When any learning experience is designed. These learning characteristics are said to be subconscious, innate, and stable traits that affect an individual's information processing, cognition, and behavior. Sadler-Smith defined learning style as "a distinctive and habitual manner of acquiring knowledge, skills and attitude through study or experience." This needs to be contrasted from a "learning strategy" that is a conscious attempt to adopt knowledge or skills.¹

INTRODUCTION

The concepts of medical education have now evolved to encompass the “learning characteristics of students” along with organizational and environmental factors when any learning experience is designed. These learning characteristics are said to be subconscious, innate, and stable traits that affect an individual’s information processing, cognition, and behavior. Sadler-Smith defined learning style as “a distinctive and habitual manner of acquiring knowledge, skills and attitude through study or experience.” This needs to be contrasted from a “learning strategy” that is a conscious attempt to adopt knowledge or skills.¹

Key words: Learning styles, medical education, moderate learning–teaching mismatch

Introduction: The vagueness surrounding “learning style–teaching mode mismatch” makes its effects uncertain. This study tried to tackle that controversy by comparing and assessing the effect of different learning styles on performance in physiology examination when teaching mode was somewhat different than learning preferences of the 2nd year medical students.

Methods: A total of 102 2nd year medical students participated in this study. Honey and Mumford learning style questionnaire was used to categorize the participants into one of the four learning styles (activist, reflector, theorist, and pragmatist). Many teaching modes were used in the medical college. The first professional theory and practical physiology scores of these 102 students of University of Health Sciences were obtained online. Learning styles were compared with physiology scores and age using one-way analysis of variance and post hoc statistical analysis and between males and females by using Chi-square test.

Results: Pragmatists had the lowest total physiology score \((P < 0.001)\), while theorists had the highest total physiology scores \((P < 0.001)\). Activists and reflectors had scores in between pragmatists and theorists, and there was no statistical difference between these two styles of learning \((P = 0.9)\). No student scored below 60%.

Conclusion: This study demonstrated that the effect of moderate teaching–learning mismatch is different for different learners. Theorists excelled as they had the highest physiology score, while pragmatists lagged in comparison. Reflectors and activists performed better than pragmatists but were worse than theorists. Despite this, none of the students scored below 60%. This shows that a moderate learning style–teaching mode mismatch is not harmful for learning.

Key words: Learning styles, medical education, moderate learning–teaching mismatch

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The new concept breaks away from the notion in which trainees and students were thought to be a homologous mixture of learners who required a single teaching approach. Instead, now, heterogeneity in learners is universally recognized across important characteristics such as attention span, needs, self-confidence, and expectations. The problem of heterogeneity cannot be solved by throwing random activities and exercises at a group on the assumption that their learning styles will be different. This problem demands a highly individualized method of teaching congruent with an individual’s learning style.[2]

The most widely used classification system of learning styles is derived from the “learning cycle” of Honey and Mumford that explains the conversion of experiences into concepts via four learning stages. Honey and Mumford used the “learning style questionnaire (LSQ)” to identify individual’s strengths and weaknesses for each stage of the cycle and suggested four learning styles as follows:[3]

1. Activist – Enthusiastic people who crave new experiences, tackle problems by brainstorming, and move from one task to the next as the excitement fade
2. Reflectors – Cautious and thoughtful people who consider all the possible angles before formulating any decisions and whose actions rely on observation and reflection of the past experience
3. Theorists – People who assimilate their observations into logical models based on analysis and objectivity
4. Pragmatists – Practical people who like to apply new ideas immediately and get impatient with an overemphasis on reflection.

A great learner has the characteristics of all the four types which is rare. One learning style dominates the rest.[3]

In order to optimize learning in students, Sadler proposed to:

1. Match the learning styles with individualized and customized learning programs that fit well with learning preferences of the students
2. Attempt to match all the preferences in a given group of learners to a limited extent by means of a balanced approach, i.e., to use different methods of instruction on a given population of students with different learning styles. This is called a moderate learning style-teaching mode mismatch strategy.[2]

The latter approach is more pragmatic, and there is some evidence that suggests that learners may benefit from teachers of an opposite style.[2] However, a literature search showed no studies that examined the characteristics of such a relationship. This study attempts to examine the mismatch in learning style and teaching strategy in a medical college with diverse learning preferences through academic performance.

METHODS

Teaching modes in the medical college
This study was conducted in Rawalpindi Medical College, Rawalpindi, Pakistan, from November 2016 to January 2017. The medical college had a department of medical education that was responsible for delivering information in different strategies. The department was aware about the importance of individual learning styles, but there was no record regarding the learning styles of the students. No individualized or customized teaching programs were offered by the college. The different teaching modes were as follows:

1. Bulk of the information was delivered through lectures with question–answer sessions
2. Problem-based learning sessions in which students were encouraged to solve creative clinical problems
3. Discussion sessions that allowed the students to discuss concepts among themselves and with teachers
4. Practical sessions that included clinical tests and laboratory work
5. Self-study sessions.

Teaching methods in the medical college

1. Structured lectures were the primary source of teaching in the medical college. The instructors focused mainly on the content that was difficult to understand and that was not easily accessible to the student. The primary goal of such lectures was to cover as much syllabus as possible oftentimes at the expense of question–answer sessions. Most of the lectures relied heavily on prepared slides, diagrams, and illustrations. Demonstrations on live subjects and cadavers were also used in some lectures, but most of the time, students were encouraged to visit the laboratory and the dissection hall themselves in their free time. Theorist learners in the college preferred this type of teaching method
2. Problem-oriented sessions were active learning interactive sessions that relied heavily on clinical skill, diagnosis, creative problem-solving, reasoning, and concepts. In these sessions, a clinical scenario would be presented to the students and they were asked to provide pathophysiology, diagnosis, prognosis, and treatment through discussion
3. In discussion sessions, instructors and students would discuss the topics taught in the lecture sessions and students would then prepare a lecture of the same topic in their own words to deliver in front of a class.

Mode of examination
The first professional physiology examination was conducted by University of Health Sciences (UHS) which was the central examining body. The physiology examination had separate theory and practical components. The scores obtained were out of 200. Theory examination consisted of multiple-choice questions and short essay questions that focused heavily
on core physiology concepts and their clinical correlations. The practical examination consisted of clinical tests and laboratory work. The score for each of the student in this study was obtained through the UHS website.

**Determination of learning style**

The learning style was determined using Honey and Mumford system of classification. The LSQs, derived and validated by Honey and Mumford, were distributed among the students and were collected from them in the subsequent days. Each questionnaire had twenty questions for each of the four learning styles for a total of eighty questions. Scores out of twenty were given to each learning style on each questionnaire. The dominant learning style was then determined by the interpretative criteria of Honey and Mumford.\(^1,3\)

**Sample size**

Sample size estimation was done for an effect size of 50% and a confidence interval of 95% by using Statistical Package for the Social Sciences (SPSS, IBM, Armonk, New York, USA) version 19. Accordingly, a sample size of 102 2nd-year medical students (54 males and 48 females) was selected by probabilistic sampling. Questionnaires were then distributed to these 102 students and the response rate was 100%. All the students had ages in between 18 and 21.

**Statistical analysis**

Learning styles were compared with physiology scores and age using one-way analysis of variance and post hoc statistical analysis. Learning styles were also compared between males and females by using Chi-square test. \(P < 0.05\) was considered statistically significant. All statistical tests were performed on SPSS version 19.

**Ethical declaration**

The study was reviewed by the ethical board of Rawalpindi Medical College and no ethical breaches were found during the conduct of this study.

**RESULTS**

According to the study criteria, 102 students were selected for this study in the age range of 18–24 years. Forty-eight out of the 102 (47%) students were male and 54 were female (53%).

Students with pragmatic style of learning had a greater mean age than the rest of the categories (20 vs. 19.5), but this was not statistically significant (\(P = 0.2\)) [Table 1].

All the four learning styles were present among the students. Males had a greater preference toward theorist and pragmatist styles of learning (72% of total males), while females had a greater preference toward activist and reflector styles of learning (79% of total females), and this was statistically significant at \(P < 0.001\) [Table 2].

Among all the four learning styles, pragmatists had the lowest total physiology score (\(P < 0.001\)), while theorists had the highest total physiology scores (\(P < 0.001\)). Activists and reflectors had scores in between pragmatists and theorists, and there was no statistical difference between these two styles of learning (\(P = 0.9\)) [Tables 1 and 3] All the four learning styles had scores above 60%.

Among the different learning styles, activists preferred problem-based learning sessions, reflectors preferred discussion sessions, theorists preferred lectures, and pragmatists preferred problem-based learning and practical sessions. Overall, problem-based learning sessions were the most preferred mode of teaching (30.3%) and self-study sessions were the least preferred (11.7%) [Table 4].

**DISCUSSION**

The results of this study indicate that learning and teaching mismatch does not result in any significant academic failures in medical education since all the students scored above 60% and activists and reflectors had almost the same results. Our study, however, demonstrates that this mismatch might have a beneficial effect on theorist learners and a harmful effect on pragmatic learners.

It was thought earlier that a mismatch in learning style and teaching mode results in frustration and learning failure,\(^4,5\) but recently, many studies indicate that a moderate mismatch does not leave students and teachers

| Table 1: Characteristics of population |
|---------------------------------------|
| **Learning style** | **Number of students (n=102) (%)** | **Gender (male 48, female 54)** | **Mean age (19.56±1) (P=0.2)** | **Mean physiology theory marks (72.8±8.8)** | **Mean physiology practical marks (69.8±5.8)** | **Mean total marks (142.7±12.1)** |
|---------------------|-----------------------------------|-------------------------------|-----------------------------|---------------------------------|---------------------------------|---------------------------------|
| Activist            | 24 (23.5)                         | Male 3                       | 19.0±0.7                    | 74.5±5.3                        | 67.5±5.2                        | 142±7                           |
| Reflector           | 23 (22.5)                         | Male 6                       | 19.4±0.8                    | 75.1±6.8                        | 67.9±4.2                        | 143±9.5                         |
| Theorist            | 27 (26.4)                         | Male 19                      | 19.6±1.0                    | 79.3±5.1                        | 75.4±5                          | 154.7±9                         |
| Pragmatist          | 28 (27.4)                         | Male 20                      | 20±1.2                      | 63.2±7.7                        | 68.1±4.5                        | 131.4±8.6                       |

Values are reported as mean±SD. Learning styles are determined by Honey and Mumford’s questionnaire. SD – Standard deviation
In this study, problem-based learning sessions were the most preferred mode of teaching among the students. This result is supported by Novak et al.\textsuperscript{16} and contradicted by Costa et al.\textsuperscript{17} and Carrier et al.\textsuperscript{18} Self-study sessions were the least preferred mode of teaching in our study which is contradicted by Mukhtar et al.\textsuperscript{19}

\section*{Limitations}
Our study is limited by the fact that the mismatch in learning and teaching in this study was not compared with an environment where there is complete learning style and teaching mode match. Our study also did not ascertain the degree to which different teaching styles impact overall physiology scores.

\section*{Implications}
This study would allow the instructors and teachers to tailor their lectures and discussion sessions according to the needs of the students. This would help optimize learning and will improve academic performance in all types of learners.
CONCLUSION

This study demonstrated that the effect on academic performance due to moderate mismatch in teaching mode and learning style is different for different types of learners. Theorists cope with this mismatch the best as they had the highest physiology score. Pragmatists, on the other hand, suffer and have the lowest score. Reflectors and activists coped better than the pragmatists but were worse than theorists. Despite the mismatch, none of the students scored below 60%. This shows that a moderate learning style–teaching mode mismatch does not affect academic performance, but it can benefit the theorist style of learning. Our study also found that gender and learning styles were significantly related, with males being mostly theorists and pragmatists, while females being reflectors and activists.

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Conflicts of interest
There are no conflicts of interest.

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