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A Comparative Study on Scientific Epistemological Views of Postgraduate Students of Different Discipline

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Abstract
Fostering the sophisticated epistemology of science among students has been a fundamental goal of science education. The study aims to understand the SEV of postgraduate students in relation to their gender, stream, and locality. For this research 150, postgraduate students were randomly selected from the Aligarh Muslim University. The investigators used the SEV (Scientific Epistemological Views) scale standardized by Liu, S.Y., and Tsai, G. C. (2005). The findings of this study are that a significant statistical difference in the mean scores of Scientific Epistemological Views of science and non-science major postgraduate students were observed. Higher values of SEV scores of science major students indicate more '*sophisticated'* beliefs while non-science major students had a lower score, meaning they had '*naive*' views of SEV. No significant gender differences have been reported in the study. However, it was seen that the mean score SEV of the female is slightly higher than the male. When studying the SEV among rural and urban postgraduate students, no significant difference was found between them. The finding did reveal a minute noteworthy difference: the urban postgraduate students scored more than the rural postgraduate students. Interestingly, two groups, according to streams, stood out to be remarkably significantly different in SEV. The science group scored significantly high on the SEV than the commerce group.

Keywords: scientific epistemological views, postgraduate, science education

1. Introduction
Epistemology is the philosophical project of formulating an explanation of origin, nature, and scope of knowledge. The term "*epistemology*" is derived from the Greek words *epistēmē,* which means knowledge and *logos* as the reason. That is why the field is sometimes cited as the theory of knowledge. Epistemology, together with logic, metaphysics, and ethics, is one of the four essential branches of philosophy.
On the other hand, knowledge can be defined as the information, facts, and skills acquired through experience or education. While in reference to school education, it is the theoretical or practical understanding of a subject. Knowledge is the familiarity or awareness gained with the experience of a situation. Socrates defined knowledge as absolute truth. He believed that everything present in the universe is somehow innately connected, and if we know one thing, then potentially we can derive everything from that one truth.
Epistemological beliefs have become an increasingly important dimension of educational research. According to Soloman (1996), investigation of student's epistemology has had a long tradition in science education research. Student's science epistemological views have been related to the richness, extent, and accuracy of their cognitive structure outcomes of science learning (Tsai, 1998) and the performance level on learning tasks involving abstract problem solving (Novak, 1988).
Philosophers from the very beginning have emphasised the authenticity of knowledge, beliefs, and thoughts. It involves what we perceive, the nature of perception, and what we can know or may think we know through the perception or other sources of knowledge, including memory. Memory is a storehouse of what we have learned in the past. It is consciously revealing our inner lives and reflection as a way to acquire knowledge of abstract matters. Epistemology is the answer to all these questions.
Systematic organisation of knowledge on a particular subject is termed science. Intellectual

activities and practical aspects encompass a systematic study of the structure and behaviour of the natural and physical with the help of observations and experiments. In the present modern world, science is manifested all around us. We don't have any single aspect of our lives today that has not been shaped and influenced by science in one way or the other way. It is so because we are living in the age of scientific culture. Science has contracted the world, made it accessible, and has changed our outlook. In fact, science is now pulling strings of every aspect of human life.

Modern science is not just confined to this globe; its scope of achievements has reached beyond this world. In recent times, there has been a rapid augmentation of knowledge to the world of science. Outstanding achievements of science and technology and the use of these scientific achievements in promoting humanity's well-being through their application in the field of transport engineering, industry, agriculture, medicine, and communication have made science more vital than ever before.

1.1 Scientific Epistemology:

Scientific epistemology is a philosophy to which the follower of science stands committed. Albert Einstein insists that his scientific epistemology made his discovery of relativity possible. He believed it was his understanding of the relationship of experience and reason that allowed him to reconsider certain "truths" of physics.

Epistemology explains the way a man thinks. In order to differentiate the truth from the false information, epistemology is required by determining a proper method of evaluation. Without epistemology, we would not be able to distinguish truth from error or erroneous knowledge. There will be some apparent consequences. The essence of reality solely remains dependent on the amount of knowledge we have about the sciences. Flaws in scientific epistemology will hinder the accomplishment in the field of science. The studies of Ruhn (1991) and King, Kitchener (1994) showed us essential things in epistemology thinking. The studies talked about epistemological understanding, how it gives us information related to comprehending, how individuals resolve competing knowledge claims, evaluate new information, and make fundamental decisions that affect their lives.

1.1.2 Scientific Epistemological Views: SEV is described as one's epistemological beliefs towards science. The five dimensions of SEV are the *Role of social negotiation (SN), the inventive and creative nature of science (IC), the theory-laden exploration (TL), the cultural impacts (CU), and the changing and tentative features of science knowledge (CT).*

- (Tsai and Liu, 2005)

2. Review of Related Literature:

Based on the findings of the researches reviewed, it can be said that one's epistemic beliefs have been one of the critical issues in previous research investigations, probably because of the close connections between student's epistemic beliefs and their learning performance. It was observed that the researches on Scientific Epistemological Views were initiated after 1995, and before that, studies were conducted on variables like scientific attitude, scientific creativity, etc. Even after 1995, there were very few researches explicitly conducted on scientific epistemology. Chin-Chung Tsai gets the credit for his contribution to SEV studies. Researchers have conducted studies on Scientific Epistemological Views with different variables such as ICT (Feng and Carol, 2018; Ozge, Oskay, et al.,2011), reasoning process (Shiang-Yao, et al., 2010), socio-scientific decision making (Shiang-Yao Liu et al., 2010), science instructions (Chin-Chung, 2006), SEV as interdisciplinary research (Mieke and Sophie, 2018), SEV and gender differences (Fang-Ying et el, 2014), SEV and grit (Ahmed, 2020), SEV and learning orientation (Chin-Chung, 1997).

The sample selected in most of the researches were school students (Chin-Chung, 1997; Chin-Chung, 1999), teachers (Vandana and Renu, 2009; Fouad, Randy, et al., 1997; Chin-Chung and Shiang, 2005; Songer and Mustafa, 2009; Chin-Chung, 2006) and university students (Jihn, Scott, et al., 1993; Fang-Ying, Tsai, et al., 2014; Ahmed, 2020)

The academic subjects selected in many researches were chemistry (Ozge, Oskay, et al.,2011), biology (Nelliappan,1992; Yi-Chun, Jyh-Chong, et al., 2012), physics (Stathopovlov & Vosniadu, 2007)

The literature review and studies on SEV have revealed a growing body of evidence demonstrating the role of epistemic beliefs in more specific disciplines. As rightly pointed out by Pintrich (2002) that epistemic beliefs are discipline-specific and thus deserve further exploration in various academic disciplines. Therefore, this study attempts to study SEV in different streams like Science, Arts, Commerce, and Social-Science. As no research was found in the Indian context, the investigators were all the more tempted to study SEV among the Indian postgraduate students.

3. Significance of the study:

Fostering the sophisticated epistemology of science among students has been a fundamental goal of science education. Despite decades of research, it remains tough to change student's understanding of the nature of science and science inquiry. Students' belief and understanding of science are merely limited to performing activities (e.g., Constructing concrete things, data collection, or testing variables), unlike the experts in science who believe in making abstract theories to explain natural phenomena and improve these theories (Sandoval, 2003) collectively. With such a limited epistemic understanding of science, students may have little motivation to learn science. They may not understand how to produce and improve ideas based on evidence or construct new ideas. Therefore the study aims to understand the SEV of postgraduate students in relation to their gender, stream, and locality. This study's findings might help in training the pre-service teachers in SEV, which, once employed, will help the students in their school life to enhance their SEV belief.

4. Research Questions:

The purpose of this study is to explore the SEV of a sample of postgraduate students, majored in science and non-science subjects (belonging from arts, commerce and social-science group). Since the students of two majors have different academic experiences, the investigators assumed and anticipated that the SEV of students from different majors would also be different.

The following research questions guided the research.

- On what dimensions do the science group differ in their SEV from the non-science group.

- What are the different dimensions that are to be considered which will encompass the true essence of scientific epistemology?
- Do the scientific epistemological views of the students differ according to the courses they are pursuing?
- Whether there exists gender difference in the scientific epistemological views of postgraduates?
- Do postgraduate students belonging to different localities hold different views about scientific epistemology?

5. Objectives of the study:

The objectives formulated for the study are:

1. To find the difference in mean scores of SEV and its sub-dimensions between science and non-science postgraduates.
2. To find the difference in mean scores of SEV and its sub-dimensions between male and female postgraduate students.
3. To find the difference in mean scores of SEV and its sub-dimensions between students belonging to an urban and rural locality.
4. To find the difference in mean scores of SEV and its sub-dimensions among the different streams.

6. Population of the study:

The population of the study is defined a**s** a group of individuals, objects, or items having one or more common characteristics, out of which samples are taken for statistical measurement. Population in this particular study comprises postgraduate students from various faculties.

7. Sample of the study:

A sample is a small group selected from the population for research purposes. For this research 150, postgraduate students were randomly selected from the faculty of social science, arts, commerce, and science of Aligarh Muslim University.

Science major postgraduate students are students pursuing masters in science in a discipline like physics, chemistry, mathematics, zoology, botany, biochemistry, statistics, geology, etc.

Non-science major postgraduate students in this study are those students pursuing masters in arts, commerce, and social science subjects

8. Tool used in the study:

For this study, the investigators used the SEV (Scientific Epistemological Views) scale standardized by Liu, S.Y., and Tsai, G. C. (2005), which comprises 25 questions.

The scale used for this study was with five dimensions, namely:

1. *Role of social negotiation (SN)*
2. *The inventive and creative nature of science (IC)*
3. *The theory-laden exploration (TL)*
4. *The cultural impacts (CU)*
5. *The changing and tentative features of science knowledge (CT)*

8.1 Description of the various dimensions:

"*The role of social negotiation*" (SN) means that the development of science relies on communication and negotiations among scientists (the constructivist-oriented view). The opposite position (empiricist or positivist-aligned view) is that science is a process of individual exploration, mainly depending on personal efforts.

The dimension of the "*Invented and Creative nature of science*" (IC) is to assess whether students understand that scientific reality is invented rather than discovered (the constructivist-oriented view). It also has the notion that human imagination and creativity are vital for the growth of scientific knowledge.

"*The Theory-Laden exploration*" (TL) dimension refers to the idea that scientists' personal assumptions, values, and research agendas may influence the scientific explorations they conduct (the constructivist view). An opposite (empiricist-aligned) view argues that scientific knowledge is derived from totally objective observations and procedures.

The dimension of "*the Cultural impacts*" (CU) addresses the culture-dependent nature of the development of scientific knowledge. Traditional science instructions often portray science as a western product and overlook different ways of knowing in different cultures.

"*The Changing and Tentative feature of scientific knowledge*" (CT) indicates the conceptual change of scientific progression. It claims that scientific knowledge is constantly changing, and its status is tentative (constructivist-oriented view), which opposes the idea that science provides the truths of nature (empiricist-aligned view).

8.2 Reliability and Validity of the test:

The internal reliability of each dimension of this scale was re-established as 0.61, 0.60, 0.61, 0.61, and 0.60, with an overall alpha value of **0.60**. Content and face validity was determined for this tool by consulting the experts.

9. Result:

Objective 1 – To find the difference in mean scores of Scientific Epistemological Views and its sub-dimensions between science and non-science postgraduates.

Hypothesis (H_{01}): There will be no significant difference in the mean scores of Scientific Epistemological Views and its sub-dimensions between science and non-science postgraduates

Table 1: The difference in the mean score and t-value between Science and Non-science groups.

SEV Sub-dimensions	Science (N=56)		Non-Science (N=94)		t-test	H_0 A/R
	Mean	SD	Mean	SD		
SN	29.1071	3.9018	26.7553	4.4351	-3.282	R
IC	18.5179	3.7416	18.1489	3.3083	-.629	A
TL	9.6607	2.1681	9.6383	2.3456	-.058	A
CU	14.2857	3.0908	14.3617	2.8581	.153	A
CT	20.6946	3.3624	19.7979	3.8341	-1.452	A
TOTAL SEV	92.2679	9.1363	88.7021	10.4365	-2.118	R

H_0= Null Hypothesis, A/R= Accepted/Rejected.

Table 1 indicates the descriptive statistics and t-value computed for the Science and Non-Science sub-sample. The findings show that the students in the science group have a relatively high score on the Scientific Epistemological Views scale than the students of the non-science group (M=92.26 versus M=88.702). When sub-dimensions of Scientific Epistemological Views are investigated, it was observed that both science group and non-science group students scored highest on dimension *"role of social negotiation"* (M=29.10 and M=26.75 respectively). And also, both the groups scored similar lowest on *"the theory-laden exploration"* dimension (M=9.66 and M=9.66), respectively. (The same result is yielded even when the means were made comparable according to the number of items in each dimension).

An independent t-test analysis revealed that students' Scientific Epistemological Views were significantly different on one dimension only; Science major students gained higher scores than non-science major on the dimension *"role of social negotiation"* (M=29.10 versus M=26.75). The calculated t-value was: t (148)= -3.282, p= 0.001; thus, the science group was statistically different on the dimension "*role of social negotiation*" from the non-science group in having the larger mean. Therefore null hypothesis for this dimension is rejected.

Furthermore, for Total Scientific Epistemological Views, the independent sample t-test was associated with a statistically significant effect, t(148)=-2.118, p=.036. Thus the science group was statistically different on SEV from the non-science group in having the larger mean. (M=92.26 versus M=88.70). Therefore the null hypothesis of objective one is rejected.

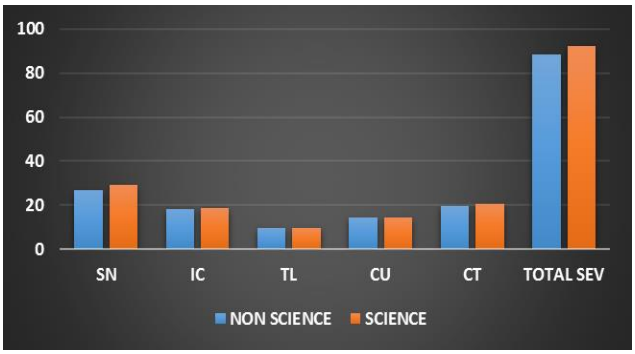

Fig. 1: Mean score of science and non-science groups on each dimension of SEV scale.

Objective 2 - To find the difference in mean scores of Scientific Epistemological Views and its sub-dimensions between male and female postgraduate students.

Hypothesis (H_{02}): There will be no significant difference in the mean scores of Scientific Epistemological Views and its sub-dimensions between male and female postgraduates.

Table 2: The difference in the mean score and t-value between Male and Female subsample.

SEV Subdimensions	Female (N=86)		Male (N=64)		t-test	H_0 A/R
	Mean	SD	Mean	SD		
SN	27.7442	4.7581	27.4844	3.8503	.358	A
IC	18.1744	3.2437	18.4375	3.7707	-.458	A
TL	9.4070	2.3881	9.9688	2.0852	-1.503	A
CU	14.2674	2.9602	14.4219	2.9266	-.318	A
CT	20.5000	3.5670	19.6406	3.7979	1.420	A
Total SEV	90.0930	9.2693	89.9531	11.1717	.084	A

H_0= Null Hypothesis, A/R= Accepted/Rejected.

Data tabulated in table-2 highlights the descriptive statistics and t-test analysis of male and female sub-samples. An independent t-test analysis tabulated shows that the students' SEV was not statistically significant on any dimension in the male and female sub-sample.

The descriptive statistics revealed that both male and female sub-sample scored highest on dimension "*role of social negotiation*" (M=27.48 versus M=27.74 respectively) and lowest on the dimension "*the theory-laden exploration*" (M=9.9 versus M=9.4 respectively). The interesting result found is that both the samples scored almost the same on all dimensions, irrespective of the subject they were enrolled in, except in dimension "*the cultural impacts*." The female sub-sample scored highest on the dimension "*the changing and tentative features of science knowledge*" than the male sub-sample (M= 20.50 verses M=19.64 respectively)

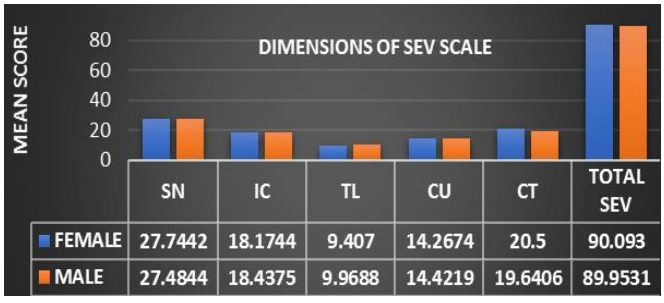

Fig. 4: Mean score of SEV and its sub-dimensions between postgraduate male and female.

Objective 3 - To find the difference in mean scores of Scientific Epistemological Views and its sub-dimensions between students belonging to an urban and rural locality.

Hypothesis (H_{03}): There will be no significant difference

in the mean scores of Scientific Epistemological Views and its sub-dimensions between postgraduate students belonging to an urban and rural locality.

Table 3: The difference in the mean score and t-value between Rural and Urban groups.

SEV Sub-dimensions	Rural (N=54)		Urban (N=96)		t-test	H_0 A/R
	Mean	SD	Mean	SD		
SN	27.4074	3.5846	27.7604	4.7853	-.472	A
IC	17.9074	3.3379	18.5000	3.5392	-1.004	A
TL	9.4259	2.4387	9.7708	2.1787	-.891	A
CU	14.5000	3.1428	14.2396	2.8274	.520	A
CT	19.6667	3.8214	20.3958	3.5908	-1.166	A
Total SEV	88.9074	10.2796	90.6667	9.9785	-1.025	A

H_0= Null Hypothesis, A/R= Accepted/Rejected

After going through descriptive statistics and t-test between postgraduate of urban and rural locality it was observed that urban postgraduates scored slightly higher than Rural postgraduates, the means on sub-dimension *"the inventive and creative nature of science"* is (M=17.9704 versus M=18.5000) for rural and urban postgraduates respectively, while on the dimension "*the changing and tentative features of science knowledge*" mean was found to be (M=19.6667 versus M=20.3958)

The descriptive show that both rural and urban sub-samples scored highest on the SN dimensions of SEV (M=27.4074 verses M=27.7604 respectively) and lowest on the dimension "*the theory-laden exploration*" of SEV scale (M=9.4259 versus M=9.7708 respectively).

The total score of SEV shows an observable difference among the means of the rural and urban sub-sample. The mean of the urban sub-sample is slightly higher than the mean of the rural sub-sample (M=88.9074 versus M=90.6667) but statistically significant difference, and hence our hypothesis is accepted.

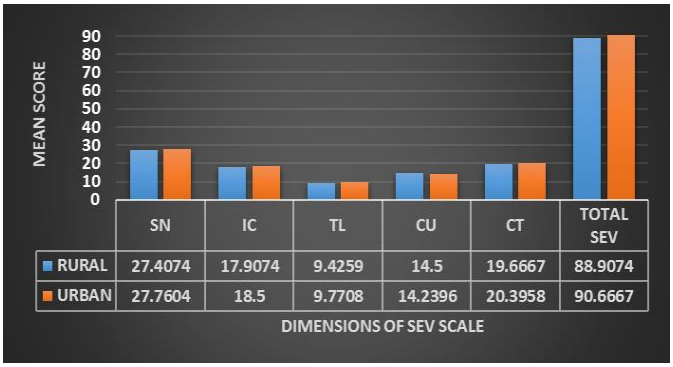

Fig. 3: Mean score of SEV between rural and urban postgraduate students.

Objective 4- To find the difference in mean scores of Scientific Epistemological Views and its sub-dimensions among the different streams.

Hypothesis (H_{04}): There will be no significant difference in the mean scores of Scientific Epistemological Views and its sub-dimensions among postgraduate students of different streams.

Table 4: Summary of one-way ANOVA of SEV in different streams.

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
The Role of Social Negotiation (SN)	Between Groups	304.637	3	101.546	5.800	**.001**
	Within Groups	2556.196	146	17.508		
	Total	2860.833	149			
The inventive and creative nature of science (IC)	Between Groups	22.292	3	7.431	.613	.608
	Within Groups	1770.381	146	12.126		
	Total	1792.673	149			
The theory laden exploration (TL)	Between Groups	5.119	3	1.706	.326	.807
	Within Groups	765.154	146	5.241		
	Total	770.273	149			
The cultural impacts (CU)	Between Groups	53.875	3	17.958	2.129	.099
	Within Groups	1231.458	146	8.435		
	Total	1285.333	149			
The changing and tentative features of science knowledge (CT)	Between Groups	56.245	3	18.748	1.396	.246
	Within Groups	1961.088	146	13.432		
	Total	2017.333	149			
TOTAL SEV	Between Groups	923.689	3	307.896	3.156	**.027**
	Within Groups	14243.145	146	97.556		
	Total	15166.833	149			

Table 4 yields the result of one-way ANOVA, which shows that the effect of SEV on the four streams was significant, F (3,146)= 3.156, p= 0.027. Further analysis revealed that only dimension SN '*The role of social negotiation*' had a significant effect on the four streams.
F(3,146)=5.800, p=0.001. This implies that Scientific Epistemological Views significantly affect the postgraduate students belonging to four streams, namely arts, commerce, science, and social science.
This part of the analysis was done as a post hoc comparison of mean scores of relevant dimensions of SEV scales. For this, we applied Scheffe's post hoc test of multiple comparisons.

Table 5: Scheffe's Test of multiple comparisons of SEV on four groups of different streams.

Dependent Variable	(I) Stream	(J) Stream	Mean Difference (I-J)	Std. Error	Sig.
Role of Social Negotiation (SN)	Commerce	Arts	-1.000	1.086	.838
		Science	-3.440*	.873	**.002**
		Social Sci.	-2.527	1.007	.103
Total SEV	Commerce	Arts	-4.558	2.562	.370
		Science	-6.242*	2.060	**.030**
		Social Sci.	-4.587	2.377	.297

Table 5 displays the significant results found using Scheffe post-hoc analysis. The Scheffe post-hoc criterion for significance indicated that the mean difference between commerce and science group is -6.24, which is significant at a 0.05 level of significance with a p-value of 0.03. This indicates that the commerce group's mean score (M=86.03, SD=12.644) was significantly different from that of the science group (M=92.27, SD=9.136) in SEV. However, the commerce group did not significantly differ from the arts and social science group.
Another significant finding revealed through Scheffe post-hoc analysis was that in the dimension SN (*role of social negotiation*), the mean difference between commerce and science group is -3.44, which is significant at a 0.01 level of significance with a p-value of 0.002. This indicates that the mean score for the commerce group (M=86.03, SD=12.644) was significantly different than the science group (M=92.27, SD=9.136) in the dimension SN (*role of social negotiation*). However, the commerce group did not significantly differ from the arts and social science group.

10. Major findings and Discussion:

10.1 According to groups: With regard to Objective 1, there was a significant statistical difference in the mean scores of Scientific Epistemological Views of science and non-science major postgraduate students. Higher values of SEV scores of science major students indicate more 'sophisticated' beliefs while non-science major students had a lower score, meaning they had 'naive' views of SE.
Moreover, on further analysis, it was revealed that one dimension of Scientific Epistemological Views, i.e, SN (*Role of social negotiation*) was the only dimension with a significant statistical difference in the mean score of science and non-science major students. It means that science major students believe that the development of science relies on communications and negotiations among scientists. They have a sophisticated and constructivist-oriented view. Whereas the non-science major students held a 'naïve' and positivist aligned view, which indicates that they believe that science is a process of individual exploration mainly depending on personal efforts.
This finding is inconsistent with Schommer's (1993) findings. That showed that students from sciences major did not have a more sophisticated view than non-science major students. Edmondson and Novak's (1993) study illustrated the dynamic relationship between students' Scientific Epistemological Views and their orientations to learning strategies. Students who held constructivist views tended to use meaningful and effective learning strategies, and the students who were identified as logical positivists or empiricists tended to be rote learners. There is a widely held view that students belonging to arts and social science are good rote learners than science students; further studies by Songer and Linn (1991), Tsai (1998, 2000) also revealed similar findings like the present research.

10.2: According to Gender difference: Gender difference has been one of the focal points in research studies, probably owing to the innate difference between men and women. No significant gender differences have been reported in the study. However, it was seen that the SEV of the female (M=90.0930) is slightly higher than the male (M=89.9531).
The finding of the study is not consistent with Tsai and Linn (2005) and other researchers like Hoffer (2000) and Schommer (1993). Their study reported gender differences in epistemological belief in which male students gain a higher score on "*the inventive and creative nature of science (IC)*" and "*the changing and tentative features of science knowledge (CT)*" dimensions. Baxter Magolda (1992) has his views as to how gender influences ways of reasoning which appear to be one of the crucial factors in epistemic beliefs.
On close analysis, it was revealed that female and male postgraduate students have similar scores on all the dimensions except the CT dimension, i.e., "*the changing and tentative features of scientific knowledge*." Female scored higher (M=20.5000) than the male (M=19.6406) this could imply that females believe that scientific knowledge is constantly changing and its status is tentative. That is, they may be having a more constructivist-oriented view than the male postgraduate students. Even though Paulsen and Wells (1998) asserted that men have more mature beliefs about the certainty of knowledge than women.
Therefore, this study did not reveal any significant gender difference on epistemic beliefs, and this study is similar to Conley et al. (2004) and Pintrich (2002).

10.3 According to Locality: When studying the SEV among rural and urban postgraduate students, no significant difference was found between them. The finding did reveal a minute noteworthy difference: the urban postgraduate students scored more than the rural postgraduate students (M=90.6667 versus M=88.9074), and in exploring the sub-

dimensions, out of the five sub-dimensions only in two dimensions, the urban postgraduate students scored more than the rural postgraduate students.

CT dimension "*the changing and tentative features of science knowledge*" was scored more by the urban postgraduate students (M=20.3958 versus M=19.6667). This may imply that urban postgraduate students believe that the development of scientific knowledge often involves the change of concepts. This dimension also assert that scientific knowledge is dynamic and its status is tentative (constructivist oriental view)

In the IC dimension, "*the inventive and creative nature of science*," the urban scored higher than the rural postgraduate students (M=18.5000 versus M=17.9074). The possibility could be that urban postgraduate students believe that scientific reality is invented rather than discovered that is a constructivist-oriented view. In addition to it, they might have a notion that human imagination and creativity are essential for scientific knowledge growth.

The lack of significant difference in SEV between urban and rural postgraduate students could be directed to their learning experiences of science at the school level. Traditionally the process and knowledge in science is often presented as objective and universal in the secondary science classroom (Palmer & Marra, 2004)

10.4 According to different streams: The 4th objective of this study was based on studying the significant difference in the SEV among different streams, namely arts, commerce, science, and social science postgraduate students.

According to ANOVA results, Interestingly, two groups stood out to be remarkably significantly different in SEV. The science group scored significantly high on the SEV than the commerce group (M=92.27 versus M=86.03). And also in the SN dimension (*Role of social negotiation)* of the SEV science group scored more than the commerce group (M=29.11 versus M=25.67).

Commerce group – a non-science major group, was the only group that was significantly different from the pure science group. Commerce group held more positivist oriented SEVs, which could mean that they are passive and have a rote view about learning science and rely on teacher-directed instructions. Having an empiricist or positivist aligned view in the SN dimension means that they believe that science is a process of individual exploration, mainly depending on personal efforts. At the university level, the relation between students' major and their views of the nature of science may be associated with their academic majors (Dagher and BouJaoude, 1997; Edmondson and Novak, 1993), as found in this study also.

On the other hand, the Science group had high SEV and scored the highest on the SN dimension (*Role of social negotiation),* which means that the science group believes that the development of science relies on communications and negotiations among scientists (the constructivist oriented views). This finding does share the similarity with the study of Sadler and Fonder (2006), who reported that science majors frequently reference science content knowledge in justifying their claims because of their science background; these students might be less critical of science information provided and tend to believe in the scientific authority.

Hence the science group in this study is more likely to accept scientific authorities as the basis of scientific truth than the commerce group. The findings show that discipline does influence students' image of science development.

11. Educational Implications:

1. The teacher's understanding of science and scientific endeavour proposed to significantly impact their students' scientific understanding and philosophy. Therefore it is recommended to promote sophisticated SEV in the teacher education curriculum.
2. In learning academic subjects, the reading ability has been well recognized as a crucial way of obtaining subject-related knowledge, training teachers to read science texts, and make the students understand the language and context is empirical in enhancing the students' Scientific Epistemological beliefs.
3. Training of teachers in different methodology to teach science and other subjects (instructional approaches and practices to be followed in the classroom should be the main focus of teacher training institutions.
4. Training should be given to the pre-service teacher in the light of constructivist-oriented SEVs. As it will train them to focus on student's understanding, and they will allocate time to student inquiry activities or interactive discussions.
5. Student's epistemological views might undergo change as they move from high school through higher education to become practitioners of some academic fields; hence providing a proper nurturing school environment is necessary as student's views about the culture of science were influenced by their school science.

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