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# A modified student personalized learning approach to prompt academic acquisition in health sciences

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## Abstract:

**BACKGROUND:** Metacognition activation is described as a pillar of a driver in the learning process. The current study investigated the effectiveness of a modified protocol of “student personalized learning” (SPL) (integrating elements of differentiation approach) on metacognitive skills development.

**MATERIALS AND METHODS:** A cross-sectional study was conducted among 22 bachelors during the academic period of 2016–2017. A SPL program was designed in magnetic resonance physical principles (16 courses of 2 h). The participants underwent pre-SPL evaluation tests as to assess their respective prior knowledge, learning style, and metacognitive skills. Attendant advisory meeting allocated personalized educational planning and educational resources. During SPL, students were regularly monitored by advisory supervising meetings. Descriptive statistics were used to describe the features of the data (sums, frequencies, percentages, means, and standard deviations).

**RESULTS:** The results showed a visual learning style emerging as prevalent (61.9%). The completion rate of SPL was 73%. SPL participants passed the educational module with a mean final examination score reaching  $16.72 \pm 3$  versus  $10.7 \pm 5$  assessed by prior knowledge testing ( $P < 0.05$ ). The average global metacognition score enhanced from average to very good. Knowledge and control of self, knowledge and control of process planning, and knowledge of process regulation increased from average to very good levels.

**CONCLUSIONS:** The resorted SPL proved its efficacy in recruiting and developing metacognitive skills. Nevertheless, knowledge and control of process-evaluation metacognitive component needs to be further investigated, especially when SPL relies on a short-term program.

## Keywords:

Academic achievement, metacognitive skills, student personalized learning

## Introduction

Generating conflicts in the course of learning process, displaying poor academic performance, sustaining academic failure, and expressing social violence are considered as adversities, and short comes to the classic cognitive-based pedagogic strategies. In an aim to overcome cognitive limits, the driving role of metacognition in the learning process was increasingly recognized as crucial. Educational

researchers dug routes to evoke, provoke, recruit, and flourish innate students’ metacognition. The latter required defining and implementing the metacognitive skills.<sup>[1]</sup>

Student personalized learning (SPL) was advanced as an efficiently pedagogic approach as to target activation of metacognitive skills. By drawing insightful pedagogic solutions, SPL does provide leading effects in enhancing academic acquisitions and outcomes.<sup>[2-12]</sup> Using a properly designed SPL, given its inherent

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instructional flexibility, does incur a high-rising level of situational “self-awareness” to acquire ability in proceeding “self-learning.” Ensuing motivation in response to activated metacognitive skills paws the way to take advantage of “self-knowledge” and “self-regulation” learners’ potentials.<sup>[13]</sup> SPL is conceived and based on integrating instructional strategies, which impact on metacognition in optimizing the learning process.<sup>[2,8-12]</sup> Instructional strategies such as using inquiry-based learning, applying the culture to collaborative support, incurring instructions to strategically solve problems, promoting construction of mental models, encouraging educational technology; though the role of individual believes are essential keys to metacognitive expression.<sup>[14]</sup> Accordingly, training metacognitive skills does play an important role in strengthening students’ self-directed learning.<sup>[14]</sup>

Given the prominent key role of metacognition in enhancing academic acquisition, the need to resort on new educational programs that do activate, recruit, and flourish the metacognitive skills was felt in our institution. In line with the latter, an original SPL program that integrates the element “regulations and rules” of “differentiation approach” in elaborating course plan was designed and implied on a group of bachelors in medical radiation science. The current study aimed to investigate the effectiveness of a modified SPL in raising efficiency to academic outcomes through metacognitive skills’ training.

## Materials and Methods

### Study design and participants

To design the SPL program, participants underwent a series of prior knowledge assessment, learning style determination, and metacognition preevaluation. Instructive and advisory meetings were scheduled prior and throughout SPL time frame. Metacognition was re-evaluated at the end of SPL. The current study enrolled 22 bachelors in medical radiation science attending the module of physical principles of magnetic resonance imaging (MRI) during September 2016–February 2017.

### Prestudent personalized learning assessment of prior knowledge

The prior knowledge of students on prerequisite MRI physical fundamentals was assessed by a questionnaire elaborated by SPL design team. The latter consisted of a series of 16 open-ended and closed-ended questions exploring three different areas of student’s knowledge: the physical fundamentals of MRI, optional knowledge on MRI physics, and ongoing module content. The participants were individually rated from 0 to 20. The obtained scores led to elaborate personalized educational goals.

### Prestudent personalized learning determination of learning style

To determine the optimal individualized learning style in respect to participants’ believes and behavior, Mangrum-Strichart web-based questionnaire was used.<sup>[15]</sup> The latter relies on 30 questions scaled in three levels of very low, somewhat, and very high. The learning style was characterized as being visual, kinesthetic, or auditory learners.

### Prestudent personalized learning evaluation of metacognitive skills

The students’ metacognitive skills were evaluated using a questionnaire developed by Karami<sup>[16]</sup> The latter consists of 29 questions (stratified according to Likert scale) that assess two major metacognitive categories: “knowledge and control of self” and “knowledge and control of process.”<sup>[16]</sup> “Knowledge and control of self” was additively scored according to its three investigating indices (commitment, attitude, and attention). “Knowledge and control of process” was additively scored by evaluating the weight of its three independent components (planning, evaluation, and regulation). The additive scores obtained by Karami’s questionnaire were categorized into three levels of low, average, and high scores.

### Student personalized learning allocating personalized educational planning

An advisory meeting was carried out to assign the respective participants’ learning style and instruct on how optimally utilizing the allocated educational resources. To the latter purpose, videos, e-books, web pages, and audio recording were used. The participants were instructed about the process to self-evaluation that should be implemented at the end of each course. The process to self-evaluation was ensured using an SPL-team designed sheet to be conducted by both participant and SPL teacher [Figure 1]. The participants were assisted to elaborate their educational planning for the first five courses; thereafter, they were charged for their respective educational self-planning.

### Student personalized learning procedure

A total number of 16 courses, structured in an increasing complexity, were scheduled to cover the learning objectives. The courses took place in the allied faculty of SKUMS on a basis of weekly courses (2 h), coupled with a weekly individualized advisory meeting for each participant. The first five courses were attempted to level up the students’ knowledge on MRI fundamentals, as well to assist them in acquiring sufficient autonomy in their respective courses’ self-planning. The students were guided by SPL teacher to rely on supplementary

Surname-First name:.....		Student ID No: .....		
Row	Specific Objective	Learning level		
		Good	Average	Weak
1				
2				
3				
Planning for Learning:.....				
Recommended Resources:.....				

Figure 1: A teacher sheet aimed at evaluating learning level and their self educational planning

educational resources as to cover the identified students' average and weak areas in accordance to their individual predetermined learning styles [Figure 2]. At the end of the educational program, participants' metacognitive skills were reevaluated using Karami's questionnaire, and their academic acquisition was reassessed using a final examination.<sup>[16]</sup>

### Data processing

The obtained scores to metacognitive skills were entered to SPSS software version 16 (SPSS Inc., Chicago, IL, USA) and descriptive statistics (sums, frequency, percentage, means, and standard deviation) were calculated.

### Results

The completion rate of successfully attended SPL was 16 over 22 initially enrolled participants (73%). The score of pre-SPL assessment of prior knowledge was  $10.7 \pm 5$  that raised to  $16.7 \pm 3$  ( $P < 0.05$ ) according to the final examination reflecting the efficiency of conducted original SPL educational program in respect to achieve the goal of academic acquisition.

Mangrum-Strichart web-based questionnaire displayed 13 students (61.9%) as visual learning style whereas 5 (23.8%) and 3 (14.3%) of the remaining students were considered as being tactile/kinesthetic and auditory learning styles, respectively [Table 1].

Table 2 displays results of metacognitive skills scores and its four components at the beginning and the end of SPL. The metacognitive scores were 1239 (average) and 1502 (very good) at the beginning and at the end of the program, respectively, displaying an obtained global improvement of metacognitive skills after

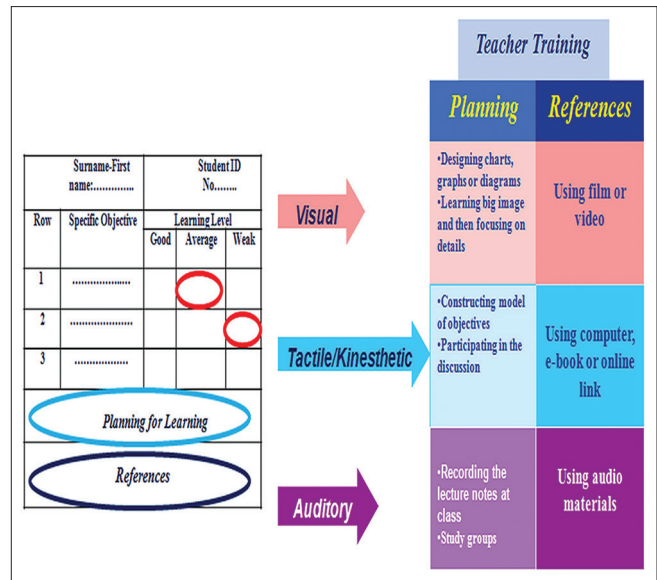


Figure 2: A diagram of teacher training to student based on identified learning style

Table 1: Identifying the learning style of student

Learning style	Frequency (%)
Visual	13 (61.9)
Tactile/kinesthetic	5 (23.8)
Auditory	3 (14.3)
Total	21 (100)

implementation of SPL. Knowledge and control of self was rated 271 (average) at the beginning that rose to 470 (very good) at the end of SPL. Knowledge and control of process planning was scored from 395 (average) to 470 (very good) at the beginning and the end of the program, respectively. Similarly, knowledge and control of process regulations showed an improvement from 139 (average) at the beginning to 178 (very good) at the end of SPL, while knowledge and control of process evaluation ranked average at the beginning and the end of SPL.

The final courses' scores are reported in Table 3. None of the students failed to pass the educational module. Twelve (75%) of the students were ranked as obtaining excellent results. The mean final scores were  $16.72 \pm 72$  compared to the pretest mean of  $10.7 \pm 5$ .

### Discussion

The short comes of traditional learning methods to engage adequate and effective responsiveness of learners that in turn do sustain conflicted behavior, poor academic performance, and a higher rate of failure were consistently reported. The latter triggered educational researchers to explore overlooked factors, that could play salient key roles in reaching superior efficiency and outcomes to academic programs.<sup>[2-12]</sup>

**Table 2: Rating results of metacognitive skills scores and its four components**

Row	Variable	Low scores	Average scores	High scores	Total score	
					Beginning of semester	End of semester
1	Metacognitive skills	464	1392 464-924=weak 924-1392=average >1392=very good	2320	1239 Average	1502 Very good
2	Knowledge and control of self (commitment, attitudes, and attention)	96	288 96-144=weak 144-288=average >288=very good	480	271 Average	328 Very good
3	Knowledge and control of process-planning	144	432 144-216=weak 216-432=average >432=very good	720	395 Average	470 Very good
4	Knowledge and control of process-evaluation	176	528 176-264=weak 264-528=average >528=very good	720	434 Average	524 Average
5	Knowledge and control of process-regulation	48	144 48-72=weak 72-144=average >144=very good	240	139 Average	178 Very good

**Table 3: Students ranking based on final examination scores**

Grading level	Scores	Frequency (%)	Mean scores±SD
Excellent	16-20	12 (75)	16.72±3
Very good	14-15.99	1 (6.25)	
Good	12-13.99	1 (6.25)	
Acceptable	10-11.99	2 (12.5)	
Failed/unsatisfactory	0-9.99	0	

SD=Standard deviation

Metacognition described as the psychological process to thinking, apprehension, and mind self-awareness is broadly considered in ongoing learning approaches. Consistently, metacognition emerged as the most powerful predictor of the learning process.<sup>[2,5,17]</sup> Therefore, self-awareness and self-evaluation to learning process and required adequate strategies in conjunction to monitoring learning effectiveness are the main purposes of applied metacognition in the field of education.<sup>[12]</sup> These later lead to express and strength self-regulation, self-planning, self-assessment, modulating increasing motivation, more favorable attitude, and elaborating enhanced strategies to learning. Developing learners' knowledge and control of self (commitment, attitude, and attention), as well knowledge and control of process (knowledge type and behavior executive control) does enhance respective overall educational intake that should result in a higher academic performance.<sup>[18]</sup>

SPL as one arm of "student-centered learning" concept refers to a variety of educational programs, learning experiences, teaching approaches, and scientific advocacy

strategies that showed a strong correlation to favorably recall and engage metacognitive skills.<sup>[18]</sup> SPL is aimed at taking into consideration the individualized factors influencing students' acquisitions such as pedagogic requirements, interesting focuses, inspirational methods, and cultural background as to empower the process of learning. SPL recalls on encouraging active participation of students to create a prone learning environment. The latter improve reciprocal interactions with educational intervenes, boost self-awareness to educational requirement, and incurability to self-planning and evaluation.

The current study was undertaken as to evaluate the effectiveness of an originally modified SPL program in enhancing metacognitive skills. In addition to classical SPL components (student motivation to advance learning process, elaborating links with regard to learning goals and interesting focuses, assisting in adequately selecting educational resources, and promoting self-assessment to acquire self-learner ability), the current protocol included guided specific course objectives. The latter comprised coaching learner skills and designing educational modules based on regulations and rules from "differentiation" arm of student-centered learning concept. In this study, the metacognitive skills scores raised from average to very good level based on Karami's questionnaire. This result paralleled previous findings, reporting the favorable influence of metacognition on learner performance.<sup>[18]</sup> When it comes to metacognitive components, the control of self, planning, and regulation displayed improvement from an average to very good



level, albeit control of self-evaluation remained at the same average level at the beginning and the end of the SPL protocol. The later does point out the weakness of our strategy to predetermine and instruct students to the process of self-evaluation. Ku and Ho showed conferring activated metacognitive skills may imply long-time training.<sup>[2]</sup> Thus, the short duration of the current study does partly explain the relative inefficacy in enhancing control of self-evaluation. The importance of determining the individual learning style as a backbone of any successful SPL program has been reported by several previous studies.<sup>[19-22]</sup> In the current study, the visual style emerged as the prevalent learning style using the Mangrum-Strichart web-based questionnaire. The improvement of the control of self, planning, and regulation metacognitive skills obtained at the end of the current study confirmed the ability of Mangrum-Strichart questionnaire in determining individual learning style. To successfully relay on an SPL program, it is salient that the purpose and advantages of metacognition be fully explained to the learners, and the learners be aware of adequate advocacy.<sup>[2]</sup> The observed mean final course grade of  $16.72 \pm 3$  reflected the overall effectiveness of the current SPL protocol to reach the expected educational performance, especially given the initial heterogeneous pretested learners' prior knowledge.<sup>[23-26]</sup>

The effectiveness of SPL as a new metacognitive-based learning approach seeks its effectiveness in recalling the active learner participation, coaching to elaborate individual learning pathway, apprehending progressively self-monitoring, and incurring the ability to self-evaluation in view of timely adjusting the learner requirement.<sup>[1]</sup> Moreover, the current study first showed that components of differentiation approach can be successfully incorporated in a SPL program.

### Limitations to the current study can be formulated as follow

This study was conducted among a limited number of students in a given field of study from a tertiary medical university; thereby raising the issue of generalizability. The short frame time of resorted SPL might be an operational barrier to flourishing all metacognitive components as reflected by the steady status of self-assessment skill at the completion of SPL. The current results stand enough incentive to further investigation in a larger scale encompassing various fields of study, covering students in different academic degrees and educational environments.

### Conclusions

Metacognitive based learning strategies such as SPL have proven to be effective in improving academic performances. The current study, implementing a

local modified SPL protocol undertaken in a group of bachelors in medical radiation science, parallels the previous reported encouraging results. In spite of the observed educational effectiveness, further emerging instructional steps should be conceived to strength adequate activation of metacognitive skills when relying on a short-time SPL protocol.

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### Conflicts of interest

There are no conflicts of interest.

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