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Role of multiplicity in examination oriented teaching destroying mathematics quality education

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ABSTRACT

Today the teacher does not focus on knowledge oriented but on result oriented teaching of mathematics in which s(he) focuses on the probable topics that may be asked in mid and end term examinations, so that maximum students can get good grades. Feedback from students and student centric teaching has bounded a teacher to complete the curriculum within a fixed time period and the students' examination centric study has compelled the teachers to focus on examination oriented teaching. The concept of multiplicity plays an important role in it. Introducing its concepts in definitions, properties, named theorems and examples, we get the concept of recent trends of examination oriented teaching of mathematics. In the paper it has been shown that how the role of multiplicity is applied and how it has been destroying mathematics quality education.

Keywords: quality education, teaching methodology, examination, multiplicity

INTRODUCTION

Education is the process of providing knowledge. Although it has produced inequality among population but only it can restore what has been lost in the society. To provide equal and quality education to all has become the aim of all most all national governments and international organizations (Apple, 2012). It may be of science, arts, commerce, humanity, social values, ethics, morals, etc. The education takes place under the guidance of teachers; however learners can also educate themselves (Education–Wikipedia, n. d.). The student's success depends on the quality of education they receive during the courses and the quality of education depends on the quality of materials available with the teachers and the students. The quality education is evaluated through different examinations (Ball, 2021).

Examination plays an important role as an indicator of learning outcomes. It is used as gatekeepers of access to schooling and higher studies. It is an educational assessment tool to measure test takers knowledge and the depth of quality is evaluated by competitive examinations. Today learning is all about passing examinations and getting good grades. Due to the importance of grades in admission, selection in jobs, etc., learning has become the means of passing examination with good grades (Brown et al., 2013; Examination–Wikipedia, n. d.).

The examination results are also treated as one of the indicators used by government to assess the performance of educational institutions. Institution with higher examination results and high scores are labeled by parents as good institutions, which directly influence the higher income for the institutions. Since the examination results are associated with the career prospects of the head of the institution and the reputation of institutions, the institutions compete fiercely with each other for better results. It is the conventional practice for institutions to relate rewards, sanctions and promotion to the quality of teachers, which is measured by the examination results. So all most all the institutional activities are examination oriented, and the teaching activities revolve around examination results. The teachers analyze the examination papers of last few years and then work out the patterns hidden behind the examination papers. In this way the teachers become sure that students are now more confident in examination (Hu & West, 2015).

Exam-centric education causes extreme stress for students, and it downplays the ultimate purpose of education, the critical thinking (Lee & Coniam, 2013). Singapore's education system is known for examination oriented. An examination oriented education restricts a student's ability to learn using techniques that a particular student finds most effective. Students are overburdened with homework on a daily basis that exceeds their normal capacities to memorize, allowing students to recite knowledge, but lack the intellectual depth to synthesize or appreciate abstract concepts. Students spend years of continuous

memorization and writing preparing for the examinations. This approach stifles student's imagination, creativity, and sense of self, etc. (Kirkpatrick et al., 2011; Ratnam-Lim & Tan, 2015). These subsequently make teachers adopt conventional approaches, which will make learners excel in examinations at the expense of quality education. Thus exam oriented model led to in efficiencies in education (Mackatiani, 2017). In the present paper we have theoretically analyzed the effect of examination oriented teaching on mathematics quality education.

The knowledge of mathematics is one of the most important parts for the human beings. It is the subject, which compels the person to think. It is a machine of increasing mental ability by using the power thinking as fuel. It is the subject, which develops reasoning intelligence, sharps mind, and makes mind creative. It is a common perception that the citizens who cannot reason mathematically, are cut off from whole realms of human endeavor (Atta & Bonyah, 2023; Cynthia et al., 2019). Learning of mathematics completely depends on thinking power of the learners that to what extent s(he) will learn and digest the subject (Da, 2023). The subject plays an important role in life through its contributions in the development of civilizations, science, technology, medicine, finance, social science, management, banking, universe study, space exploration, etc. The study of mathematics provides personal satisfaction, but everyone cannot enjoy it (Buehl & Beck, 2015; Malambo et al., 2023; Mathematics–Wikipedia, n. d.). The performance of the students in mathematics depends on students' personal receiving capacities (Aguilar Batista, 2017). Not only in 21st century but in coming centuries too, it will play a vital role in the lives of all human beings (Brewster & Miller, 2023).

That's why through mathematics education, it is being tried to induce the values of friendship, self-control, responsibility, patriotism, justice, honesty, respect etc. it is also recommended to teach how to integrate root values into a mathematics classroom (Horzum & Yildiz, 2023). So the quality education of mathematics is necessary for complete development of science and technology (Potari, 2017). The quality of education depends on the receiving ability of the learner and the teaching methodology of the teacher (Fenstermacher et al., 2015). Mathematics quality education and students' capacity for problem solving are still below expectations.

The question of how teaching can be improved is one of the international challenges in professional life of teachers. Mathematics anxiety is one of the topic of research in psychological and educational research field in recent few decades. In much research it has been shown that mathematics anxiety is the main obstacle on student's achievement in educational institutions (Al Mutawah, 2015). The students' anxiety towards mathematics was mostly related to teaching and many examinations (Brewster & Miller, 2023). The satisfaction with the teachers affects students' anxiety about mathematics. Being satisfied with the teachers and having a positive attitude toward the teachers, students are positively affected towards mathematics. If the students like the mathematics teacher, they may like the subject mathematics, too (Ozdemir & Sezginsoy Seker, 2019).

A good relation between mathematics teacher and student positively affect the attitudes of the students toward mathematics (Basar, 2021; Ongcoy et al., 2023; Park et al., 2018). A good relationship is the basic need for the development of academic engagement and achievement (Furrer et al., 2014). It has been found that good relationship between teachers and students reported good interest in mathematics. Teachers' classroom behavior and socio-emotional support behaviors attract the students' learning (Prewett et al., 2019; Shen et al., 2015). The role of a teacher has been changed from teacher-centered to student-centered and the skills needed for qualified teachers have also changed (Keiler, 2018). Bowles et al. (2014) state the logic that the quality of teaching is a function of the quality of the teacher. Approaches chosen in teaching mathematics have to help the learners to create and discover their own knowledge with the help of teaching-learning techniques (Barton et al., 2012; Castelino & Hegde, 2019; Zare & Othman, 2013).

The best teachers know their material to deliver as well as a lot about the process to deliver (Abell, 2013; Makeleni & Sethusha, 2014). It is suggested that first write up syllabi by including all mandated material and then prepare a list of the material to be covered in classroom (Gouëdard et al., 2020). Thus, development of mathematics depends on teacher, teaching and the effective curriculum (Alsubaie, 2016). So, all blames go to teachers experience and practical knowledge what they apply in teaching.

Due to the burden of many curriculums, the teachers feel limited in delivering the whole updated contents and accordingly teachers limit the contents of the lectures and briefly discuss the syllabus, which depends on his (her) practical knowledge in the past classroom. Teacher's practical knowledge is concerned with the amount of basic knowledge to be put in the classroom in teaching to get the maximum satisfactory feedback from the students. Teachers' practical knowledge is developed through participating in and reflecting on action and experience and is dependent on the specific context in which it is materialized (Elbaz, 2018; Segal et al., 2021; Steele & Rogers, 2012; Van Driel, 2021). Finally it is all about the teachers and students perceiving capacity of learning mathematics, who are responsible for the development of the subject (Fosu et al., 2023; Park et al., 2017).

So, teaching has become a commercial art and teacher acts like a salesman, whose aim is to sell (spread) knowledge among students. Thus the activity having the intention to induce learning has become a profession first to attract students towards the subject and then to induce learning. In fact teaching is all of the three sciences, arts and commerce. Gaining knowledge is science, presenting knowledge (teaching technique) is an art and applying knowledge (spreading the benefits of the subject) is commerce. In the paper we have exposed how a Mathematics teacher applies the concepts of multiplicities on different topics for examination oriented teaching and how it is destroying the quality education of mathematics.

Preliminary Ideas

Curriculum

A curriculum is a planned sequence of instructions of the set of courses and their content offered at a school or university (Young, 2014), whereas syllabus is a summary of the curriculum (Gannon, 2018).

Table 1. Questions asked in three universities

Questions	Level	Asked in examinations		
		University-1	University-2	University-3
Q-1	U	9	1	8
Q-2	U	8	0	1
Q-3	U+C	6	9	8
Q-4	U+C	2	8	7
Q-5	U+C	1	6	8
Q-6	U+C	0	8	9
Q-7	C	0	0	0
Q-8	C	0	0	0

Note. U: University level questions; C: Competitive level questions; & U&C mean useful for university & competitive examinations, respectively

Table 2. Local & global multiplicities of questions

Questions	Local multiplicities			Global multiplicity
	University-1	University-2	University-3	
Q-1	9	1	8	18
Q-2	8	0	1	9
Q-3	6	9	8	23
Q-4	2	8	7	17
Q-5	1	6	8	15
Q-6	0	8	9	17
Q-7	0	0	0	0
Q-8	0	0	0	0

Multiset

Multiset is a set, where an element can occur as a member more than once and multiplicity of an element is the number of times the element appears in the multiset. For example, A = {1, 1, 1, 1, 2, 2, 2, 3, 3, 4} is a multiset and multiplicities of the elements 1, 2, 3, and 4 are 4, 3, 2, and 1, respectively (Isah & Tella, 2015).

MATERIALS AND METHODOLOGY

The present study is an attempt to disclose the hidden application of multiplicity in examination oriented teaching and its effect on the quality education of mathematics. It is based on teaching experiences and for this we are considering only two different chapters of mathematics and the drawbacks that generally a teacher skips in student centric teaching in view of examination oriented teaching.

Role of Multiplicity in Examination Oriented Teaching of Mathematics

A student studies for making his or her career. S(he) has three options: one is for end term examination to get good score, second is to prepare for competitive examination, and third for depth knowledge. Maximum teachers in educational institutions teach for mid and end term examinations and do not focus on depth knowledge. They have constraints of time to complete the courses of study within a fixed period of time before different term examinations. Therefore the teachers have chosen the shortest path to get the maximum output using the concepts of multiplicities on different subtopics in the chapter.

Let us see how a teacher applies the concepts of multiplicities in teaching. Consider that in a chapter there are eight questions in its exercise and have been asked in different examinations in three different universities in last 10 years as shown in **Table 1**.

In **Table 1**, the number of times a question has been asked may be called local multiplicity and global multiplicity of that question. Local multiplicity would be defined with respect to a particular university, for example for University-1, whereas the global multiplicity would be defined with respect to all the universities. In the global multiplicity, we sum all the local multiplicities of that question asked in different universities within a territory of a nation. Therefore, the multiplicities of all eight questions can be shown as in **Table 2**.

What a teacher will teach in classroom completely depends on the local multiplicities of a question as far as it is concerned in an educational institutions, whereas they will choose the global multiplicity if they are teaching for competitive examinations.

In **Table 3** given for university-1, it has been indicted that which question of the chapter a teacher will prefer to teach. A teacher would not prefer to teach Q-6, Q-7, and Q-8 because their possibility to come in university examination is very less whereas they will certainly teach Q-1 to Q-3 because their possibility to come in end term examination is very high. But if they get sufficient time after that then they may consider Q-4 and Q-5 also because their possibility is at least not zero.

In **Table 4** given for university-2, it has been indicted that which question of the chapter a teacher will prefer to teach.

In this case a teacher would not prefer to teach Q-2, Q-7, and Q-8 because their possibility to come in end term examination is very less, whereas they will certainly teach Q-3 to Q-6 because their possibility to come in end term examination is very high. But if they get sufficient time after that then they may consider Q-1 also because their possibility to be asked is at least not zero.

In **Table 5** given for university-3, it has been indicted that which question of the chapter a teacher will prefer to teach.

Table 3. Possibility of teaching for university-1

Questions	Local multiplicities			Teacher's decision (will teach or not)
	University-1	University-2	University-3	
Q-1	9	1	8	Will teach
Q-2	8	0	1	Will teach
Q-3	6	9	8	Will teach
Q-4	2	8	7	May or may not
Q-5	1	6	8	May or may not
Q-6	0	8	9	Will not teach
Q-7	0	0	0	Will not teach
Q-8	0	0	0	Will not teach

Table 4. Possibility of teaching for university-2

Questions	Local multiplicities			Teacher's decision (will teach or not)
	University-1	University-2	University-3	
Q-1	9	1	8	May or may not teach
Q-2	8	0	1	Will not teach
Q-3	6	9	8	Will teach
Q-4	2	8	7	Will teach
Q-5	1	6	8	Will teach
Q-6	0	8	9	Will teach
Q-7	0	0	0	Will not teach
Q-8	0	0	0	Will not teach

Table 5. Possibility of teaching for university-3

Questions	Local multiplicities			Teacher's decision (will teach or not)
	University-1	University-2	University-3	
Q-1	9	1	8	Will teach
Q-2	8	0	1	May or may not teach
Q-3	6	9	8	Will teach
Q-4	2	8	7	Will teach
Q-5	1	6	8	Will teach
Q-6	0	8	9	Will teach
Q-7	0	0	0	Will not teach
Q-8	0	0	0	Will not teach

Table 6. Possibility of teaching for competitive examinations

Questions	Local multiplicites			Teacher's decision (will teach or not)
	University-1	University-2	University-3	
Q-1	9	1	8	Will teach
Q-2	8	0	1	Will teach
Q-3	6	9	8	Will teach
Q-4	2	8	7	Will teach
Q-5	1	6	8	Will teach
Q-6	0	8	9	Will teach
Q-7	0	0	0	Will certainly teach
Q-8	0	0	0	Will certainly teach

A teacher would not teach Q-7 and Q-8 because their possibility to come in end term examination is very less, whereas s(he) will certainly teach Q-1, Q-3 to Q-6 because their possibility to come in end term examination is very high. But if s(he) gets sufficient time after that then s(he) may consider Q-2 also because their possibility to be asked is at least not zero.

Similarly in **Table 6** given for competitive examinations, it has been indicted that which question of the chapter a teacher will prefer to teach.

Obviously, a teacher will prefer to teach all questions from Q-1 to Q-8 because their possibility to come in competitive examinations is always possible. The teacher will certainly teach Q-7 and Q-8 because they have been asked in the competitive examinations and it shows the pattern of questions to be asked in competitive examinations.

From above six tables we can observe that how a teacher chooses the types of questions according to examination oriented motives. In the three universities the questions are not considered on its quality but on the possibility to come in university examination, whereas for competitive examinations, a teacher cannot take risk and teaches all most all types of questions related to the chapter. The students follow the same routes for study in their students' life. Therefore, in university (school) teaching quality does not matter but in competitive examination quality matters as far as higher studies are concerned.

Deterioration of Quality Due to Time Management in Teaching Mathematics

Before going to discussion let us analysis some topics of mathematics in context of past years teaching experience. We know that mathematics follows a pattern and is an order based science. So, to understand any topic of it, we should follow the sequence to get the best outcome as far as quality of mathematics education is concerned. Let us suppose that we have to teach simplex method to solve a linear programming problem of a system of m simultaneous linear equations in *n* unknowns (*m*<*n*) of the standard form: Maximizes=c^T× subject to the constraints $Ax=b$, $x\geq 0$, where *A*, *b*, and *c* are real *m*×*n*, *m*×1, and *n*×1 matrices, respectively. If we teach it just to find the optimal solution of a basic problem, then two hours of lecture is sufficient to complete it. But if we teach it step by step so that the students can understand its basics with how and why questions smoothly, then we need at least eight to ten hours of lecture to complete it.

When we teach in detail we have to explain basic solution, basic variable, basis matrix, basis vectors, degenerate solution, basic feasible solution, associated cost vector, improved basic feasible solution, optimum basic feasible solution, theorem of reduction of a feasible solution to a basic feasible solution and its corollary, theorem on extreme point correspondence, fundamental theorem of linear programming, nature of optimal solution, theorem on replacement of a basis vector, net evaluation, conditions of optimality, and at last the computational procedures of simplex method with examples (Ficken, 2015). For examination and result oriented teaching, teachers are provided less time. Therefore, they skip many basic concepts and directly introduce the procedures to find basis and non-basis solutions using simplex table.

Let us consider another topic linear differential equations with constant coefficients whose general form is $(\mathrm{D}^{\mathrm{n}}+a_1\mathrm{D}^{\mathrm{n}-1}+a_2\mathrm{D}^{\mathrm{n}-2}+\cdots+\mathrm{a_n})\,\mathrm{y}=\mathrm{X}$, where *X* is a function of x only and $a_1, a_2, a_3, \ldots, a_n$ are constants. This equation is written as $\mathrm{f(D)y}=\mathrm{X}$, where *f*(*D*) acts like a differential operator. The general solution of this equation consists of two parts: complementary function (CF) the solution of *f*(*D*)=0, and particular integral (PI) the solution due to *X*. Thus, the general solution is given by y=CF+PI (Godunov, 1997; Karachik, 2012). There are some formulae to find the CF and PI, which can be applied and is generally applied for examination and result oriented teaching to complete it in three to four hours of lectures. If we teach both basics and derivation of standard formulae to find the solution for each particular case, we will need at least ten to twelve hours of lecture. Thus we may observe the differences and the lack of qualities in teaching that how we have been destroying the quality of mathematics education due to constraints of time and examination oriented teachings.

DISCUSSION

In the era of commercialization of the education, the students are more focused on the examination oriented learning than the knowledge based learning as well as the industries prefer the trained employee and not the knowledgeable employee. Whereas the classroom management plays an important role in teaching, and this comprise three abilities: to control the classroom, to attract students' attention, and to manage time. The students will be in control only if they get their expectations fulfilled in the classrooms. The teachers get less time to complete more curriculums. Pedagogical knowledge and past teaching experiences can only help the teachers' in classroom management. Pedagogical approaches used by teachers can either be teacher centered or learner centered. Trigwell (2012) states that the teachers use approaches that ease their work. The choice is based on teachers' beliefs and preferences in relation to excelling in examinations. But learner centered approaches are most effective in influencing learning and today learners preference is to get good grades and not depth knowledge. Therefore in one sight teachers are following learner centered techniques but on another sight s(he) is using teacher centered techniques using multiplicities concepts on questions and its subtopics. To present the possible questions and examples attract the students' attention in the classrooms. Due to the short period and less time with heavy curriculum, the teachers are constrained to complete the courses of study before mid and end term examinations, so that the students may get sufficient time for revision. This expectation compels the teachers to follow examination oriented teaching and bounds to teach possible questions without considering the depth of quality.

CONCLUSIONS

A good teacher should be a good learner, a better actor, and a best salesman to gain knowledge, to present knowledge and to voice about the benefits of the knowledge respectively. Obviously a good learner can only be a good teacher if s(he) is a good actor, which is possible only if s(he) knows the characters to play in depth and behaves like the demanded story. A teacher is expected to have depth knowledge of the subject and is aware about the expectations of the students, to teach them with strong confidence. As discussed the students expect good grades, which compels the teachers to follow examination oriented teaching and the concept of multiplicity plays an important role in the selection of subtopics in the subject (mathematics) for it. Consequently it lacks and destroys the quality of mathematics education by ignoring many important concepts of the subject, which are generally not asked in mid and end term examinations conducted by the concerned Board or University.

Limitations and Possible Scope of Research

Although the study was based on two chapters in the paper but in fact it's based on so many subjects of mathematics. The six tables show that this approach is valid on all branches of mathematics.

The same can be applied on all most all branches of science, engineering, commerce, arts, etc. The demerits found in six table show that how can a teacher choose the teaching techniques to maintain the mathematics quality education.

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