CONTEXTUAL INVITATIONS IN THE TEXTBOOK AND ALL RELATED DIMENSIONS TO TRANSACT THE MATHEMATICS CURRICULUM AT SECONDARY LEVEL

(**Dr.Minikumari D.,** Assistant Professor in Mathematics Education, NSS Training College, Ottapalam, Palakkad, Kerala)

ABSTRACT**:** Mathematics has provided a rational organization of natural phenomena. The concepts, methods, and conclusions of Mathematics are the substratum of the Physical Sciences. Mathematics has brought life to the dry bones of disconnected facts and served as connective tissue, binding a series of detached observations into bodies of science. For the teacher of integrity this "tailoring of the educational environment" is a complex operation. The present study aims to check whether the teachers were using contextual invitations in the textbook and all related dimensions to transact the mathematics curriculum. The analysis of the responses to a 26 item interview schedule (with sub items under some major categories) administered to 100 teachers in order to elicit the teachers' awareness / use of the multiple contexts in the text book and related dimensions. It can be concluded that success in teaching Mathematics depends on the teacher's ability to organize the immediate learning environment and deciding how to tailor the total educational environment to the needs of children. The message coming through is that real education is about equipping pupils to use their skills in real context, and that skills taught in isolation are likely to remain bound within that single context for pupils

(**KEY WORDS**: Context, Textbook, Mathematics, Curriculum, Secondary level)

Mathematics is probably the oldest organized discipline of human knowledge, with a continuous line of development spanning over 5,000 years. It is a body of ideas structured by logical reasoning. The facts, principles and methods developed in early Mesopotamia, Egypt and Greece play central roles in the learning of the subject even today. The sustaining social interest in mathematics is based on at least four major themes in its development; (1) the arithmetic of whole numbers and fractions for recording and ordering commerce and practical affairs; (2) The ideas of Algebra, Geometry, Statistics and Calculus providing valuable models in the biological and physical world; (3) the aesthetic qualities of mathematical structures embodied in art; (4) the patterns of logical reasoning in mathematical proofs carried over in many other disciplines.

Mathematics is a method of inquiry known as postulation thinking or reasoning from carefully formulated definitions and assumptions, and deducing conclusions by the application of the most rigorous logic that man is capable of using. Mathematics is also a field for creative endeavor constructing methods of proof and employing a high order of intuition and imagination.

Mathematics has provided a rational organization of natural phenomena. The concepts, methods, and conclusions of Mathematics are the substratum of the Physical Sciences. Mathematics has brought life to the dry bones of disconnected facts and served as connective tissue, binding a series of detached observations into bodies of science.

LITERATURE REVIEW

Russell (1919) the master of abstract mathematical thought has also praised the beauty of mathematics: "Mathematics, rightly viewed, possesses supreme beauty, a beauty cold and austere, like that of sculpture, without appeal to any part of our weaker nature, without the gorgeous trappings of painting or music, yet sublimely pure, and capable of a stern perfection such as only the greatest art can show. The true spirit of delight, the exaltation, the sense of being more than man, which is the touchstone of the highest excellence, is to be found in mathematics as surely as in poetry".

Tracing the history of Mathematics, Kline mentions that the simple steps made in primitive civilizations were prompted by purely practical needs. The barter of necessities requires some counting. It is not surprising that primitive man used his fingers and toes as a tally to check off the things he counted. The use of the word 'digit' in English and the ten-base numeral system are evidences of it.To the Egyptians, geometry developed literally from the earth and its measurement. In Greek geometry the abstract is dominant. Plato's philosophy is on exactly the same mental level as the abstract concepts of mathematics. Mathematics is indeed distinct from the physical objects it describes. Hence mathematical thinking prepares the mind to consider higher forms of thought.

Kline (1964) mentions the Mathematics embedded in painting. He points out that for several reasons the problem of depicting the real world led the Renaissance painters to Mathematics. The Renaissance artist became thoroughly familiar and imbued with the doctrine that mathematics is the essence of the real world, that the universe is ordered and explicable rationally in terms of geometry. He believed that to penetrate to the underlying significance, that is the reality of the theme that he sought to display on canvas, he must reduce it to its mathematical content. It is no exaggeration to state that the Renaissance artist was the best practicing mathematician and that in the fifteenth century he was also the most learned and accomplished theoretical mathematician.

Galileo's observation and mathematisation of the swinging of a great hanging lamp and of various mechanical devices is another landmark. Galileo had a grand plan for reading the book of nature. In essence, it offered a totally new concept of scientific goals and of the role of Mathematics in achieving them. The new goal for scientific activity set by Galileo and pursued by his successors, is that of obtaining quantitative descriptions of scientific phenomena independently of any physical explanation. This gave man much power to predict and control the course of nature.

Kline (1980) states that, the formulae such as those developed by Galileo are a way of representing a relation between variables. The relationship itself, which may be known to exist on physical grounds, is called today a function or functional relation. Such relations hold in practically every sphere.

Galileo proceeded to exploit a philosophy of nature founded by both himself and Descartes. The latter had already fixed on matter moving in space and time as the fundamental phenomenon of nature. All effects were explainable in terms of the mechanical effects of such motions. By analyzing and reflecting on natural phenomena, Galileo decided to concentrate on such concepts as space, time, weight, velocity, acceleration, inertia, force and momentum. These concepts did prove to be most significant in the rationalization and conquest of nature. The sequel was that science was to be patterned on the mathematical model. Galileo's examples also illustrate how the mathematician can sit back in his arm-chair and obtain dozens of significant laws of nature. Mathematical deduction, the essence of his work, produces knowledge of the physical world.

The above discussion throws light on the fact that the amazing practical as well as theoretical accomplishments of modern science have been achieved mainly through the quantitative, descriptive knowledge that has been amassed and manipulated rather than through metaphysical, theological, and even mechanical explanations of the causes of phenomena.The teaching and learning of Mathematics have offered many significant themes for educational research. The highly structured nature of mathematical knowledge has also attracted the attention of some psychologists who have used mathematical learning tasks as vehicles for research that seeks general principles of human learning and ability. Recently, psychologists have proposed the computer, a mathematical-logical machine, as a model for human information processing.

After elaborately analyzing the nature of mathematics, Fey (1997) points out those public expectations assume that all students acquire the ability to perform basic computational skills and their applications to practical life situations. But most mathematics educationists consider that a return to the traditional skills of school level will be poor preparation for any student facing a working life time largely in the twenty-first century.

OBJECTIVE

To check whether the teachers were using contextual invitations in the textbook and all related dimensions to transact the mathematics curriculum.

METHOD

The real world and unreal world problems given in the texts for the application purposes etc have been analyzed by the investigator. A self filling questionnaire was administered to 100 teachers at secondary level. But then it was found that many respondents tended to make tick marks mechanically without actually entering into the full consciousness of pedagogical skills. This was evident from follow up discussions without the teachers in the tryout sample. So it was decided to use the tool (with some modifications) as a schedule for focused interview with probes.

TOOL

26 item interview schedule (with sub items under some major categories) administered to 100 teachers in order to elicit the teachers' awareness / use of the multiple contexts in the text book and related dimensions.

STATISTICAL TECHNIQUES USED

Percentage analysis was used to interpret the interview schedule.

ANALYSIS

The analysis of the responses to a 26 item interview schedule (with sub items under some major categories) administered to 100 teachers in order to elicit the teachers' awareness / use of the multiple contexts in the text book and related dimensions is presented below.

a. The adequacy of problem solving contexts in the textbook and their awareness of the same.

b. Judge the ways of getting product answers by skipping the process.

c. Teachers' awareness of divergent approaches to problem solutions.

d. To judge the competency to convert verbal problems into mathematical form.

e. Respondents' reactions on the effectiveness of project approach in realizing the higher objectives of teaching mathematics like spatial imagination, ability of discovery, abilities of thinking, reasoning, problem-solving, critical thinking, decision making, hypothetical formation, experimentation etc.

f. Open responses regarding the "Students' Committed Errors in Doing Mathematical Problems"

a) **The adequacy of problem solving contexts in the textbook and their awareness of the same**

Table 1

Percentage of Judgement of teachers' towards the Adequacy of Problem Solving Contexts in the Text Book and their Awareness of the same (N=100)

Sl. No.	Statement	Response	Percentage
1.	Adequacy of problem solving contexts in the text book	Yes	42%
		No	58%
2	Encouraging to problems themselves	Yes	23%
		No	77%
3.	Fail first attempt, encouraged to try different approach	Yes	25%
		No	75%

Questions 1, 2 and 3 invite the teachers to judge the adequacy of problem solving contexts in the text book and their awareness of the same. The teachers were asked to judge the questions, by answering 'yes', or 'No'

Regarding the adequacy of problem solving contexts in the textbook, about 42% of the teachers report that the mathematics textbook include adequate problem solving contexts, while for the 58% of teachers, it was found to be inadequate. When asked about the encouragement they provide to students for doing problems themselves, only 23% of teachers indicated that they provide encouragement, at the same time from the 77% of teachers; no such encouragement was provided to students in doing problems themselves. Around 75% of teachers indicated that even if the students fail at the first attempt, they never encourage students to try a different approach. Such sort of an attempt was made by only 25% of teachers.

Teachers' judgement on the problem solving context in the mathematics textbook as revealed in the responses of Qns. 1, 2and 3, lead to the assumption that the ample provisions of problem solving contexts in the textbook are not productively utilized by teachers which further accounts for the discouragement from teachers in trying out different approaches for students in attempting to do problems themselves.This indicates that even though problem based learning is taking place, the learners are not being the central point.

b) Ways of getting the product answers to mathematical problems (weightages are given in brackets)

Table 2 presents the responses of the teachers for questions 4, 5, 6 and 7 through which the teachers were invited to judge the method of getting product answers by skipping the process and trying to get the answers from bazaar notes, guides or some other such means instead of actually working it out. Teachers were asked to judge the question 4 by answering 'All' (0), 'most', 'a few' (2), and 'none' (3), and question 5 and 6 by 'Always' (0), 'often' (1), 'sometimes' (2) and 'never' (3).

Table 2

Percentages of teachers' responses to the ways of getting product answer bypassing the process (N =100)

Sl.No.	Statement	Response	Percentages
1	Most pupil try to get the answer from bazaar notes	All	0%
		Most	52%
		A few	41%
		None	7%
2	Getting the product skipping the process	Always	10%
		Often	15%
		Sometimes	20%
		Never	55%
3	Play the full game of mathematics	Always	5%
		Often	30%
		Sometimes	55%
		Never	10%

4	Prefer product than process	Yes	55%
		No	45%
5	This approach is feasible	Yes	55%
		No	45%
6	Written out correct answer in the book itself	Yes	68%
		No	32%
7	This prevent the student from re-reading	Yes	74%
		No	26%
8	Advice not to write the answer in the book	Yes	72%
		No	28%

Examining data from teachers on the product and process approach of students while attempting mathematics problems indicate that a higher proportion of the students (52%) try to get answer from bazaar notes and those who do not try to get answer from bazaar notes is limited to mere 7%.

Addressing the teachers' judgement regarding students skipping the process for getting the product, it could be seen that, only 20% of the students sometimes skipped the process to get the product, at the same time 10% of the students always skipped and 15% of the students often skipped. It is heartening to note that 55% of students never skip the process for getting the product.

The teachers' judgement indicates that 55% of students sometimes play the full game of mathematics. Only 5% play the full game of mathematics. While 30% of the students often play the full game of mathematics. Atleast 10% of the students never play the full game of mathematics.

Considering the teachers' judgement on students' preference of product than process, approximately an equal percentage (55%) prefer product than process. Regarding the feasibility of this approach as per the teachers' judgement, for the 55% of students, it is feasible and for the 45% of students it is not feasible.

Teachers' judgement regarding writing the correct answers in notebooks endorses the information that 68% of students write the correct answers in their notebooks. According to 74% of teachers, writing correct answers in the notebook prevents students from re-reading and to the

26%, this practice does not prevent students from re-reading. With respect to 72% of teachers, students are advised to write down the answers in their notebooks and only 20% of teachers do not give such advice.

c) The teachers' awareness of divergent approaches to problem solutions

Table 3 presents the responses of the teachers' to the Qn. 12 "Do you encourage the students to repeat the process after getting the right answer" or "Do you give similar problem with slightly different figures". Qn. 13 "Do you encourage copying the problem worked out in the black board and pass or to the next sum. Qn. 14 "some problems need time to get the answer. Do you give enough time". Qn. 15 "Do you appreciate divergent answer". Qn. 16 "Do you advice the student to help or teach another who has learning difficulties?"

Table 3

Percentages of teachers' responses to the divergent approaches towards problem solutions

Sl. No.	Statement	Response	Total
12	Encourage to repeat the process	Yes	31%
		No	11%
		No time	58%
13	Encourage to copy the worked out problem	Always	57%
		Often	20%
		Sometimes	23%
		Never	0%
14	Need more time to get the answer	Always	9%
		Often	11%
		Sometimes	215
		Never	59%
15	Appreciate divergent answer	Yes	11%
		No	18%
		No time	71%
16	Encourage Peer tutoring	Yes	37%
		No	8%
		No time	55%

Concerning the teachers' awareness of divergent approaches to problem solution, students are encouraged to repeat the process of getting the answers by 36% of the teachers. At the same time 11% do not encourage it. 58% of teachers reported that they have no time for this sort of encouragement.Considering the nature and type of problem, students are encouraged to copy the worked out problem. The data from teachers reveal that around 57% of the teachers always encourage students to copy the worked out problem, while 30% of the teachers sometimes encourage it and another 20% often encourage copying it.

Taking into consideration the time required to get the answer while using divergent approaches, 21% teachers opined that sometimes while using divergent approaches, it takes more time to get the answer. For 9% of teachers, using divergent approaches always consumes much time in getting the answer, 11% of teachers' state that it often needs more time to get an answer while using divergent approaches. To the 59% of teachers, divergent approaches never consume more time to get answers.

With regard to appreciating divergent answers, 11% of teachers do appreciate the divergent answers from the part of the students and 18% do not attempt appreciating the divergent answers from students. For 71% of teachers, there is no time for them to appreciate the divergent answers from the part of the students. On the aspect of encouraging peer tutoring, 37% of teachers encourage peer tutoring in their class room, while only 8% of teachers encourage peer tutoring and for the 55% of teachers, they do not get time for promoting peer tutoring in class rooms.

d) Judgement of the competency to convert verbal problems into mathematical form.

Table 4 presents the responses of the teachers to the questions (17, 18). These question actually an invitation to the teachers' to judge the competency to convert verbal problem into mathematical form for working out the sum.

Table 4

Percentages of teachers' responses to the students' competency to convert verbal problems into mathematical form

Sl. No.	Statement	Response	Total
17	Pupil translates verbal problems into Mathematical Forms	All	0%
		Most	14%
		Some	18%
		None	78%
18	Teacher demonstrates how to make this conversion	Always	12%
		Occasionally	71%

ISSN 2229-5518

		None	7%

Examining the data regarding teachers' judgement of students' competency in converting verbal problems in to mathematical form reveal that most of the pupils are competent to translate verbal problems in to mathematical forms as perceived by 14% the teachers'. According to the 18% only some of the students are competent in translating verbal problem to mathematical forms. A majority, i.e. 78% of teachers opine that none of the students are competent enough to translate verbal problems to mathematical forms.

With regard to teachers' demonstration in converting verbal problems to mathematical forms, only 12% of teachers attempt demonstration always, while 77% teachers' occasionally demonstrate such conversion and 7% of the teachers never attempt such conversion.

(e) **Judgement of the Understanding mathematics through projects and real world problems**

Table 5 presents the responses of the teachers to the questions 21, 22, 23, 24,25 &26. These question actually an invitation to the teachers' to judge the understanding mathematics through projects and real world problems".

Table 5

Percentages of teachers' responses to the students' understanding mathematics through projects and real world problems

Sl. No.	Statement	Response	Total
20	Unreal problems to real one	Yes	41%
		No	34%
21	Limit the project as suggested in the book	Always	85%
		Occasionally	11%
		No	4%
22	Projects really done	Yes	4%
		No	71%
23	Provide Creativity triggering contexts	Yes	13%
		No	14%
		No time	73%
24	Project based training without extracting the basics	Yes	13%
		No	87%
25	Analogical transfer	Yes	20%
		No	15%
		No time	65%
26	Pre-requisite mapping occurs	Yes	21%
		No	79%

Analyzing the data regarding teachers' judgment of understanding mathematics through projects and real-world problems, unreal problems are treated as real ones by 41% teachers' and no such treatment is done by 34% of them while the 25% lacks time in considering these problems. About 85% of teachers' always limit the projects as suggested in the textbook while about 11% teachers only limit the project as suggested in the book occasionally. Only 4% of teachers' don't limit the project as suggested in the book. To the statement "projects are really done, teachers' judgement falls to 4% while stating that the projects are done by students. While 71% of them report that they are not really done and a 25 % report that they bypass the process.

Taking into consideration creativity triggering contexts provided in classrooms, 13% teachers' provide such contexts in classrooms, 14% of them do not provide such contexts and 73% of them don't have time to provide such creativity triggering contexts. With respect to providing project base training the students without extracting the basics, 13% of teachers' provide such training, while 87% of teachers don't resort to such project based training.

With regard to analogical transfer taking place in the learning context, 20% of teachers provide provisions in the classroom for the analogical transfer, while 15% of teachers provide no such provisions for it. 65% of the teachers' find no time for analogical transfer exercises. Regarding pre-requisite mapping, 21% of teachers respond that pre-requisite mapping occurs in their classroom, while for the 79% it doesn't occur in their classroom.

(f) Open response regarding the "Students' Committed Errors In Doing Mathematical Problems"

Analyzing the data regarding the teachers' judgement of errors committed by the students in doing mathematics (item 19), about 70% of the teachers commented that they repeat the whole class explanation procedure often; after explanation, give a different but similar sum and ask the pupil to analyze it on similar lines; look through the individual student's analysis and counsel those students who need help; form the students into heterogeneous groups so that the stronger students may help the weaker ones. While 30% of the teachers report that there is no time for doing all these.

DISCUSSION

First of all, the pupils should have the thorough understanding about the fundamental concepts and skills in mathematics at the beginning of the schooling itself. It must be developed from primary grade onwards. They agreed, since mathematics is an abstract science, it must be concretized by providing wide range of contexts to students so that they get a chance to analyze the contexts logically and meaningfully with the proper guidance from teachers. Meaningful participation in the activities and projects given in and out of the classroom would result into meaningful memorization of the procedures and methods. In this way, they are able to extract the basics and build their own knowledge and strengthen the pre-requisites for learning of mathematics in live forms. We couldn't get time to build basic concepts at secondary level, because at this stage the textbook includes higher mathematical concepts and also introduces new branches. We have no time to stick on to build basics or to master the basics at the secondary level.

Analytical way of approaching a problem is a good idea. The teacher will facilitate learning by linking prior knowledge to the new knowledge through inquiry. She should select tasks that incorporate previously learnt concepts and enable new mathematical understanding to grow. The teacher should encourage the students to communicate their ideas. He/she should select activities from various sources that facilitate understanding and meaningful learning. She should support the students' investigative processes. She should allow students to use intuition and logic aside from their mathematical skills in solving problems. She should also encourage learners to use various strategies including guessing and estimation with the goal of helping them gain expertise in the process. She should find ways to make all forms of reasoning available to students and help them gain meaningful learning. She should give them opportunities to reflect on their thinking and reorganize their learning.

The teacher should establish an environment that is conducive to collaboration and mutual support, as well as class norms that encourage learning with understanding. The teacher should be able to encourage student autonomy and accountability for their learning. They should articulate their mathematical thinking, views and insights and critique each others' work. At the same time they demonstrate respect for each others' capabilities and help each other gain the desired expertise.

CONCLUSION

What the teachers have to do is to immerse the child in a mathematical environment if we want him to learn mathematics. Dienes argues that the result of our efforts will be interaction between the actual ways in which the child's environment is set up for him. The environment also includes other children and the teacher, the interaction between one child and another, intellectual, emotional as well as social interactions. Possibly the least important of these interactions is the direct one between teacher and the child. But the teacher will play a subtle part in setting up the situation - which includes the interactive as well as mathematical environment. With some structuration of the situation including particular kinds of materials and with some minimal suggestions, the children are more likely to discover mathematics.

REFERENCES

Becker. (1997). *The Open-Ended Approach: A New Proposal for Teaching Mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Dienes, Z. P. (1960). *Building up Mathematics*. London: Hutchinson.

Kerala Curriculum Framework. (2007). Govt. of Kerala: State Council of Educational Research and Training. Retrieved from http// www. scertkerala.gov.in/index.php_ content & view/article//

Kerala Reader Mathematics Std. VIII (Volume I-II). (2015). Govt. of Kerala: State Council of Educational Research and Training.

Kerala Reader Mathematics Std. IX (Volume I-II). (2015). Govt. of Kerala: State Council of Educational Research and Training.

Kerala Reader Mathematics Std. X (Volume I-II). (2015). Govt. of Kerala: State Council of Educational Research and Training.

Manuel, N. Vedamani. (1999). Application of Spiral Curricular Concepts in the K12 Span. *The Kerala Journal of Education, Research and Extension*, 1 (1), 12-16.

Manuel, N. Vedamani. (2001). *Integrated Approaches in Classroom Transaction of Poothiri Texts, Subtexts and Inter-Texts and Contexts: Problems, Solutions, relevant Functional Theory Illustrated with Practical Models*. (DPEP Project). Kerala: SCERT.