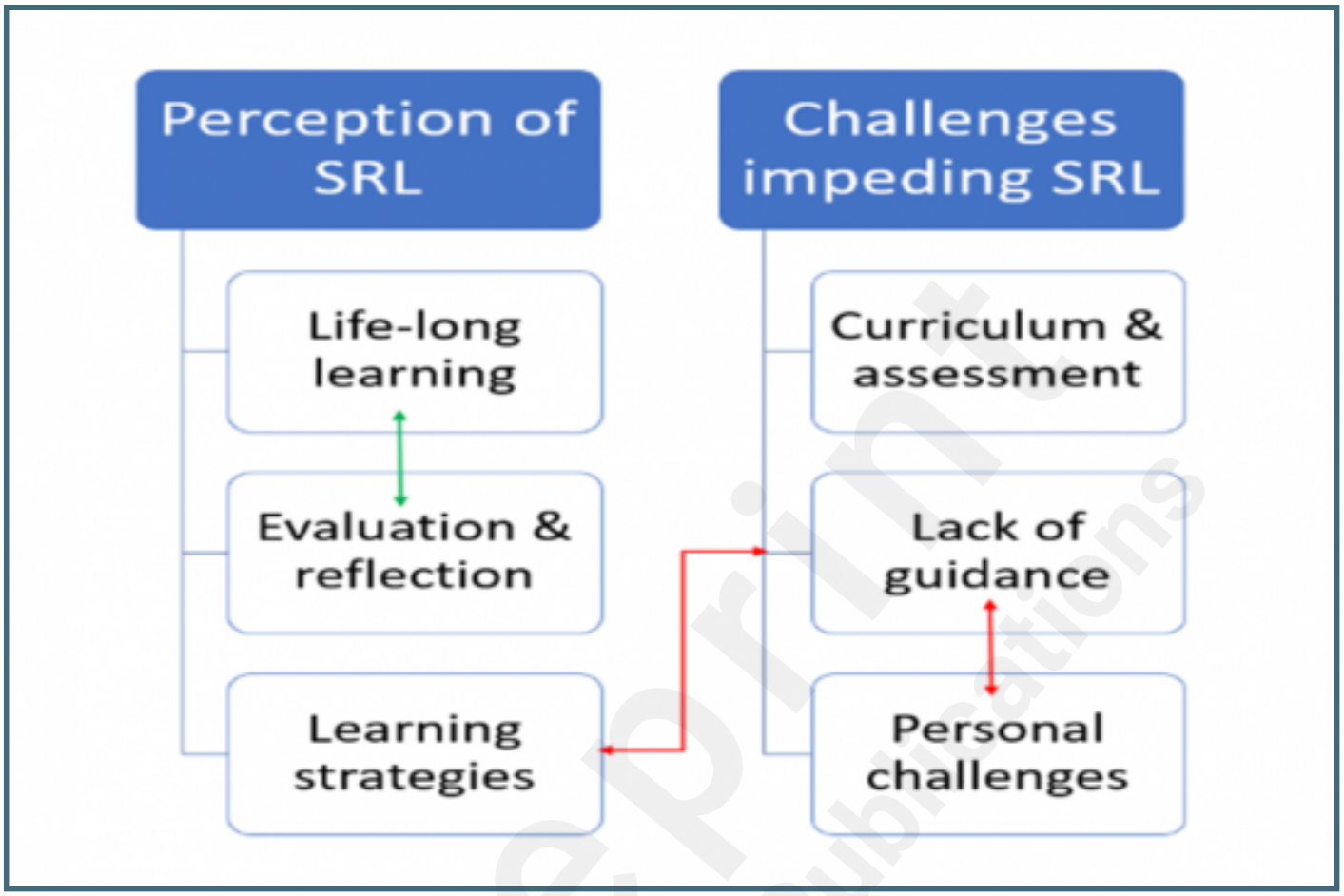
Relationship between key themes.



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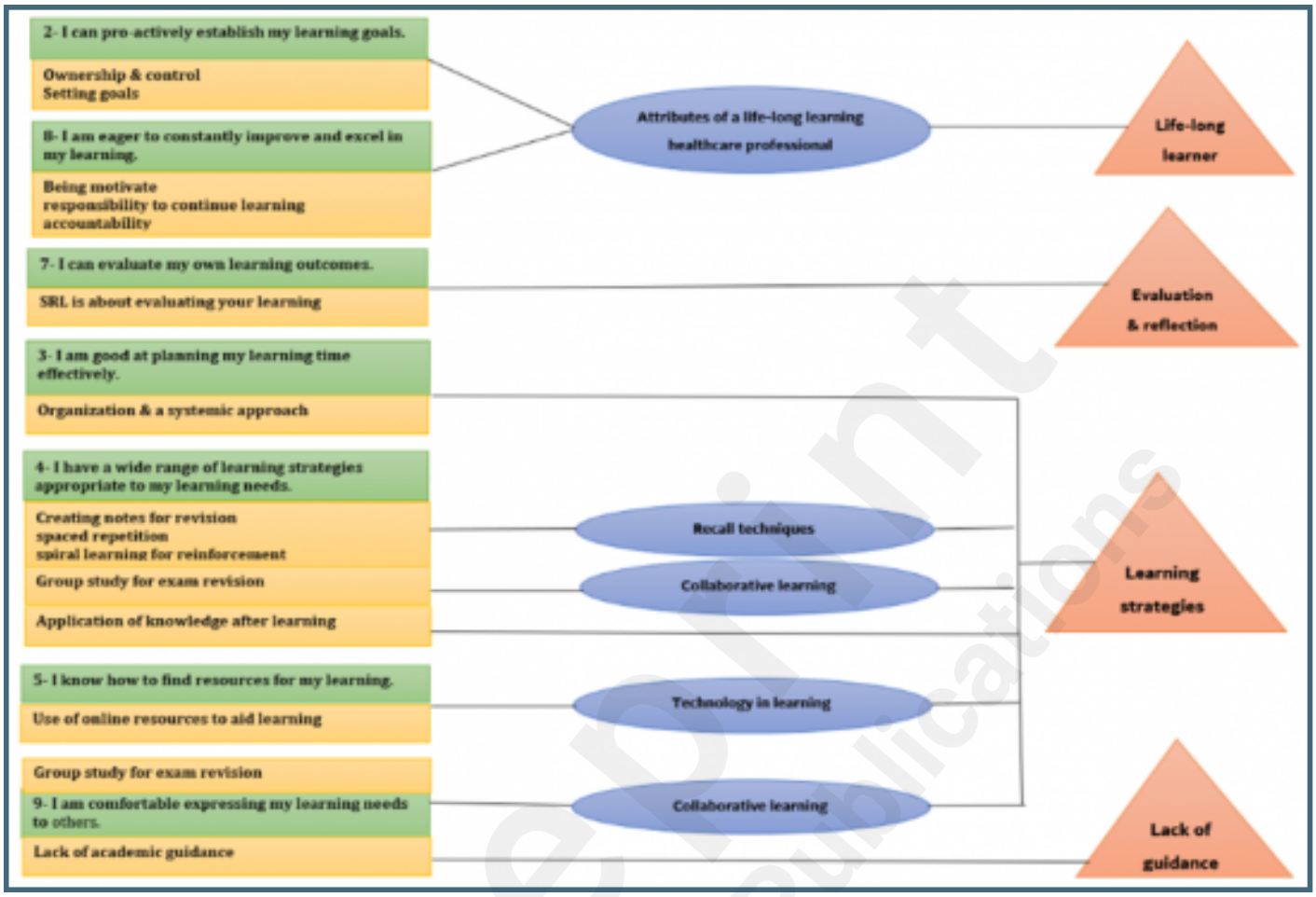
Joint display analysis.



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