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Problems Faced by Teachers and Students in Teaching-Learning Geometry at Secondary Level

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Abstract

Visually Impaired (VI) students confront a diversity of challenges in the area of learning Geometry. Such challenges create hurdles for visually impaired students to approach visual and tactile sense in learning Geometry. Diversity of challenges in spatial concepts of Geometry will continue to exist unless effort is directed to find the depth of these problems. This study was designed to explore the challenges of visually impaired students in learning Geometry at the secondary level. For this purpose, the data was collected from 100 visually impaired students learning Geometry at the secondary level, including totally blind and low vision studying at secondary level in 6 districts of Punjab (D. G. Khan, Rajanpur, Multan, Muzaffargarh, Attock and Bahawalpur and their teachers teaching them geometry (30). A 5 point Likert scale questionnaires were prepared to collect the data from VI students and teachers. After the analysis, results revealed that visually impaired children were facing numerous challenges affiliated with learning of Geometry. Unavailability of course material in updated Braille version, individual differences (low vision, totally blind), excessive homework, and difficult Geometry concepts were reported major problems for visually impaired children. Teachers' qualifications did not matter unless they would not be trained to develop visual and spatial concepts of Geometry for visually impaired students. It was also analyzed that teachers did not motivate the students who did not like Geometry.

Keywords: visually impaired students, geometry, spatial concepts, updated braille version, individual differences

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Introduction

The geometry provides the foundation for the development of mind and knowledge. It plays a vital role in everyday life to identify shapes and understand the material used in routine life. On the basis of knowledge of geometry, a student can enhance his or her mental ability and can develop mathematical reasoning. Geometry and spatial sense are fundamental components of mathematics learning. Braille is the most powerful medium used by visually impaired children. In geometry class, students learn features of spatial visualization, thinking of two or three dimensions of a geometric shape in space, and looking at various aspects is the most important part of geometric thinking.

Geometry as a subject area is a complex and difficult field for sighted people hence it is more challenging for a visually impaired person to learn and get the concept of Geometrical shapes as well. Visually impaired children must be taught more explicitly rather than sighted students these geometrical shapes. Visually impaired students learn in the same way as sighted students but some modifications and adaptations are required to teach them (Tanti, 2007). Students face different problems in mathematics, especially in Geometry. Learning geometry is not just learning the definitions or the attributes of geometrical concepts but also have the ability to analyze the properties of two dimensional (2D) and three dimensional (3D) geometric shapes and develop mathematical arguments about geometric relationships, to specify locations and spatial relationship, to apply transformations and to use symmetry, visualization, spatial reasoning, and geometric modeling to solve problems. To approach these Geometric concepts, children need their visual or tactile senses. The children who use these senses tend to recognize Geometric shapes (Bouaziz, Russier, & Magnan, 2005). To help visually impaired children Mathematics notations are used that are named as Braille codes (Bitter, 2013). Visually impaired children require more time to get concepts about Geometrical shapes such as: Line, graph, symmetry, rectangle, triangle, square, area, and Perimeter.

Mathematics is the subject of figures and numerals and Geometry is that area of Mathematics which is understandable through touch and sense especially for the visually impaired children. The quality of teaching Geometry depends on the quality of teaching. Teacher can give concepts about Geometry through touch and sense to their visually impaired students for teaching Geometry. Agrawal (2004) suggested that cognitive structures of a student are not affected by vision loss. “What they grow deficient in are primarily their perceptions and secondarily their symbolic

abstractions which are gained through visual perception". These perceptions are given through touch and sense and more time is dedicated by the teacher for better effective and useful understanding (Boafo-Agyemang, 2010).

The quality of mathematics learning depends on the quality of the teaching. Mathematics pedagogy emphases on the pathway in which teachers help their students come to perceive and to become competent to use mathematics in different domains. Naik (2018) observed that teacher's qualification matters along with his training to tackle the situation according to student's need. The teachers have to introduce and explain a topic in different approaches, describing reasons about its existence and appropriateness through some exertions, like models, small group discussion, asking questions which push students to explore and reveal their ideas (Das, 2015). A student can be a good student if a teacher concentrates on his learning, use different methods to teach him and develop interest to gain the knowledge and seek something. Effective mathematics teaching requires a serious commitment to the development of students understanding of mathematics. A Mathematics teacher requires more time, efficiency, knowledge, competency, and patience to teach Geometry to visually impaired students. Some of the general approaches to teaching geometry to the blind are: Tactile as in Braille and other raised representations. Tactile features are used to read characters with fingers and it depends on the medium that is used (Prescher, Nadig, & Weber, 2010).

It has been observed that Children with Visual Impairment face barriers in education particularly in the field of Mathematics. They are not able to get quality education. There are some issues in specials education schools related to teachers and students in teaching and learning Geometry. Change in curriculum, non-availability of instructional material (Braille books, Audio aids, Tonal aids and Geometrical instructional material), Pedagogical skills (Teaching methods) and other issues with respect to the subject Geometry. "Teachers are expected to teach geometry when they are likely to have done little geometry themselves since they were in secondary school, and possible little even then"(Jones, 2000).

Visually impaired students face many problems in daily life to learn. It is very hard to build geometrical concepts for students with visually impaired. One of the most difficult challenges has been teaching concepts involving three-dimensional objects. 3-D problems are found in all levels of mathematics. It comprises different shapes, lines and angles that

overlaps and students become confused to solve problems and to make diagrams (Osterhaus, 2001).

Equipment usage is crucial for the achievement in geometry especially for the visually impaired students during the lecture. Students use different materials to have a deeper perceptive of Geometry, to appraise their own knowing, and seeking contiguous support when they need to. Most important material that visually impaired children may use are those from which they can take visual concept and/or voice support.

Learning Geometry is biggest obstacle for the visually impaired children. It needs highly haptic skills and read or writes tactile graphs and geometric shapes. Visually impaired children's strongest haptic medium is Braille. (Christensen & ApS, 2000) described that Braille code is an important medium for visually impaired children but information technology has pivotal role for learning with best suitable way.

Personal observation shows that in special schools only Braille books are provided for reading and Braille frame, Braille papers and charts for writing. Geometry is a subject that is more practical than reading and writing. So, it requires more practical work. And blind children require equipment to do practical work. It is also observed that it is very challenging situation that teachers are available for teaching the visually impaired students but due to lack of large print books, Braille books and other relevant Geometry material, they are deprived of teaching and learning Geometry.

Brawand and Johnson (2016) argued that effective methods including a combination of abacus, braille codes, tactile materials and concrete materials must be used during instructions to students with visual impairment. Some students need oral assessment, some require written, some wants written work and majority of students need more time completing the geometry task. Several studies have shown that blind students can learn Geometry when they are taught in an appropriate manner. This encourages us to argue in favor of giving blind students the opportunity to follow the same mathematics syllabus of their sighted peers (Buhagiar & Tanti, 2013). Teachers do not give proper time to every student with their special need. Karshmer and Farsi (2007) reported "Majority of mathematics teachers don't know, and don't care to learn math Braille notations and you can easily see the problems associated with learning math if you are severely visually impaired or blind".

Geometry is a broad field of Mathematics; it has great importance in our daily life. Tanti (2007) argued that teaching of Mathematics is perpetual duty of the teacher to attempt and practice what they evaluate to be the most efficient way to boost up learning and acquiring knowledge.

The teaching of Geometry can return various forms and different methods and it can be conveyed through the different experience and perceive.

Objectives

The objectives of the study were:

1. To explore the problems faced by visually impaired student in studying Geometry.
2. To analyze the challenges face by teachers while teaching Geometry to visually impaired students.
3. To find out the knowledge and skills of teachers while teaching Geometry to visually impaired students.

Methodology

The research method was quantitative in nature. Survey method was used to analyze the challenges in learning of Geometry for visually impaired students at secondary level.

Population

Population of the study comprised of all visually impaired children (100) including totally blind and low vision studying at secondary level in 6 districts of Punjab (D. G. Khan, Rajanpur, Multan, Muzaffargarh, Attock and Bahwalpur) and their teachers teaching them geometry (30).

Sample and sampling technique

All population was taken as the sample of the study.

Tools of the research

i) Questionnaire for Students:

The questionnaire for the students to explore the challenges in studying and learning geometry. It consisted of 22 items with Likert scale response type and one open ended question. 5 point Likert scale scoring scheme was SA=5, A=4, UNC=3, DA=2, SDA=1

ii) Questionnaire for Teachers:

The questionnaire was developed for teachers to analyze the challenges they face while teaching Geometry to visually impaired students and to find out their knowledge, skills, and attributes as teachers. It comprised of 23 items divided in two sections:

i. Difficulties in teaching Geometry (Items no 1 to 8).

ii. Teacher's knowledge and skills (Items no 9 to 21).

5 point Likert scale type was used and scoring scheme was SA=5, A=4, UNC=3, DA=2, SDA=1. Two open ended questions were also included. (Item no 22 and 23).

Validity and Reliability

Tool was validated on the opinions of experts of the field, focusing on objectives defined for the study. The committee approach was used to determine the validity of the tool. Senior special education teachers and faculty members of university working in special education department were in the committee. The committee suggested several alterations in the wording of some statements. The changes suggested by the committee were discussed with supervisor and incorporated.

A pilot test was conducted on 5 senior special education teachers teaching Geometry, 5 parents and 5 visually impaired students studying at secondary level for each respective tool. These teachers and students were not included in the sample. After analyzing the results of pilot test, the tools were ready to be administered as a data gathering tool. The reliability of questionnaires for students and for teachers was determined through SPSS using Cronbach's Alpha, the readings were 0.95 and 0.93 respectively.

Data Collection and Data Analysis

For the purpose of data collection, questionnaires for teachers, visually impaired students and parents residing at D.G.Khan were personally distributed and collected the data whereas for the other cities, friends and colleagues were used for this purpose. They were explained the processes on Skype, phone and meetings whichever the mode was convenient. The data collected through the questionnaires from the sample of 30 teachers and 100 visually impaired students were tabulated and analyzed by using percentage and mean score of their responses.

Results

1. Analysis of Questionnaire of Visually Impaired Students:

Questionnaire was administered with the visually impaired students at secondary level. Frequency and percentage were calculated through SPSS for the analysis of each item.

Table 1.
Choice of Subject for Visually Impaired Student

Statement		Response Category				
		SA	A	UDC	D	SD
Geometry is one of my favorite subjects	Frequency	10	15	20	30	25
	%	9.0	13.5	18.0	27.5	22.1
I find geometry interesting.	Frequency	15	26	8	26	25
	%	13.5	23.4	7.2	23.4	22.5

Table 1 indicated that about 49 percent respondent were disagreed about the statement that Geometry was their favorite subject. Geometry was favorite subjects of only 22 percent respondent. About 18 percent don't know whether the geometry was their favorite subject or not. About 46 percent of respondent were in favor of the above statements that they find geometry interesting while 37 percent against the statement. However, about 7 percent were uncertain.

Table 2.
Parents/Siblings Help in the Geometry Work

Statement		Response Category				
		SA	A	UDC	D	SD
My parents buy necessary things to learn geometry when I ask them.	Frequency	3	13	5	42	37
	Percentage	2.7	11.7	4.5	37.8	33.3
My siblings/ anyone else help me when I require for geometry.	Frequency	8	15	8	47	22
	Percentage	7.2	13.5	7.2	42.3	19.8

Table 2 indicated that about 71 percent of respondent were against the statement that they are provided with items required for geometry work by their parents. Similarly, 62 percent of respondents negated the provision of help from their siblings.

Table 3.
Teachers Training and Qualification as Reported by VI Students

Statement		Response Category				
		SA	A	UDC	D	SD
Our geometry teacher is well trained for teaching geometry.	Frequency	18	18	10	31	23
	%	16.2	16.2	9.0	27.9	20.7
My Math teacher is well qualified for teaching visually impaired students.	Frequency	5	9	0	38	48
	Percentage	43.2	34.2	0	8.1	4.5

Table 3 indicated that teachers teaching Geometry to visually impaired children were well qualified but not well trained for this purpose.

Table 4 .
Availability of Braille and Supported Material

Statement		Response Category				
		SA	A	UDC	D	SD
I am provided with tactile/soft copy/audio material.	Frequency	18	13	0	42	27
	%	16.2	11.7	0	37.8	24.3
I am provided with course material/textbook in Braille.	Frequency	39	39	0	15	7
	Percentage	35.1	35.1	0	13.5	6.3
I have a geometry box	Frequency	18	18	10	31	23
	%	16.2	16.2	9.0	27.9	20.7

Table 4 indicated that necessary equipment such as Geometry boxes, Course material in Braille version / soft copy or audio material was not provided to them.

Table 5.
Difficulty in Learning Geometry Concepts and Geometry Instruments

Statement		Response Category				
		SA	A	UDC	D	SD
I find it difficult to learn geometry concepts.	Frequency	42	38	7	9	4
	%	37.8	34.2	6.3	8.1	3.6
Teacher always demonstrates geometry lesson with geometrical instruments.	Frequency	3	8	5	53	31
	%	2.7	7.2	4.5	47.7	27.9

Table 5 indicates that about 72 percent of respondent were in favor of the above statements they felt difficulty to learn Geometry concepts. Perhaps the reason was that 65 percent of respondent were against the statements that their teacher use Geometrical instruments for demonstration geometry lessons.

Table 6.
Satisfactory Response on Student's Question and teacher's Knowledge

Statement		Response Category				
		SA	A	UDC	D	SD
My teacher always gives satisfactory answers of student's question on lesson taught.	Frequency	40	34	7	11	8
	%	36.0	30.6	6.3	9.9	7.2
Geometry teacher's knowledge is poor.	Frequency	23	31	10	18	18
	%	22.1	27.5	0	18.0	13.5

Table 6 indicated that about 66 percent of respondents were in favor of the above statement that their teacher gave them satisfactory answer on lesson taught. 50 percent of respondents were in favor of the statement that Geometry teacher's knowledge was poor.

Table 7.
Activity Method for Teaching Geometry

Statement		Response Category				
		SA	A	UDC	D	SD
Teacher uses activity method to teach us geometry.	Frequency	24	33	0	28	15
	%	21.6	29.7	0	25.2	13.5
We are taught geometry formulas through lecture method.	Frequency	30	49	0	17	4
	%	27.0	44.1	0	15.3	3.6

Table 7 indicated that about 51 percent of respondents were in favor of the above statements that the teacher used activity method to teach Geometry. While 39 percent were against the statement. Similarly, 71 percent of respondents were in favor of the statement that teacher taught Geometry formulas through lecture method. While 19 percent were against the statement.

Table 8.
Geometry Syllabus and Teacher's Method

Statement		Response Category				
		SA	A	UDC	D	SD
Geometry syllabus is too long to learn	Frequency	46	38	2	10	4
	%	41.4	34.2	1.8	9.0	3.6
Teacher's method of teaching geometry makes boring to us.	Frequency	43	40	0	11	6
	%	38.7	36.0	0	9.9	5.4

Table 8 indicated that about 76 percent of respondents argue that Geometry syllabus was too long. The same % of student reported that

teacher's method made them boring. And 15 percent were against the statement.

Table 9.
Satisfactory Response on Student's Question and Teacher's Attitude

Statement	Response Category	Frequency	Percent
Teacher's attitude puts me off from geometry	Strongly Disagree	23	20.7
	Disagree	31	27.9
	Uncertain	10	9.0
	Agree	18	16.2
	Strongly Agree	18	16.2

Table 9 indicated that about 48 percent of respondents against the above statement and said that teacher's attitude did not put them off from Geometry. While 9 percent were uncertain the statement. And 32 percent were in favor of the above statement.

Table 10.
Homework and test Preparation

Statement		Response Category				
		SA	A	UDC	D	SD
I am given a lot of homework in geometry which I cannot cope	Frequency	31	32	0	20	17
	%	27.9	28.8	0	18.0	15.3
I study geometry only when I am going to have a test.	Frequency	18	18	10	31	23
	%	16.2	16.2	9.0	27.9	20.7

Table 10 indicated that about 56 percent of respondents said that they were given a lot of homework in Geometry. While 33 percent respondents were against the statement. About 48 percent of respondents were against the statement that they studied Geometry only when they were going to have a test.

Table 11.
Teacher's Help in Learning Geometry Concepts

Statement	Response Category	Frequency	Percent
Teacher always helps me when I need assistance in learning the concepts of geometry.	Strongly Disagree	7	6.3
	Disagree	6	5.4
	Uncertain	4	3.6
	Agree	47	42.3
	Strongly Agree	36	32.4

Table 11 indicate that about 75 percent of respondents were in favor of the above statement that their teacher helped them in learning Geometry concepts when the students need assistance. About 4 percent were uncertain and about 12 percent were against the statement.

Table 12.
Teacher's Attitude with Individual Differences

Statement	Response Category	Frequency	Percent
Teacher addresses individual differences in the classroom.	Strongly Disagree	11	9.9
	Disagree	50	45.0
	Uncertain	0	0
	Agree	39	35.1
	Strongly Agree	0	0

Table 12 indicated that about 55 percent were against the statement that they understand that teacher did not address individual differences in the classroom. While 35 percent were agreed the above statement.

Table 13.
Analysis of Open-ended Questions

Item No.	Question's Theme	Analysis of Responses
2.	Solutions and suggestion to minimize these barriers	• Geometrical instruments should be provided. • Updated syllabus should be provided • Teachers should be trained for teaching Geometry. • Braille books and large print books should be provided.

Respondents suggested to provide geometrical instruments, Updated syllabus, Braille books and large print books. Moreover, teachers should be trained for teaching Geometry.

Table 14.
Problems Reported by Teachers Teaching Geometry to VI Students and their Ranking

Statement	Mean	Rank
Geometry syllabus is too long to cope with visually impaired students.	4.43	1
I frequently feel burnt out because of my job.	4.23	2
I find teaching geometry a challenge for myself	4.20	3
Class size is manageable for the teacher.	4.13	4
Lack of instructional aids make teaching and learning of geometry difficult.	4.10	5
I have enough expertise to adapt the contents and methodology myself.	3.96	6
Mathematics teacher is well trained to modify his/her instructional style according to need of visually impaired students.	3.93	7.5
Teaching geometry to visually impaired children give me anxiety	3.93	7.5
Teachers are trained to teach Geometry through Braille.	3.46	9
Principal monitors activities and performance of all teachers.	3.36	10
Foundation of most mathematics teachers in geometry is good.	3.13	11
Teaching of graph is very challenging for me.	2.83	12
There are enough geometrical aids given to the teachers to make the teaching practical for visually impaired children.	2.76	13
Students are provided audio aids to help in reading material.	2.63	14
School provides course material/textbook in Braille.	2.50	15
I get guidance by the seniors/experts for adaptation the curriculum	2.46	16
School provides course content/textbook in soft form.	2.13	17
I was properly trained for teaching geometry before I started.	2.10	18
Guidelines for adaptations are provided by the competent authorities	2.06	19
We are provided periodic training to teach geometry to visually impaired students.	1.90	20

Table 14 depicted the ranking of the respondent statements in which problems of the teachers were find out in teaching Geometry to visually impaired students. Teachers were feeling difficulty in teaching Geometry due to the long syllabus of Geometry, teachers felt burnt out due to their job and also felt a challenge for them to teach Geometry to the visually impaired students so Rank 1, 2 and 3 have the highest rank in the list because they were the most challenging for the teachers.

Rank 4 points out that class size was manageable for the teacher but rank 5 demonstrate that lack of instructional material teaching Geometry was difficult. Rank 6 demonstrates that teacher had enough expertise to adapt the content and methodology. He/she can change it according to the need of the student and according to the requirement of policies.

Rank 7.5 have the same rating which reveal that teacher was well trained to modify his/her instructional style according to the need of the visually impaired children and at the same time teaching Geometry to the visually impaired children give him/her anxiety. Rank 9 shows that teacher was well trained to teach Geometry through Braille. These problems are summarized below/

Difficulties about teaching Geometry:

i. Non manageable class size,
ii. Untrained teachers for teaching Geometry,
iii. Too long syllabus of Geometry,
iv. Unavailability of course content in soft form and audio aids to the students,
v. Not providing extra allowance for teaching Geometry and
vi. Unavailability of geometrical aids were some problems of teachers teaching visually impaired students at secondary level.

Teacher's knowledge and skills:

vii. Periodic trainings were not provided,
viii. Lack of instructional materials,
ix. Teachers are trained through Braille,
x. Principal monitors activities and performance of all teachers but challenges faced by teachers are not addressed by them,
xi. Seniors or experts were not providing guidance for adaptation of curriculum.
xii. On job trainings /seminars or workshops are not conducted by the administration to update or enhance teachers' knowledge.

Table 15.
Analysis of Open-Ended Questions from Teachers

Item No.	Question's Theme	Analysis of Responses
1.	Barriers facing in teaching Geometry	• Non provision of Geometry instruments • Lack of Tactile material like Braille books, embossed charts etc. • Syllabus is not provided. • Trainings are not provided to teach Geometry. • Braille version of syllabus is not provided. • Teachers teach the old version of syllabus available in Braille and large print. • Teaching Geometry require to put extra hard work to teach in the same class students with different needs. • Teaching Graph is too tough to teach visually impaired students.
2.	Solutions and suggestion to minimize these barriers	• Should provide Geometrical instruments and other required apparatus. • Should provide updated syllabus in Braille version and large print books. • Trainings should be provided

Teachers teaching geometry to VI students suggested numerous measures to improve the teaching learning process as shown in the table 15.

Discussion

This study was conducted to analyze and explore the challenges of visually impaired students studying Geometry at secondary level and to find out the effects of these challenges on students' performance. Tactile/Haptic sense is very important for the visually impaired children Use of Braille as a medium to communicate in Geometry is found priceless for visually impaired children if they are provided any other medium (Tanti, 2007). Braille was mostly use medium in special education institutions in Punjab.

These institutions were provided books but these are old version due to which it did not match with print books.

Different challenges are faced by visually impaired students for learning of Geometry at secondary level. Geometry is most challenging area of mathematics. To teach visually impaired children it is more challenging situation for the teachers to tackle the students with different needs. The study by Pinho, Castro, Alves and Lima (2016) concluded that "it is necessary not only to develop more strategies for the education of these people with special needs to allow their improvement but also to increase the production of inclusive materials with the same quality of those offered to non-impaired students. The study was an attempt to review the challenges of teachers and visually impaired children. It discussed the challenges both teachers as well as visually impaired students. It focused on broad area of Geometry and highlighted all ambiguities about work related Geometry.

Teacher's content knowledge has pivotal role in teaching and adapting the curriculum, content knowledge of subject matter and pedagogical skills are essential to develop the student's interest in subject (Loewenberg , Thames, & Phelps, 2008). In this study it was concluded that teacher's training is most important for teaching Geometry to visually impaired students. Pedagogical skill, teaching strategies, curriculum adaptation and subject matter and teaching with individual differences are all essentials components for teaching to visually impaired children (Nathan & Petrosino, 2003). This study clearly revealed that student's performance affected by teaching strategies i.e activity method, lecture method, teaching with instruments etc. Use of Braille as a medium to communicate in Geometry is found priceless for visually impaired children if they are provided any other medium (Tanti, 2007).

Conclusions

Different challenges are faced by teachers and visually impaired students for teaching learning of Geometry at secondary level. In most of the Centers of Special Education children with different special needs sit together in a class. Geometry instruments are not available in the special education schools so that teaching and learning of Geometry subject is not taught according to its requirements. Teachers are provided with braille books of old version of syllabus. They have to get the current syllabus converted into braille which comes as a challenge for them in terms of time required and financial constraints. Required tactile material and Geometry apparatus is not available for students and teachers. Non

availability of required material is a big hindrance in appropriate transfer of geometrical concepts to the students. Teachers are not given proper trainings to teach Geometry. Teachers are not guided by competent authorities to adapt the syllabus of Geometry. Class size is manageable for the teachers but due to lack of instructional material they don't teach Geometry in a proper way. Students are not provided with audio aids of notes in soft form. Software are not introduced in the schools, if available, teachers are not trained to operate these. Couple of dilemmas in learning Geometry lessons without Geometrical instruments and without using activity method suffered the visually impaired students in trouble.

Recommendations

Following recommendations were made on the basis of above study:

1. Teachers of visually impaired students should opt the teaching strategies involving touch sense to expertise the students to their tactile sense.
2. Teachers should take care of individual differences, low vision students should sit near the teacher and teachers should not hesitate to answer. Students may be motivated by the teachers in learning Geometry.
3. Braille is the strongest medium to study for visually impaired students so it is highly recommended that updated Braille and large print books version may be provided in every special education institute.
4. Teachers may be provided with trainings periodically for teaching Geometry to update their knowledge.
5. Student may be taught with geometrical activities by instruments, and they should not be given excessive homework.

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