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University Students' Perception regarding Inquiry-Based Learning of Science at Secondary Level

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Abstract

Inquiry-based learning adds immediate support to science education with a growing number of teachers interested in teaching that includes programs or inquiry (Eltanahy et al., 2019). It is a method that engages students in activities that copy scientific research methods and related content or give a presentation in the context of an inquiry (Constantinou, Tsivitanidou & Rybska, 2018). The main focus of the study was to find the views of university students regarding learning science through inquiry-based learning. A survey method was used and a questionnaire regarding the perception of inquiry-based learning in science was filled by students of the university. The sample of this study was 110 students who were doing graduation in a different program of science subject. The results of this research showed that the majority of the students gave a satisfactory and positive response, as they mostly agreed with every item of the questionnaire, and in their opinion inquiry-based learning should be used for science subjects at the secondary level. Students also claimed that it is a more effective method, they acquire motivation and are encouraged during inquiry-based learning. The study recommended that teachers should use specific methods in their classes to give better education. To systematize these applications, teachers can be assigned the researcher role in action research to be directed in the field of education to allow them to conduct inquiry and engage the students in learning on their own.

Keywords: Science Students' Perceptions, Inquiry Based Learning in Science, Challenges of Inquiry-Based Learning

Introduction

Inquiry-based learning has been implemented and valued as instructional method for students of all levels (Teig, Scherer & Nilsen, 2018). Inquiry involves doing observations, asking questions, organizing queries and to review what is already known under the experimental evidences, as inquiry is a complicated activity (Guido, 2017). It also involves the usage of tools to collect, analyze and infer data and suggesting answers, descriptions and calculations and the result (Constantinou, Tsivitanidou & Rybska, 2018). Recognition of expectations, usage of critical and logical reasoning and deliberation of substitute explanation is needed in inquiry (Fernandz, 2017). Inquiry-based learning is a divergent manifestation, even this appearance has many changes and substitutes itself, for example: inquiry, undergraduate research, guided-inquiry, research based teaching, teaching research links and inductive teaching and learning, discovery learning (Areepattamannil, Cairns & Dickson, 2020).

Learning with the inquiry method offers an opportunity for students to discover and investigate the notion of a procedural, systematic, and interconnected between one concepts with another concept (Constantinou, Tsivitanidou & Rybska, 2018). According to Summerlee and Muree (2010) those students of university who took part in inquiry-based learning (IBL) classes showed increased level of motivation, in their community, to volunteer, as compared to those students who didn't take IBL classes (Eltanahy et al., 2019). Studies have shown that students who are more involved in class discussions receive higher marks in standardized examinations (Guido, 2017). Through inquiry based learning students can develop an understanding of the deep and real world and begin to enjoy, understand it, predict and create new knowledge on their own when they are given the chance to nurture their own skills and construct their concepts and ideas (Gholam, 2019).

The concept of Inquiry has a broad history in teaching method, specifically in the teaching of science, and is evident backwards in scholars such as Dewey, Bruner, and Postman and Weingarten

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(Eltanahy et al., 2019). It is broadly acknowledged by the science education communal that inquiry-based learning is an extremely operative approach, and through this derives the suggestion that inquiry-based learning is an additional real teaching method than other approaches like traditional and teacher-centered teaching (Areepattamannil, Cairns & Dickson, 2020). Inquiry-based learning to add immediate support to science education with a growing number of teachers interested in teaching that includes programs or inquiry (Aydeniz, Bilican & Senle, 2020). Consequently, improving learners' attitude of self-reflection is at the central of inquiry application, and it is supposed as a valued produce of this procedure (Guido, 2017). Student attitudes can be shifted toward inquiry when the content holds meaning to their experiences and the learning environment is caring and fosters individual growth and isn't based on measuring one student against another (Cairns & Areepattamannil, 2019).

The main focus of the study was to identify t the views of university students regarding learning of science through inquiry-based learning. As inquiry learning involves critical thinking, experimentation and problem-solving, which is mainly included in learning of science subjects, that's why students with any subject of science as their major were a central concern of this study. This research helped to recognize their perceptions and ideas, and the problems or challenges that they faced at their secondary or current level of education.

Objectives of the study

The main objectives of the study were to:

1. Know views of university students regarding Inquiry based learning of science.
2. Identify effectiveness of Inquiry based learning in science learning.
3. Recognize the problems and challenges of inquiry based learning of science at secondary level.

Research Questions

Following research questions were framed in the light of research objectives:

1. What are the views or perceptions of university students about inquiry-based learning in science learning?
2. What is the effectiveness of inquiry based learning in science learning?
3. What are the challenges and problems of inquiry based learning in science subject at secondary level?

Significance of the Study

The tenacity of the present research is to explain students' perceptions regarding the application of inquiry method for teaching and learning science at secondary level, and effectiveness and challenges of the inquiry technique in science classes. The research findings will be explained in light of participants' perspectives. This study will be importance to highlight the useful role of inquiry-based learning in supportive science learning in light of students' perceptions. Students and teachers were the focal subjects that ensure the effective application of inquiry-based learning, by supportive its perspectives. This study will be beneficial for future science teachers and science students and probably for the curriculum designers who can include or keep in mind inquiry learning while making curriculum design.

Literature Review

Inquiry is a method that is used in education and learning to seek reasons or information by asking questions (Suwono, Cahya-Adi & Suarsini, 2019). Sometimes related to research or the search for truth within education, research may be useful in other areas such as history (Teig, Scherer & Nilsen, 2018), geography art and scientific and mathematical ability and work whenever questions are raised and possible reasons are evaluated (Guido, 2017).

Inquiry-based learning to add immediate support to science education with a growing number of teachers interested in teaching that includes programs or inquiry (Eltanahy et al., 2019). It is a method that engages students in activities that copy scientific research methods and related content or give a presentation in the context of an inquiry (Constantinou, Tsivitanidou & Rybska, 2018). Inquiry-based learning should address the importance of "learning scientific processes, such as the inclusion of explicit questionnaires and data-based support rights" (Guido, 2017). Researchers explores the difference among three inquiry terms: inquiry, science inquiry, and scientific inquiry (Constantinou, Tsivitanidou & Rybska, 2018). Firstly, inquiry mentions to looking for information to resolve an inquiry deprived of making actions or events that support resolve this inquiry. The second term, science inquiry, shows the scientific techniques of studying an inquiry through actions, search, and

tests that might be postured by the educator, the learner, or if in the textbook. Lastly, scientific inquiry is a comprehensive notion that mentions to the entire procedure of education, counting learners' results such as the information, attitudes, and critical thinking abilities that are increased throughout the reliable inquiry of the actual realm (Eltanahy et al., 2019).

Practical use of inquiry-based learning involves students in independent research, learning logical thinking, and in the nature of the relationship between data and theory (Areepattamannil, Cairns & Dickson, 2020). It is not so much the result of the most important inquiry but the process used, so it is important to take the time to discuss and encourage students to make their views clear (Cairns & Areepattamannil, 2019). Watson in 2000 defined that working on this common understanding of scientific inquiry, extensive research supports the amount of research as a teaching method (Aydeniz, Bilican & Senle, 2020). According Kubicek, (2005) the advantages of inquiry-based learning might be reduced at what time accomplishments are not exposed and targeted at students (Gholam, 2019).

Inquiry-based learning method contains of actions concentrating on students' information, abilities, and attitudes that energetically involve learners in discovery their own replies to a doubtful problematic (Fernandz, 2017). It is significant that learners select their own inquiry or problematic to be examined (Guido, 2017), and that they are able to direct their own investigations (Eltanahy et al., 2019). This not only raises motivation, it is also a real way of inquiry, and thus builds a higher understanding of the state of science (Teig, Scherer & Nilsen, 2018). Moreover, inquiry-based learning methods deal chances for students to improve higher-order intellectual abilities that permit for the presentation of their deepest sympathetic of scientific values to daily occurrences, and individual and social matters (Anderson, 2002; Constantinou et al., 2018). Therefore, scientific abilities are important for learners to associate their knowledge to real preparation, the realistic actions specified in the science textbook would be sustenance the great phases of inquiry to improve the process of the scientific teaching in the informative background (Aydeniz, Bilican & Senle, 2020). Therefore, applying inquiry actions steadily might encourage learners' attitudes in the direction of science and improve their interest to study, that in opportunity might reduction their misunderstandings regarding scientific learning and eradicate their chance of getting inappropriate decision in their experimentations (Eltanahy et al., 2019).

Research Methodology

In this research quantitative research was used and the paradigm of this study was positivism. A survey method was used and a questionnaire regarding the perception of inquiry-based learning in science was filled by students of the university. The sample of this study was 110 students who were doing graduation in a different program of science subject. Which were selected randomly from the Township campus of the University of Education, Lahore.

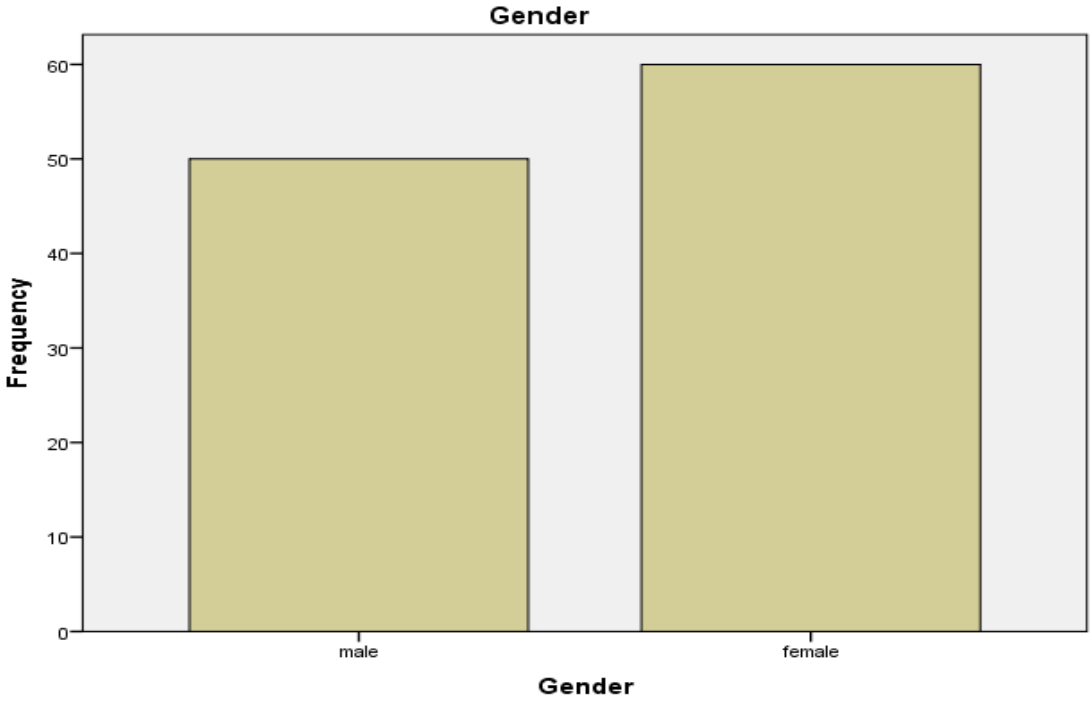
In this research, a self-constructed questionnaire was used as the tool which was consisted of a total of 32 close-ended questions. A Likert scale of 1 to 5 was used, strongly Agree (5), agree (4), neutral (3), disagree (4), and strongly disagree (1) for measuring responses of the respondents. In the questionnaire, there were three main sections. The first section was related to the views and perceptions of students. In the second section, there were questions related to the effectiveness of inquiry learning. In the third section, students were asked about the challenges and problems of inquiry learning of science. The validity and reliability of the questionnaire were checked by pilot testing. In this study, the content validity of the questionnaire was approved by university professors and 0.958 reliability was obtained with Cronbach's appropriate alpha coefficients. A reliability coefficient greater than 0.70 confirms that the scale used in the study is reliable (Hair et al., 2006).

Data Analysis and Interpretation

Data were analysis with Statistical Package for Social Sciences (SPSS). Descriptive statistics (percentage, frequency, mean, standard deviation and One-Sample test) were used to analyze the data.

Table 4.1: Demographic description of participants' data on the basis of Gender

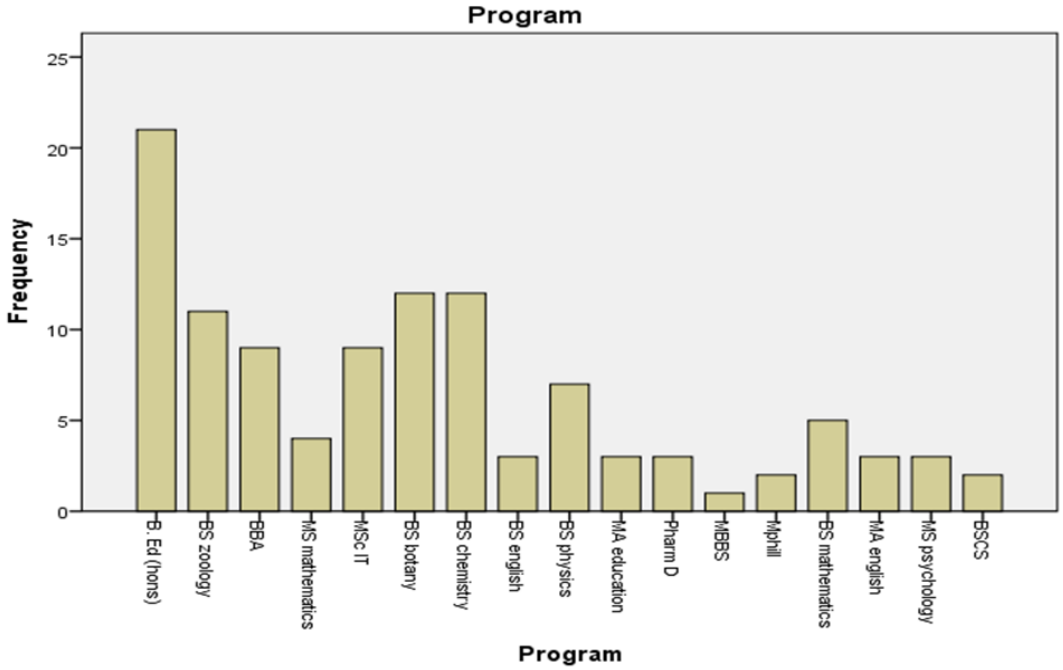
Gender		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	50	45.5	45.5	45.5
	Female	60	54.5	54.5	100.0
	Total	110	100.0	100.0	



In frequency, table the male students, 45.5% and Female students, 54.5% of the study.

Table 4.2: Demographic description of participants' data on the basis of Program.

	Program	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	B. Ed (hons)	21	19.0	19.1	19.1
	BS zoology	11	10.1	10.0	29.1
	BBA	9	8.2	8.2	37.3
	MS mathematics	4	3.6	3.6	40.9
	MSc IT	9	8.2	8.2	49.1
	BS botany	12	10.9	10.9	60.0
	BS chemistry	12	10.9	10.9	70.9
	BS English	3	2.7	2.7	73.6
	BS physics	7	6.4	6.4	80.0
	MA education	3	2.7	2.7	82.7
	Pharm D	3	2.7	2.7	85.5
	MBBS	1	.9	.9	86.4
	MPhil	2	1.8	1.8	88.2
	BS mathematics	5	4.5	4.5	92.7
	MA English	3	2.7	2.7	95.5
	MS psychology	3	2.7	2.7	98.2
	BSCS	2	1.8	1.8	100.0
	Total	110	100.0	100.0	



In frequency table (4.2) the B. Ed (hons)19.0%, BS zoology students 10.1%, the students of BS botany 10.9% and BS chemistry 10.9%. Whereas, students of other programs were comparatively less.

Table 4.3: Views and perceptions of university students about inquiry based learning in science.

Statements	Mean	Std. Deviation
Do you like learning new things while using inquiry method?	1.95	.892
Do you spent your time during your learning experience in solving your own inquiry or wondering the study of science?	2.15	.887
Do you prefer learning through inquiry over ways you have been taught in the past?	2.09	.884
Do you think you would like to take more courses that use inquiry based instructions?	2.42	1.128
Do you enjoy doing lab activities in class using inquiry based learning?	1.94	1.034
Do you like science experiments while using inquiry method?	2.18	.969
Do you like to explore your experiment rather than look at the textbook?	2.09	1.216
Do you think you will ask higher order questions to extend your knowledge during study of science with?	2.22	.882
Do you think Inquiry based learning is the best way of learning science.	2.08	1.059
Students like working by exploring the information with inquiry learning.	2.15	1.021
Students gain new knowledge because of learning inquiry based instructional strategies during study of science.	1.91	.991

Table 4.3 shows the highest mean (Mean=2.42) on the item which stated 'Do you think you would like to take more courses that use inquiry based instructions'. The second highest mean on item which sated that 'Do you think you will ask higher order questions to extend your knowledge during study of science with' (Mean=2.22). The third highest mean was on the statement 'Do you like science experiments while using inquiry method' (Mean=2.18). It indicates to the above table that means of the statements about presents **Views or perceptions** that promoted by the university students of the educational institutions is ranging from 1.91–2.41 which including "Mean" of the scale. The result that is conducted from this table is that majority of students like to take more courses that use inquiry based learning.

Table 4.4: Perception regarding of the effectiveness of inquiry based learning of science.

Statements	Mean	Std. Deviation
The inquiry based learning in science will be useful in improving learners' critical thinking skills.	1.96	.834
After using inquiry approach learners can convert information from one form to another.	2.10	.948
After using inquiry approach learner can give an example and classify or sort items into meaningful categories.	2.08	1.015
After using inquiry approach learner can describe, interpret or explain issues and problems, patterns, reasons, cause and effects, significance or import relationship points of views or process.	2.06	.960
Using inquiry based instructional strategies learner can draw conclusions and cite evidence.	2.17	1.039
After using inquiry based instructional strategies can analyze and synthesis information from multiple sources.	1.97	.981
Inquiry based learning in science is very useful for you to solve everyday problems.	2.11	1.008
Doing an experiment through inquiry makes learners more aware of the topics they learned.	2.04	1.013
Students will remember learning if they do with their own selves through inquiry.	2.24	.967
After the using inquiry method in science experiment learner have much interest about the topic.	2.06	.989
Using inquiry based learning enhances learner's interest in Science.	2.13	1.076
Inquiry based learning is more effective than traditional learning.	2.06	1.086
Inquiry based learning enhance learners' critical thinking and cognitive skills.	2.14	1.053
Inquiry based learning involves an extra level of motivation.	2.29	1.103
The inquiry based learning in science will be useful in improving learners' critical thinking skills.	2.04	1.013

Table 4.4 shows highest mean on the statement of 'Inquiry based learning involves an extra level of motivation' (Mean=2.29). Second highest mean on the item that stated 'Students will remember learning if they do with their own selves through inquiry' (Mean=2.24). And the third highest mean on statement 'Using inquiry based instructional strategies learner can draw conclusions and cite evidence' (Mean=2.17). It indicates to the above table that means of the statements about presents **Effectiveness** that promoted by the university students of the educational institutions is ranging from 1.97–2.29 which including "Mean" of the scale. It is concluded that majority of the statements are shown satisfied. So, they are agreed.

Table 4.5: Perception regarding the challenges of inquiry based learning of science.

Statements	Mean	Std. Deviation
When learner take part in an inquiry in a disengaged manner (with less motivation level), it does not support learning.	2.32	.957
Meeting the limits of the environment in Inquiry based learning is quite challenging factor.	2.42	1.017
Do you think learning through inquiry gets difficult due to limited numbers of resources?	2.29	1.061
Efficiency of inquiry learning is effected due to lack of background information.	2.39	1.041
Do you think time limit is a major factor in delimitations of inquiry learning?	2.16	1.105
Do you think inquiry learning can have bad impact on teacher's or student's attitude (due to lots of questioning it may cause anxiety in their behavior)?	2.52	1.317

The highest mean in this table 4.5 was for the statement 'Do you think inquiry learning can have bad impact on teacher's or student's attitude (due to lots of questioning it may cause anxiety in their behavior)' (Mean=2.52). The second highest mean was of the item that stated 'Meeting the limits

of the environment in Inquiry based learning is quite challenging factor' (Mean=2.42). It indicates to the above table that means of the statements about presents **Challenges** that promoted by the university students of the educational institutions is ranging from2.16–2.52 which including "Mean" of the scale. It is concluded that majority of the statements are shown satisfied. So, they are agreed.

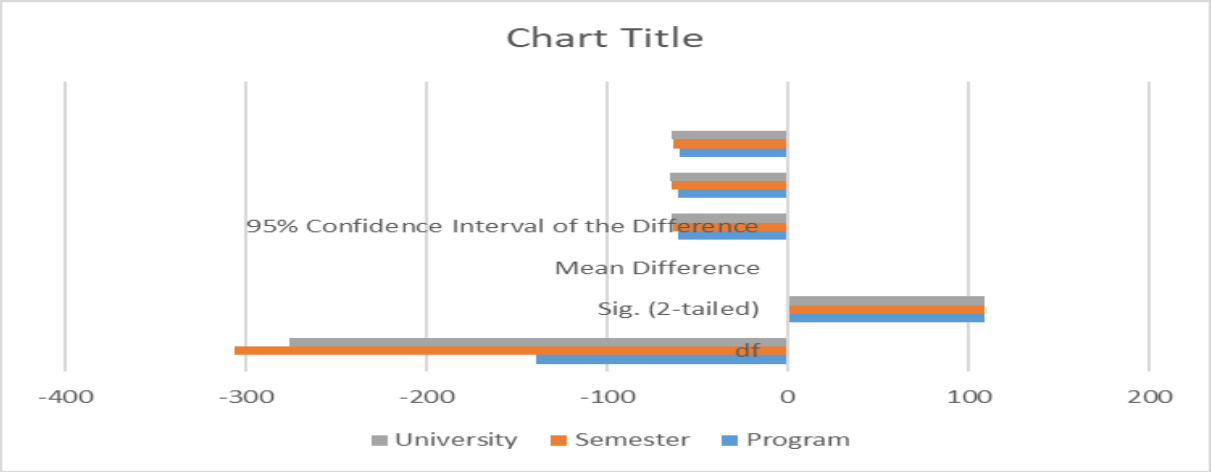
Table 4.6: One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Program	110	6.11	4.548	.434
Semester	110	2.91	2.178	.208
University	110	1.95	2.453	.234

One sample t-test examines whether the mean of a population is statistically different from a known hypothesized value it is a parametric test. Above values shows that there is a difference between the mean values of the population and hypothesized values.

Table 4.7: One-Sample Test

					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Program	-139.264	109	.000	-60.391	-61.25	-59.53
Semester	-306.211	109	.000	-63.591	-64.00	-63.18
University	-276.053	109	.000	-64.555	-65.02	-64.09



The table above shows that the calculated t value is compared from the t distribution table with degree of freedom df=n-1 and the chosen confidence level. The calculated t vale is greater than the critical t value. Which rejects the null hypothesis. It shows the satisfactory condition of the system of all programs being taught in all universities. The above results also show that those students of the university who took part in inquiry-based learning (IBL) classes showed an increased level of motivation, in their community, to volunteer, as compared to those students who didn't take IBL classes.

Discussion

This research was conducted to know the perception of university students regarding inquiry-based learning. In this research quantitative method was used. The questionnaire was designed to know the views of students and also to know about the effectiveness and challenges of this learning method. According to the findings and results of this research majority of the students gave satisfactory and positive responses, as they mostly agreed with every item of the questionnaire and in their opinion inquiry-based learning should be used for science subjects at the secondary level. It was noticeable from the research that inquiry learning is an effective method for learning science at the secondary level. The more quantified nature of the research facilitated in receiving predictable outcomes and

covered the ways for the attainment of objectives of the research. As the traditional instructions' method does not involve students' motivation and engagement, it does not enhance students learning skills. During the data collection, the researcher originates that most of the students procured an extraordinary interest in answering the questionnaire and perceptions regarding inquiry learning of science which reinforces the determination of the researcher.

This study showed a positive result towards the use of inquiry-based learning. According to the students, learning would be easy through an inquiry-based method. Students also claimed that it is a more effective method, they get motivated and encouraged during inquiry learning. The above results also show that those students of the university who took part in inquiry-based learning (IBL) classes showed an increased level of motivation, in their community, to volunteer, as compared to those students who didn't take IBL classes. According to Summerlee and Muree (2010), those students of the university who took part in inquiry-based learning (IBL) classes showed an increased level of motivation, in their community, to volunteer, as compared to those students who didn't take IBL classes (Eltanahy et al., 2019). The students' ratings on table 4.3 showed that they agreed from all the items that respond to their interests and perceptions about inquiry learning. Such reasons as inquiry-based learning assistances learners create their associates regarding what they learn. In this method, learners turn into energetic learners who examine to idea novel sense of representativeness as cheapness is abridged and teamwork is improved throughout the procedure of inquiry-based learning (Eltanahy et al., 2019). The interest assistances they involve and increase a deepest sympathetic of science subjects and content, as a substitute of mainly learning and remembering instructions, concepts, or formulations. In spirit, the additional that learners involve in the inquiry-based learning accomplishments, they would be able to improve researchable inquiries, collect and combine information, interconnect the outcomes attained, and evaluate their improvement. Consequently, increasing learners' attitude of self-reflection is at the main of inquiry application, and it is observed as valued produce of this method (Areepattamannil, Cairns & Dickson, 2020). The researcher discovered that students showed interest in learning through inquiry-based learning and engaging themselves while learning. As inquiry-based learning involves critical thinking students found it more effective than traditional learning. Recognition of expectations, usage of critical and logical reasoning, and deliberation of substitute explanation are needed in inquiry (Fernandz, 2017).

Conclusion

Whereas Students faced challenges and problems like inquiry-based learning involves an extra level of motivation, this learning is not supported when a learner has a low level of motivation. The challenging and long nature of inquiry needs a difficult level of motivation on the part of students than is needed by eldest learning actions. To raise learning that motivation must be the result of interest in the study its results and its effects (Fernandz, 2017). The major challenge was meeting appropriate and on-time learning resources and time at the secondary level. Overall students showed positive and satisfactory responses toward learning through inquiry-based learning of science at the secondary level.

Recommendation

Teachers should use specific methods in their classes to provide better education. To systematize these applications, teachers can be assigned the researcher role in action research to be directed in the field of education to allow them to conduct research and engage the students in learning on their own. However, students also face some challenges like lack of resources and less time for inquiry-based learning in science classes. These challenges and problems should be solved by the authorities of institutes to promote inquiry-based learning. Moreover, in future studies, different dimensions of inquiry-based learning can be investigated. Teachers who want to avoid typical commonplace lessons can apply the action plan proposed in this research and develop similar plans for science course units.

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