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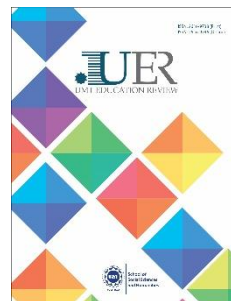
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# Exploring the Relationship between Students' Epistemological Beliefs about Science and their Approaches to Learning Science

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## Abstract

Students' approaches to the learning process, their learning style, cognitive style, learning preferences, and beliefs about knowledge had been the main focus of empirical research for many years. A quantitative survey was carried out to explore their epistemological beliefs about science and their learning approaches towards science. Moreover, the correlation between these two variables at secondary level science classroom in Chitral, Pakistan was determined. The population of the current study consisted of 59293 students from both genders studying in various public sector schools in Chitral district. Secondary school science students served as the population for this research, while 379 students were randomly selected as sample. Approaches to Learning Questionnaire (ALQ) and Students Epistemic Beliefs (SEB) questionnaire were adapted and administered for data collection. The findings showed that students employed both surface and deep approaches for science learning at secondary level. Similarly, they possessed mixed epistemological beliefs. Significant correlation was also found between some categories of students' epistemological beliefs and learning approaches. The current study also discussed the implications of the above findings for teaching and learning activities in the classroom, teacher education institutions, and other stakeholders. Specific recommendations with regards to the nature and assessment of learning were also proposed for classroom practices.

**Keywords:** deep learning, epistemological beliefs, learning approaches, surface learning

## Introduction

Science teaching and learning activities are under the maximum influence of epistemological beliefs and approaches to learning. It has been an

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attention of numerous cognitive psychologists with their growing research area highly focused on student's individuality. Thus, students' unique identity in terms of individual psychology is the hallmark of the modern teaching and learning approaches. 'Child centered pedagogy' is the result of all the developments in cognitive research. Moreover, constructivism has replaced the traditional 'jug and mug theory' of behaviorists' psychological paradigm. According to constructivism, student are no more considered as an empty vessel while they possess a considerable amount of knowledge of the society before entering a formal learning environment. Furthermore, behaviorists propose that students are not passive receivers of knowledge. Somewhat, they construct new knowledge with the help of their previous knowledge through their individual capacity based on their relationship with the surroundings. (Glynn et al., [1991](#)). In addition, constructivists' way towards teaching and learning gives an importance to the students' role in the learning. Accordingly, the teacher is a facilitator instead of mere transmitter of knowledge. The knowledge becomes meaningful by students' interaction with their peers and environment. The term 'learning' has different meanings according to the approach of constructivism. In contrast with behaviorists, learning is more social and it takes place by interaction with the social strata. Similarly, language plays a very crucial role in an effective learning. Besides, students' personal motivation, attitude and enthusiasm are highly important factors for an effective learning to be taken place. Therefore, the study of student's approaches to learning perspective becomes very important to make the teaching and learning process more conducive for learners.

Epistemology is the Logos' theory of episteme related to Knowledge. The world episteme, as defined in Oxford Learner Dictionary is a scientific knowledge or principal system of understanding. Categorically, epistemology is a belief related to nature, construction and justification of knowledge. Also, the philosophy deals with the nature of knowledge. The French child psychologist Jean Piaget, first coined the word 'genetic epistemology' to explain the various cognitive developmental stages in children. Researchers use a following range of terminologies like; epistemic belief, epistemological beliefs, personal epistemology and epistemic

cognition interchangeably are proved to be best for a student's way of knowing and justification.

Marton and Saljo (1976), studied students' 'approaches to learning' for the first time, (Solomonides, 2013). The study found six conception of learning such as learning as addition in knowledge, as memorizing, as gaining facts, and as making meaning process. These conceptions were mainly classified into 'surface learning' and 'deep learning'. Later on, Van-Rossum and Taylor (1987) confirmed the five conception of learning and further found another conception, that is, a process powered by student's interest in obtaining coherence and happiness. Since then research analysis is focused on various dimensions of the students' approaches and notions of learning and their impact on the students' epistemological beliefs and achievements. According to Biggs (1987), students' approaches refer to the students' methodologies of learning and processing their learning task.

There is a general agreement among the researchers, academicians and teachers that the manner of a students' approach to a learning situation has a control on the performance and outcome (Cassidy, 2004). Moreover, students' conception of learning has a considerable impact on their learning outcome. Previous studies, such as Lee et al. (2008), Sparks (2013), and Ellis (2004) reported the connection between the students' learning approach and other variable such as student's conception of learning, students' achievement and students' self-efficacy. Researches proved that learning approach of students strongly affects the quality of learning in different areas of discipline.

As a human, we all possess different belief systems and a belief is referred to as how a person interprets reality. People have religious, cultural, social and many other belief systems. Epistemology is an appurtenance of philosophy that discusses the nature, scope of knowledge and justified belief. Epistemological beliefs are related to the beliefs one retains regarding the nature and acquisition of a particular knowledge. Similarly, learners have different beliefs systems which provide them framework for life. Epistemological beliefs of students have a vital position in deciding about learning orientations.

Epistemological beliefs is the main focus of this research for many psychologist who are interested in human learning. Thus, there are few research evidences showing students' epistemological beliefs influencing largely students learning methods and the way they see the learning. Now a days, psychologist and educational specialist are too interested in personal epistemology of an individual. The empirical researches have also raised the important questions regarding personal epistemological beliefs and the way it influences the mental processes of thinking and reasoning. Students' epistemological beliefs are being studied to explain their responses to the learning environments and the context. The current study reveals that beliefs develop over the time and impact the cognitive process in learning. This research shows the way beliefs intervene the causes of attitude such as willingness, interest, and study habits indirectly influencing the achievements. Researcher studying epistemological beliefs about knowledge related to learning outcomes have studied the development of beliefs and potential behavior to improve it. Schomer-Aikins (2004) argues that the implicit belief about knowledge plays a crucial role in how learners reflect and solve their daily life problems. Schomer-Aikins reveals that personal epistemological beliefs further consists of independent multidimensional beliefs.

According to the developmental approach, epistemological belief develops with the development of human mind by taking different shapes. Moreover, they assert that belief about the knowledge construction, justification and nature of an individual does not remain same throughout the age from birth to death. Rather it keeps changing with the evolving environment and age. In addition, the proponents of development approach propose a linear developmental approach. Lee and Chan (2017) through a cross sectional research, investigated Chinese students' epistemic beliefs at different levels and grades. The study investigated the relationship of students' abilities to recognize different forms of misconception and fallacies. It reveals that students at higher grade level were found to be availed more with certainty of students' belief. Moreover, it has been found that students at upper grade can identify the fallacy of appeal to authority in a better way than counterparts at junior.

Epistemological beliefs may domain general as well as domain specific as proposed by some studies (Muis et al., [2006](#)). The former refers to the concept that beliefs of students in one subject area can equally be applicable to the other subjects. While the other refers to the assumption that epistemological beliefs are only limited to specific subjects such as mathematics, pure sciences, and social sciences. Many research works are conducted as if epistemological beliefs are general with respect to domain (Magolda, [1992](#); Schommer, [1990](#)).

It is shown in the above study that the epistemological belief is domain general. It means that epistemic belief held for one area can be applied to other areas or discipline. Simply, if one believes that mathematics knowledge is God gifted then one can hold the same belief for other discipline such as science subject and humanities. However, this claim may be true for some subjects but it may not be applicable at all situations. Here the question arises whether epistemic belief is domain specific or pertinent value needs to be more in-depth investigation. The real question to be considered is about the nature of epistemological beliefs at different specific levels. For instance, how do epistemological beliefs at different stages interrelate and ultimately affect other aspects of thoughts and students' performance? The current study claimed the inter-relation between epistemological beliefs at different specific levels and their special effects on problem solving in mathematics. Furthermore, this research shows that general belief in quick-fixed learning is directly affecting the domain specific belief. In addition, Schommer-Aikins et al., ([2005](#)) examined the structure of 1200 middle school students' general epistemological beliefs and domain-specific mathematical problem-solving beliefs by asking whether the two beliefs are related and whether they predict students' academic performance. Regression analyses showed that beliefs of learning as fast and instinctual and studying without strategy were significantly related to beliefs about effortful math, useful math, understand math concepts, and math confidence.

Students' approaches to learning, students learning style, students' cognitive style and learning preferences have been the focus of empirical research since 1980s. For the first time, Student learning approach was investigated by Marton and Saljo in 1976, (Solomonide, [2013](#)). The current study found six concepts of learning, such as learning is an increase in

knowledge, remembering, acquiring facts and abstraction of meaning. These conceptions are mainly classified into 'surface learning' and 'deep learning'. Later on, van Rosum & Taylor (1987) confirm the five conception of learning and further find another conception, that is, a careful process inspired by one's own interest and at gaining agreement and happiness.

Since then the current studies has been focusing on number of dimensions of approaches and conceptions and their impacts on the students' epistemological beliefs and achievements. According to Biggs (2001), the term students' 'approaches to learning' is about processing learning task. There is a general agreement among the researchers, academicians and teachers that the manner a student choose in an approach of learning has influence on their performance and outcome (Cassidy, 2004). Moreover, students' conception of learning has a considerable impact on their learning outcomes. Previous studies, such as Lee et al. (2008), Sparks (2013), and Ellis (2004) have reported the link between the students learning approach and other variable such as student's learning concept, achievement and self-efficacy. This research work proves that learning approach strongly influences the quality of learning in different areas of disciplines.

A recent study by Ongowo (2021) investigates the influence of grade level on the 'development of epistemological beliefs' and the relationship between 'science epistemic belief' and 'science achievement' among so educational secondary school in Kenya. This research work employs cross sectional and correlational survey on 214 students. The findings reveal significant grade level differences in terms of source, certainty, and development. Furthermore, certainty and justification dimensions are considered as important determinants of science achievements. Another research work by Yenice (2015) studies the epistemological belief of student, teachers and their relationship with the meta-cognitive perception of nature of science. Positive epistemological beliefs and meta-cognitive perception about nature of science are recorded. Grade or gender seemed to be affecting the epistemological beliefs of the participants. Smarandache et al. (2021) study shows that the interest-to-effort ratio is essential to children preference for deep or surface learning.

Yang and Tsai (2017) investigate learners' thought of how learning takes place and find out that teachers and learners with fragmented conception tend to have 'surface approaches' and those with cohesive conception lean towards 'deep approaches'. Surface approaches are related to illogical or non-coherent learning conception and deep approach has a tendency to be linked with cohesive conception. Shen et al. (2016) investigates conception and approach which are correlated to the self-efficacy. Exclusively, the students who think learning in earth science is more about applying are prone to meaningful learning in the subjects and they possess self-efficacy. The results further revealed the learning conception such as memorizing, testing and calculation are linked with the surface approaches. Similarly, higher conception of learning such as understanding and applying are definitely correlated with the 'deep approach'. The current study shows the relationship between general and domain specific learning in various science subjects.

It is evident from the above study that students with 'deep approach' tend to have cohesive conception. It means that deep learning leads to make connections between what students already know and want to know. This connection is well established horizontally and vertically among different disciplines. On the other hand, students with 'surface approach' cannot relate the previous and new learning materials, rather their learning occurs in bits. Moreover, surface learning only relies on the rote memorization which is not long lasting. Coherence, logic and comprehension is lacking in 'surface learning'. Liang et al. (2014) assess correlation between Taiwanese students' conception and approaches to learning in computer education. This research work finds positive correlation between conception and surface motivation to learning. Learning quality is also defined by the approaches adopted by students.

In another research by Zhang and Watkins (2001) interrelation reveals that students' approaches are connected with their intellectual development. In more specific terms the students employing the deep approach, have a tendency to think in a committed way. While on the other hand, students employing the surface approach, have a tendency to think in a dualistic way. Chiou et al. (2013) examines the strength of prediction control of students' epistemic outlook and conception. The results show that in comparison with



epistemic outlook, learning conception proved to be more dominant in predicting students' approaches. It reveals that deep approach is more probably connected to the conception of higher degree. Seeing in an innovative way is one of the highest orders learning conception. In contrast, it is seen that surface approach to learning is connected to low order conception of learning such as testing is one prominent component of low order learning conception. The current study is centered at learning physics; students with refined learning conceptions can differentiate between conceptions of learning as understanding and achieve a new way to construe natural phenomenon.

Senemoglu (2011) observes the difference in students' approaches with regard to gender, major and school year. The findings demonstrate that student in Turkish and American context adapt deep and strategic approaches. In the same way, deep approach increases with more study year. Gender wise analysis shows that the female students in both the context mostly choose 'strategic approach' while their male counterparts are more likely to use 'deep approach'. Minasian-Batmaniana et al. (2006) reports Students with constant conceptions are more suitable to apply 'deeper approaches' to their study methods than those with messy conceptions and the results are not affected by several demographic factors.

Almost all the above studies on 'surface approach' and 'deep approach' show that the former is related to students' surface learning, that is, memorization, remembering and learning only to achieve high marks in the examination. On the other hand, 'deep approach' is linked with comprehension of learning, making meaning, strategic thinking, emotional stability, optimism, digging deep into what they know and want to know and thinking in an innovative and creative ways. A deep connection here between the approaches to learning and the students' task performance is visible in most of the studies mentioned above.

The research analysis on Students' Epistemological Belief, Students' Approaches and other 'meta-cognitive processes' are conducted with the students of different context. However, only few empirical studies are available on the correlation between Epistemological Beliefs and Approaches to Learning. Furthermore, some following studies explore the

relationship between Belief and Approaches. Chan (2002) reveals a correlation among epistemology and approaches to leaning. This particular study has reported an important connection between the ‘epistemological beliefs’ and ‘learning motivation’. Same study also gives details regarding the relationship of epistemological beliefs with study approaches. For instance, learners with this beliefs that learning needs struggle would perhaps learn with a motive/object and strategy to understand instead of only depending on rote memory. Students believing that knowledge can only be achieved by being an expert in a specific field would be prone towards ‘surface learning approaches’. The same could happen when students believe that talent is inherent and knowledge is certain and unchanged. Ultimately, learning would simply become a memorization and students would follow surface approach of study.

In Malaysia, the inclination to adopt ‘surface learning approach’ is mostly in practice at the secondary level. Therefore ‘surface learning’ in the Malays higher education can be attributed to their education system. Malaysia, similar to many other countries of the world, put effort on academic qualification in terms of grades and marks. This seems to be one of the main reasons about students at the later stage cannot continue with the ‘surface approach’. The same study reports an interesting finding related to students’ ethnic background and learning approach. It shows that Chinese students are inclined towards ‘surface learning approach’ as opposed to another ethnic group. Contrary to that, Malaysian are observed to implement ‘deep approach’ in contrast to others. Employing surface approach by Chinese (Chan, 2003), may also be attributed to meet the assessment needs of the students. Beliefs about knowledge are indirectly affecting the Approaches as revealed in Cano (2005). In other words, approaches to learning mediate between epistemological belief and other variable such as achievement in the academics.

The revision of current study shows inter-correlation between ‘epistemological beliefs’ and other variables along with ‘approaches to learning’. However, the association between ‘Students’ Epistemological Beliefs’ and ‘Students Approaches’ has rarely been explored (Chiou et al., 2013). The varied findings of this research also suggest that learners may have different epistemological beliefs, especially those coming from

different backgrounds. In Pakistan already there is a dearth of context based research study on the relationship between Students' Epistemological Belief and Approaches to learning. Therefore, this particular study aims to investigate the 'epistemological beliefs' of science students, 'approaches to learning' and the relationship between these two important variables.

Epistemological Beliefs and Approaches to Learning are two very important variables in the learning process of a student. The religious, cultural or any other form related to 'Belief', has a great impact on the learning process of students as well as the teaching practices of teachers. In the term 'epistemological beliefs', specifically a word belief is taken as a filter interpreting a person's reality. Similarly, Students' Approaches to learning have been a very important determinant of students' achievement. The above literature review shows that 'approaches to learning' and 'epistemological beliefs' are highly affecting the student learning processes. All the domains of epistemological beliefs are not related to the approaches to learning. In either way it has been found that students believing science as tentative entity, behave differently, then those who consider science as a fixed body of knowledge while performing task in the classroom. Similarly, students with their 'deep approach' learning tend to achieve meaningful and authentic knowledge based on evidences. On the other hand, learners with 'surface approaches' have a constricted view regarding the knowledge, that is, only remembering the facts. Epistemic belief has an influence on study of learning material and on few major emotional and personality aspects of a person. Self-efficacy and motivation for learning are two other variables directly influenced by epistemic belief and approaches to learning. In my view, the scope of the 'Approaches' and 'Beliefs' is far wider and covers many dimensions of the students' life. In-depth, understanding of both the phenomenon is momentous to understand. It is especially important for Pakistan and third world countries to explore the students' voices and bring them to the level of decision making. Besides, they should design and implement any program related to the learning of the students. In the context of Pakistan, very little attention has been given to the students' voices. The result is that the non-availability of local empirical finding impedes the process of curriculum development, teacher training and developing instructional material according to the needs of learners.

## Statement of the Problem

In Pakistan, the curriculum planning and development as well as teaching and learning activities are based on the research work. It is associated more with teaching approaches instead of learning approaches. The findings do not confirm to what students want. Consequently, the informed decisions are not made while taking any initiatives. Research on the students learning approaches to science explores a new area of study that is contextual in nature. Many meta-cognitive processes of students such as learning approaches, learning style, and beliefs are the important determinants of students' success in their academic career. Therefore, it is highly significant that in the Child Centered Pedagogy, students' meta-cognitive abilities must be investigated before planning and designing any educational program for improvement. The current study necessitates the fact that students' belief and learning approaches must be investigated to make the informed decision about teaching and learning activities in the school. In a country with other issues of education reforms, students have also been ignored while developing curriculum, designing teaching-learning materials and assessment. Therefore, contextual knowledge on science students' beliefs and learning approaches is particularly important for the researcher, academicians, teacher and teachers' educators.

## Objectives of the Study

The current study was intended to achieve the following three objectives.

- To explore the students' approaches to learning in secondary school science classroom in Pakistan
- To explore the student's epistemological beliefs about science in secondary school science classroom in Pakistan
- To investigate the relationship between students' epistemological beliefs and approaches to learning science in secondary school science classroom in Pakistan

## Research Questions

Following research questions were framed to guide the current study.

1. What are Science Students' approaches to learning science in Pakistani secondary science classroom?
2. What are Science Students' epistemological beliefs about science in Pakistani secondary science classroom?
3. What are the relationship between students' epistemological beliefs and their approaches to learning science in Pakistani secondary science classroom?

### **Methodology**

This is a descriptive research and it is followed by the survey method.

### **Population**

The population consisted of 59293 students of both genders studying in public sector school in Chitral district. According to the latest statistics, the number of boys and girl's students in Khyber Pakhtunkhwa public sector secondary school were 30141 and 29152 respectively.

### **Sample of the Study**

A list of student was obtained from district education office to select the sample. Out of the total population, samples were selected through simple random sampling to find representative sample. The total number of sample for the study was 379 science students of both genders studying in four public sector schools in Chitral.

### **Research Tool**

For the current study, Approaches to Learning (ALQ) Questionnaire and the Students Epistemic Belief (SEB) Tsai and Liu (2005) Questionnaire were modified for data generation. Then the research tool was modified and converted on Likert scale. The original researcher previously validated the above-mentioned tools. This research required proper permission and consent of the researcher through an email before using the research tool.

Some items were reduced to the fact that they conveyed the same meaning. For example tool measuring Students' Approaches to learning contained 24 items. 6 items were removed and 18 items were remained in

the final tools. Similarly the tool for epistemological beliefs contained 17 items. 5 items were removed because of the duplication.

An expert opinion was sought for validation of the tool in the local context. Validation of the research tool was performed with the help of experts. Before conducting the data collection, initial piloting was carried out with 100 students. The pilot study was aimed at carrying out the reliability of tool for the current study in the Pakistani Context. The reliability of both the tools was found above .73 which was acceptable.

The tool for Students' Approaches to Learning contained 24 items in the 5 point Likert scale (1 strongly agree, 2 Agree, 3 Don't Know, 4 Disagree and 5 strongly Disagree). The tool contained further categories of Deep Motives with eight items, Deep strategy with six items, Surface Motives with five items and Surface Strategy with five items. Similarly, the tool for Students' Epistemological Belief contained seventeen items on a five point Likert scale'. Epistemological Beliefs had further categories, i.e. Source of Scientific Knowledge with four items, Certainty of Scientific Knowledge with five items, and Development of Scientific Knowledge with three items and Justification with five items on 5point Likert scale.

### **Analysis of the Data**

With the purpose of finding the correlation between Students' Approaches to Learning and Students' Epistemological Belief, Pearson correlation was found. Different measures of correlation were used in correlational studies. Pearson product-moment correlation coefficient or (Pearson's correlation for short) measures the linear relationship between interval ratio variables.

Initially frequency distribution was carried out with the help of appropriate statistical technique. The frequency distribution tables and graphs showed the number of samples responded to each items. Later on, correlations between those variables were drawn where the responses were significant. It was followed by correlation matrix of the two variables with different categories.

#### **Table 1**

*Descriptive Statistics of Deep Motives (DM)*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
DM	377	8.00	30.00	17.7798	4.09356	16.757

Table 1 shows the descriptive statistics (mean, standard deviation and variance) of the construct Deep motives (DM) which falls under the category of variable Deep approach of learning science. The table shows that the mean is 17.7 and standard deviation is approximately 4. The standard deviation value manifests that the values for the construct are very close to each other.

### Table 2

#### *Descriptive Statistics of Deep Strategy (DS)*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
DS	376	7.00	27.00	13.7287	3.53585	12.502

The above table 2 presents the result of mean and standard deviation for Deep strategy (DS). The minimum and maximum values are 7 and 27 respectively. The standard deviation value is 3.5 which explicates the fact that the values are close to each other.

### Table 3

#### *Descriptive Statistics of Surface Motives (SM)*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
SM	376	5.00	23.00	10.3431	3.22438	10.397

Table 3 gives a comprehensive result of descriptive statistics (maximum, minimum, standard deviation and mean) of Surface Motive (SM). The values for mean and standard deviation are 10 and 3 respectively. The results explicate that the values are not scattered rather it shows that they are closer to each other.

**Table 4***Descriptive Statistics of Surface Strategy (SS)*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
SS	369	5.00	25.00	16.4282	4.20932	17.718

Table 4 shown above gives a comprehensive result of descriptive statistics (maximum, minimum, mean and standard deviation) of Surface strategy). The values for mean and standard deviation are 16 and 4, respectively. The results elucidate that the values are not scattered rather it shows that they are closer to each other. However, the value of mean is a bit higher than the mean of surface motives.

**Table 5***Descriptive Statistics for Student Epistemological Belief (Source of Knowledge)*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Source of Knowledge	376	4.00	20.00	11.3856	3.12029	9.736

The above table 5 shows the result of mean and standard deviation for Students Epistemological Belief and Source of Scientific Knowledge. The minimum and maximum values are 4 and 20 respectively. The standard deviation value is 3 which explicates the fact that the values are close to each other.

**Table 6***Descriptive Statistics for Student Epistemological Belief (Certainty of Knowledge)*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
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Certainty of Knowledge	377	6.00	25.00	16.6525	3.23934	10.493
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Table 6 shows a comprehensive result of descriptive statistics (maximum, minimum, mean and standard deviation) of Students' Epistemological Values and Certainty of scientific knowledge. The values for mean and standard deviation are 16 and 3 respectively. The results elucidate that the values are not scattered rather it shows that they are closer to each other. However, the value of mean is a bit higher.

**Table 7**

*Descriptive Statistics for Student Epistemological Belief (Development of Knowledge)*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Development of Knowledge	376	3.00	14.00	6.1569	2.18220	4.762

Table 7 shows a wide-range result of descriptive statistics (maximum, minimum, mean and standard deviation) of Students' Epistemic Belief and Development of knowledge. The values for mean and standard deviation are 14 and 2 respectively. The results reveal that the values are not scattered rather it shows that they are closer to each other. Also, the value of mean is lower than its value in other categories.

**Table 8**

*Descriptive Statistics for Student Epistemological Belief (Justification of Knowledge)*

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Justification of Knowledge	379	5.00	23.00	8.9261	2.71188	7.354

Table 8 shows a comprehensive result of descriptive statistics (maximum, minimum, mean and standard deviation) of Epistemological Belief and Knowledge Justification. The values for mean and standard deviation are 8 and 2 respectively. The values are very close to each other following the results shown on table. Similarly, the value of mean is lower than the mean for other categories.

**Table 9**

*Correlation between Students' Epistemological Belief and Students' Approaches to Learning*

	DM	DS	SM	SS	SEBS	SEBC	SEBD	SEBJ
Deep Motives (DM)	1							
Deep Strategy (DS)	.385*	1						
Surface Motives (SM)	.034	.166**	1					
Surface Strategy (SS)	-.213**	-.103*	.150**	1				
Student Epistemic Belief Source (SEBS)	.136**	.135**	.269**	.229**	1			
Student Epistemic Belief Certainty (SEBC)	.018	-.012	.185**	.375**	.332**	1		
Student Epistemic Belief Development (SEBD)	.102*	.178**	.063	.041	.049	.010	1	
Student Epistemic Belief Justification (SEBJ)	.254**	.261**	.172**	.057	.151**	.010	.344**	1

\*. Correlation is significant at the 0.05 level (2-tailed)

Table 9 shows the Pearson correlation matrix among the variables which are used in this study. Detailed interpretation of the correlation matrix is given below.

Students' deep motives to study science have strong positive relationship with their deep strategy. The  $p$ -value for 'Deep Motive' and 'Deep Strategy' is less than 0.01, which suggests that the positive relationship between these two variables is significant at 99% confidence level.

Students' deep motives to study science have weak positive relationship with surface motive. The probability value for 'Deep Motives' and 'Surface Motive' is greater than 0.05, which suggest that the relationship between the two variables is not significant and cannot be relied upon.

Pearson co-efficient  $r$  value for 'Deep Motives' and 'Surface Strategy' is -0.21, which suggests a negative relationship between student deep motives to study science and their surface strategy. Moreover, the  $p$ -value of Deep Motives and Surface Strategy is less than 0.01, which suggests that the negative relationship between these two variables is significant at 99% confidence level.

'Deep Motives' has positive relationship with all the categories of student epistemological beliefs about science (sources, certainty, development and justification). The  $p$ -value for SEB Certainty and SEB Development is less than 0.05, which suggests that the positive relationship of these variables with 'Deep Motives' is significant at 95% confidence level. Moreover, the  $p$ -value of SEB Source and SEB Justification is less than 0.01, which suggests that the relationship of these two variables with 'Deep Motives' is significant at 99% confidence level.

'Deep Strategy' has significant positive relationship with 'Surface Motives' and significant negative relationship with 'Surface Strategy'. The  $p$ -value for 'Deep Strategy' and 'Surface Motives' is less than 0.0, which suggests that the positive relationship between these two variables is significant at 99% confidence level, while the relationship between 'Surface Strategy' and 'Deep Strategy' is significant at 95% confidence level as the  $p$ -value for these variables is less than 0.05.

‘Deep Strategy’ has a significant positive relationship with student epistemological beliefs for science regarding sources, certainty, development and justification. The p-value for ‘Deep Strategy’, ‘Students’ Epistemic Belief Source’, ‘Students’ Epistemic Belief Certainty’, ‘Students’ Epistemic Belief Development’ and ‘Students’ Epistemic Belief Justification’ is less than 0.01, which suggest that the positive relationship between these variable is significant at 99% confidence level.

### Discussion

According to the previous studies, students in Asian countries, such as in China and Taiwan, are most likely to adopt the surface approaches to learning. On the other hand, many empirical studies show that students’ approaches to learning is directed by assessment preferences (Dogan, [2012](#)), along with other variables. However, this particular study shows that students use deep strategies in studying science subjects in an inconsistent manner.

Students’ assessment preferences are strong determinants of approaches to learning (Dogan, [2012](#)) which they employ in their learning of science. Consistent students’ surface strategy confirms this notion. In Pakistan, learning strategy follows the process of rote memorization and is designed to reproduce the already memorized facts from the text book during examination. Considering the fact that toppers in examination have more chances to get admission in the top institutions which further pave their way for getting a job. Furthermore, a teacher is required to complete the syllabus within a limited time period. Moreover, the assessment systems including the school tests, quizzes and board examination are highly based on the rote memory of the students. Rote learning requires less effort on the behalf of both teachers and students to learn the concept. Another important factor in shaping the epistemological beliefs and approaches to learning is the classroom instructional practices by teachers has been found by different empirical studies. The findings reveal that teachers’ preferred approach to learning also act as an indicator of their beliefs as Chan and Elliott ([2002](#)) have put forward. The importance of Epistemological Beliefs lies in the fact that they direct our behaviors. Moreover, teachers’ belief and value systems also affect their classroom strategies and performance by shaping their teaching practices as said by (Cheng et al., [2009](#)).

The findings support the previous study about the relationship between Students Epistemological Beliefs and Approaches to Learning. It shows important relationship between students' epistemological beliefs and approaches to learning (Conley et al., [2004](#); Lee et al., [2008](#)). Liang et al., ([2010](#)) found some significant correlations between scientific epistemological beliefs and approaches to learning science. The current study finds that surface strategy for learning science is negatively foreseen by the mature belief about the source and certainty of scientific knowledge. Similarly, Beliefs about justification of scientific knowledge are positively correlated to deep strategies. Moreover, a deep motive for learning science is positively influenced by beliefs about the development and justification of scientific knowledge. Certainly, beliefs about justification of scientific knowledge have positive effects on motives for learning science.

## **Conclusion**

From the above study it is concluded that students at secondary level classes in Pakistan show a variety of epistemic belief and approaches to learning. Moreover, the correlations between epistemic belief and approaches to learning have also show different correlation value. Some of the findings of the study are consistent with previous studies in the field. However, it can be inferred that mode of examination and classroom test may have dominated the students' epistemological belief and approaches to learning. As mentioned above that examination system needs to be improvised so as to direct the shaping of belief and approaches.

Science students have below average deep motives strategy, and surface motives regarding approaches to learning science. However, science students have average surface strategy towards science learning. Similarly, science students have below average value of epistemological beliefs regarding the development of scientific knowledge and justification.

## **Recommendations**

The following recommendations are put forward for various stakeholders such as teachers, teacher's training institutions and curriculum planner on the basis of findings. Nature of Science must be incorporated into the science course at school level in order to achieve the broader objectives of National Curriculum Document. Teaching nature of science

as a part of curriculum will help the science students to understand the scientific process and to shape their epistemological beliefs about science.

It is believed that the assessment system is a major force behind shaping and directing students' approaches to learning in their relevant institution. Findings conclude that surface approaches to learning prevail due to the nature of assessment carried out in such institutions. Moreover, most Pakistani education systems encourage rote memorization. Students' deep strategy of adopting approaches assessment system should be changed. The test items should promote higher order thinking skills in students instead of asking factual questions.

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