

Influence of External Examination on The Teaching and Learning of Mathematics at the Secondary Level Education in Pakistan

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Abstract

This study explores the influence of external examination on teaching and learning Mathematics at the secondary schools affiliated with provincial and private examination boards in Pakistan. This study was conducted in two phases by employing the explanatory sequential mixed-method. First, the Mathematics examination papers of the last five years from both provincial and private examination boards were reviewed and analyzed to understand (1) the cognitive complexities required to solve the questions, (2) the frequency and variety in which the questions were repeated, and (3) the chapters of prescribed books whereby the questions were selected in the examination of last five years. In the second phase, semi-structured interviews, with teachers and students were conducted, along with participatory observation to understand how the examination patterns shape their teaching and learning. The findings revealed that the external examination directly influences teachers' teaching, and indirectly students' learning. Both the positive and negative effects of the external examination were found on the teaching-learning strategies of teachers and students respectively. The study also contributes toward filling the gap in the existing literature on assessment practices. Furthermore, it aims to encourage external examination bodies and policy-makers to reflect upon their current policies as well provide ideas suggestions to school teachers and management.

Keywords: Mathematics examination, mathematics learning strategies, mathematics teaching strategies, teaching mathematics

Introduction

External examinations play a vital role in assuring the standardization in assessment. At the secondary and higher secondary levels, the external examinations are used to universally decide which students are eligible for the next levels of education (Jensen et al., 2014). Therefore, assessment helps foster students' skills, knowledge, and real talent. Consequently, they are promoted based on their examination scores/grades (Falchikov, 2013). Specifically, the results of the external examination play a significant role in university entry for the students. Thus, there is much influence of the external examination on the teaching and learning in the affiliated schools (Djurić, 2015). Examination score is given utmost preference; consequently, both teachers and students direct all their possible efforts to achieve desirable scores (Jilani, 2009). Hence, the external examination becomes a powerful force that shapes teaching and learning. With this premise, Rind and Malik (2019) conducted a research to understand the quality of external examination at tin secondary and higher secondary education in Pakistan, and Rind and Mari (2019) researched to understand the impact of external examination on the teaching and learning of English at the secondary and higher secondary education in Pakistan. They found a strong correlation between the quality of external examination and teaching-learning patterns in the schools. Mathematics subjects at the secondary and higher secondary levels play a crucial role in building a strong foundation for the students for further studies. Considering the inevitable influence of external examination on teaching and learning, it was indispensable to understand the quality of these examinations and how they influence mathematics teaching and learning at the secondary level in Pakistan. In doing so, this study adopted Rind and Mari's (2019) model to assess the quality of external examinations conducted by a provisional and a private examination board in the norn Sindh, Pakistan, and the ways these examinations shape the teaching and learning of Mathematics at the affiliated schools.

Background of the Study

The secondary and higher secondary examinations are conducted by the external examination boards in Pakistan, known as the Board of Intermediate and Secondary Education (BISE). There are three kinds of BISEs operating in each province of Pakistan: provincial BISEs, federal BISE, and private BISEs. All these BISEs provide examination and certification facilities to the students of grades

IX to XII studying at the public and private schools that are affiliated with these BISEs. At the secondary level, provincial BISEs conduct examinations of around 0.85 million students every year (RSU, 2019), whereas federal BISE conducts examinations of n around 2 million students (FBISE, 2019) and private BISEs conduct the examination of 20,000 students every year (ASER-Pakistan, 2018). Federal BISE and private BISEs are generally more popular among parents as these are considered to provide quality assessment, fair results, and conduct examination cheating-free free environment (Rehmani, 2003).

In contrast, different research studies (Awan & Zia, 2015; Khattak, 2012; Rehmani, 2003) blame the provisional BISEs for promoting rote learning, copy culture, and an unfair assessment system. Although these studies lament the poor quality of the provincial BISEs, none of these specifically highlighted the issues related to the quality of questions in the examination papers. Rind and Malik (2019) conducted the first systematic study to evaluate the quality of the individual questions in the assessment papers of provincial BISEs and compared these with federal and private BISEs. Analyzing the past examination papers of various subjects, Rind and Malik (2019) found that the examinations of the provincial BISEs assess students' memory and comprehension only; and that the items frequently repeated in the past examination. An earlier study found that questions in the external examinations are selected from some chapters of the prescribed textbooks (Rind, 2017). Considering that the prescribed textbooks are religiously followed at the secondary and higher secondary schools, therefore, Rind (2017) invited future researchers to investigate the impact of this examination trend on the decisions of teachers and students to cover or ignore certain chapters from the prescribed books. Based on the aforementioned studies, this research attempted to understand the influence of external examination on the teaching and learning of Mathematics within and beyond the classrooms. Focusing on Mathematics only, this study attempts to understand the teaching and learning patterns generated in the schools due to external examination. For a comparative analysis, the examinations of a principal and a private BISEs were analyzed, followed by interviews and participatory observations of the schools affiliated with these two boards.

Examination Pattern of Mathematics in the provincial and private BISE

The Mathematics examinations of provincial and private BISEs consist of Multiple Choice Questions (MCQs), Constructed Response Questions (CRCs), and

Extended Response Questions (ERQs). The examination of the provincial BISE is based on a three-hour unseen paper that carries 100 marks divided into twenty MCQs, ten CRQs (Algebra=6. Geometry=3, and Trigonometry=1), and three ERQs (Algebra=1. Geometry=1, and Trigonometry=1) (BISE, 2018). Whereas, the examination of the private BISE is based on two unseen papers. The first paper is based on twenty-five CRQs of eighty marks that students have to attempt within two hours. The second paper is based on eleven ERQs of 100 marks that students have to complete within two hours. Unlike the provincial BISE, no fixed pattern of questions from Algebra/ Geometry / Trigonometry was found in the examination papers of the private BISE (CAIE, 2018).

Teaching of Mathematics as per National Curriculum at the Secondary Level in Pakistan

Mathematics is a compulsory subject in Pakistan from grades I to X, whereas in grades XI-XII it is optional as students can opt either for Biology (which is further divided into Zoology and Botany) or for Mathematics. Keeping in view the paramount significance of Mathematics in the current technologically advanced world, the National Curriculum of Pakistan emphasizes students' ability to (1) reason and justify conclusions, (2) focus on the practical implications of Mathematics in everyday situations, and (3) develop the relationship between Mathematics and other subjects so that students can apply and extend their knowledge in other fields (BCEWS, 2018). With these overarching goals, the National Curriculum of Mathematics focuses on five essential standards, i.e., (1) number and operations, (2) algebra, (3) measurement and geometry, (4) information handling, and (5) reasoning & logical thinking (Government of Pakistan, 2006). Moreover, each standard is followed by some benchmarks set as per Bloom's (1984) revised taxonomy (see Table 1).

Table 1*Benchmarks against Standards of Mathematics (Grades IX-X)*

Standard 1 Number and operations	Standard 2 Algebra	Standard 3 Measurement and Geometry	Standard 4 Information handling	Standard 5 Reasoning and logical thinking
<ul style="list-style-type: none"> • Add, subtract, and multiply matrices. • Assess determinant and inverse of a matrix of order 2-by-2. • Explain real numbers with their properties and show them on the number line. • Differentiate between real and complex numbers and use four operations on complex numbers. 	<ul style="list-style-type: none"> • Factorize algebraic expressions. • Use remainder/factor theorem to verify that a first-degree polynomial is a factor of a given polynomial. • Find HCF and LCM and square root of algebraic expressions. • Solve a system of two linear equations. 	<ul style="list-style-type: none"> • Apply the distance formula to discover distance between two points in Cartesian plane. • Convert degrees into radians and vice versa. • Determine the length of an arc the and area of a The sector of a circular region. • Apply trigonometrically identities to verify relationships between trigonometric ratios. 	<ul style="list-style-type: none"> • Gather data from a variety of sources and build frequency table (distribution) with equal and unequal class intervals. • Find measures of central tendency and dispersion to conclude. • Draw, interpret, and identify the graph of a linear function. 	<ul style="list-style-type: none"> • Examine general statements. • Select appropriate strategy to solve mathematical problems. • Frame and test logical arguments about geometric figures and patterns and communicate reasoning. • Show step-by-step deduction in solving a problem.

Note: National Curriculum 2006 for Mathematics (2006c, pp.4-7).

The review of benchmarks in Table 1 suggests that students are expected to develop higher-order learning skills in all the standards. To achieve this, the National Curriculum also recommends teaching strategies, including inquiry-based teaching, problem-based teaching, demonstrations, discussions, and group work. The work recommended assessment strategies include paper-pen assessments, presentations, portfolios, reflection notes, and individual and group projects (BCEWS, 2018). However, to what extent all these recommended policies are practiced requires further research.

Considering the above-mentioned scenario, the study hypothesizes for the quantitative part of the study that in the provisional examination board, the assessment focuses on lower order learning. On the other hand, the private board encourages higher-order learning.

Research Question

1. How does the external examination influence the teaching and learning of Mathematics in the provincial and private BISE's affiliated schools?

Literature Review

External examinations at the secondary and higher secondary are conducted worldwide to maintain standardization in admitting the desirable candidates for the limited positions at the higher education institutes. This makes the results of these examinations a critical factor that shapes the teaching and learning within the schools (Aftab et al., 2014). How pedagogies are affected by the external examination is commonly referred to as the 'washback' or 'backwash' effect (Alderson & Wall, 1993; Bachman & Palmer, 1996; Biggs, 1995; Cheng & Curtis, 2004; Gu & Saville, 2016; Messick, 1996; Pan, 2009; Spolsky, 1994). Spolsky (1994, p. 2) defines backwash as a concept that deals with the unforeseen side-effects of testing and not the intended effects when the primary goal of the examination is the control of curricula. Likewise, Biggs (1995, p. 3) maintains that backwash refers to the fact that testing controls not only the curriculum but also teaching methods and students' learning strategies.

Similarly, Alderson and Wall (1993, p. 1) argue that washback compels "teachers and learners to do things they would not necessarily otherwise do because of the test." Pearson (1988, p. 7) maintains that public examinations influence the attitudes, behaviors, and motivation of teachers, learners, and parents, and because examinations often come at the end of a course, this influence is seen working in a backward direction, hence the term, washback. Washback concerning teachers yields exam-oriented pedagogies. Although washback can have both positive and negative effects on educational practices (Djurić, 2015; Hughes, 2003), these are usually portrayed negatively in mainstream literature, mainly because of the quality of the examination. For example, if the emphasis in an examination is on lower-order learning items, then teaching practice may also focus on lower-order learning (Kirkpatrick & Zang, 2011; Qi, 2004).

Bloom defined lower and higher-order learning in his cognitive learning taxonomy whereby he also categorizes learning in a hierarchal order according to its cognitive complexities on six levels (Adams, 2015). According to the revised version of Bloom's taxonomy (Krathwohl, 2002), the first level is named Remembering, whereby students memorize facts and figures. The second level is termed understanding, whereby students understand and interpret facts in their way. The next level is Applying, whereby students use their knowledge. These first three levels fall within the purview of lower the order learning category. The fourth level is Analyzing, and here students analyze the different situations to draw their conclusions. The fifth level is termed Evating whereby students make judgments after a comprehensive learning process. The sixth and final level is called Creating, where students are expected to produce new knowledge. These learning levels are also commonly used by course designers to set benchmarks and students' learning objectives for specific courses. Usually, there is an alignment between students' learning objectives, their course material, their teachers' strategies, and assessment strategies (Chandio et al., 2016).

Teachers' role is inevitable in reshaping students' learning. Several studies have been carried out to understand teachers' perceptions about teaching and their roles in the classrooms (Kember & Kwan, 2000; Prosser et al., 1994; Samuelowicz & Bain, 1992). Although different classifications are used in each study, they conceptualize teaching as a spectrum, with teaching as 'helping students develop conceptions' at one end, and teaching as 'transmitting the concept of syllabus/teachers' knowledge' at the other (Prosser et al., 1994, pp. 223-225). Teachers, in the former category, perform the role of facilitators or collaborators, working together with students to construct new knowledge and understanding of various concepts. This approach leads to student-centered classes. The preferred teaching methods include discussion, demonstration, group work, problem-based teaching, and inquiry (Emaliana, 2017). On the contrary, teachers in the latter category form just the role of knowledge transmitters. This involves merely passing the content knowledge on to students. It is assumed that if students learn all the formulae and equations of the Mathematics delivered by teachers, they will learn Mathematics up to the level which is prescribed in the books (Stephan, 2020). This approach leads to teacher-centered classes, where teachers are the only source of knowledge. Teachers with this approach usually adopt lectures as a preferred method of teaching (Ahmed et al., 2020).

To sum up, the literature review defines washback as exam-oriented practices by not only students but also teachers. The test score is a key concern for the stakeholder. Moreover, Bloom's Taxonomy helps design papers in such a way that classifies lower and higher-order learning skills. Similarly, the role of the teacher is shaped as either a facilitator or merely a knowledge transmitter, whereby the former leads to a student-centered approach while directed as teacher-centered.

Methodology

This study was conducted in two phases. In the first phase, the quantitative content analysis method was employed to review the Mathematics examination papers for grade 10 thoroughly. For this purpose, the twenty (I&II) past Mathematics examination papers (i.e., 2013 to 2017) of the provincial and private BISEs were selected. The study reviewed past papers for five years only because the key objective of the study was to trace the influence of external examination on teaching and learning from the perspective of teachers and students. Therefore, reviewing only five years of past papers strengthened the study by adding the examination patterns and setting which ultimately paved the way for structured interviews and participatory observation. Hence, there were 100 MCQs (refer to red hereafter objective items), 350 CRQs, and 420 ERQs (referred to hereafter er subjective items) in these examination papers. Both objective and subjective items were analyzed and coded on three factors: (1) the cognitive complexity of the item (coded as 'L1', where L represents learning the, and the number represents learning level from 1 to 6 as per Bloom's taxonomy); (2) the frequency and variety of the items repetition (coded as R if it was without any change, R1 if it was repeated with a minor change or R2 if it was repeated with major change); and (3) the chapters from which the items were selected (coded as Ch1, where Ch, represents the chapter, and the number represents the number of the chapter within the prescribed textbook). The quantitative data were put into MS Excel sheet tables for descriptive analysis. A simple numerical calculation was applied to draw the erage percentage of objective and subjective items. Whereas, the results were displayed as bar graphs/figures for further interpretation.

While, In the second phase, by employing the purposive sampling technique which requires the research goals to be kept in mind (Cohen et al., 2013), in-depth interviews were conducted with students (N=16, female=50%, provincial BISE=8; private BISE=8) and teachers (N=12, female=50%, provincial BISE=6; private

BISE=6). Along with this, eight participatory observations (provincial BISE=4; private BISE=4) were conducted. These sixteen students and twelve teachers were purposively selected based on their diversity in affiliation with provincial or private examination boards. Additionally, in the case of students, their high and low scores in mathematics (as high and low achievers) according to their internal examination were also considered to ensure a good deal of variety in the resulting sample (Bryman, 2016).

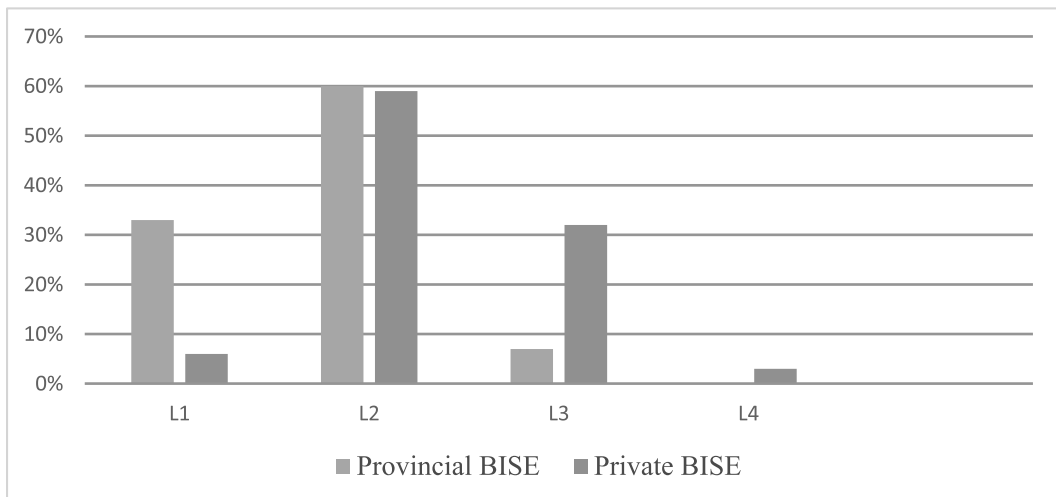
Findings

Cognitive Complexity of the Items

The data analysis suggests that there is thirty-three percent of the L1 items in the provincial BISE as compared to only six percent of L1 items in the private BISE. There is sixty and fifty-nine percent of L2 items in provincial and private BISE, respectively. There is only seven percent of L3 items in the provincial BISE as compared to thirty-two items in the private BISE. There were no L4, L5, and L6 items in the provincial BISE. Likewise, there is only three percent of L4 items in private BISE, with no L5 and L6 items (see figure 1).

Figure 1.

Statistics of Items as Per Learning Levels in Provincial and Private BISES

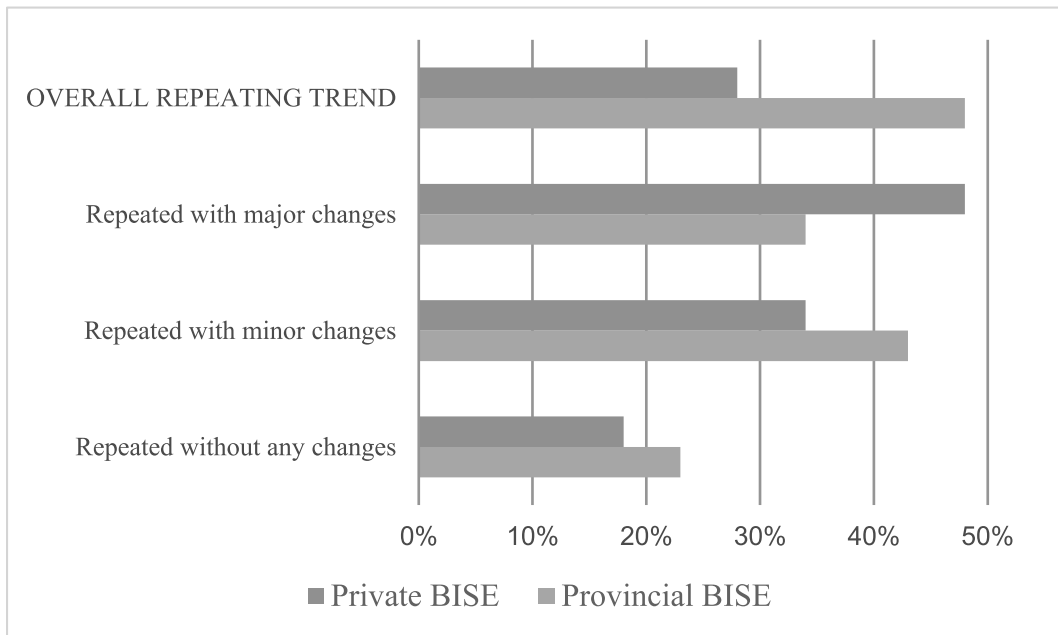


Item Repetition Trend

The data analysis suggests that overall forty-eight percent of items were repeated in the last five years’ examination papers of the provincial BISE, out of which twenty-three percent were repeated without any changes, forty-three percent were repeated with minor changes, and thirty-four percent were repeated with significant changes. In comparison, only twenty-eight percent of items were repeated in the examination of the private BISE, out of which eighteen percent were repeated without any change, thirty-four percent were repeated with minor changes, and forty-eight percent were repeated with significant changes (see figure 2).

Figure 2

Repetition trend in the examination of Provincial and Private BISEs



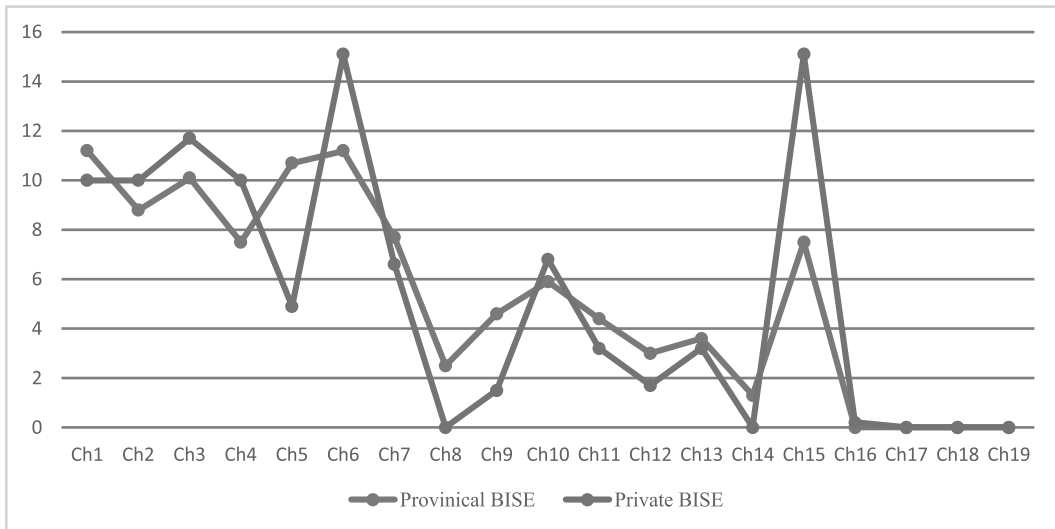
Chapter Coverage

The data analysis on the chapter coverage suggested that the examiners of both boards give some chapters high priority, some low priority, and some no priority while selecting items for the examinations. Surprisingly, it was done in a similar pattern by the examiners of both boards. Figure 3 shows the priority

trajectory of the examiners of provincial and private BISE in terms of chapters for item selection. It shows that the examiners of both boards have given high priority to chapters 1 to 8; no priority to chapter 8; low priority to chapters 9 to 13; no priority to chapter 14; high priority to chapter 15; and no priority to the remaining last chapters in the examinations of the last five years.

Figure 3

Chapter Coverage in Provincial and Private BISEs



Teaching Approaches in the Provincial and Public BISE’s Affiliated Schools

While talking to teachers of provincial BISE’s affiliated schools, it was found that they perceive teaching Mathematics as a ‘knowledge transfer’ activity, where the main goal of the teachers was to provide the ‘accurate knowledge of Mathematics’. These teachers were found to use deductive teaching methods in the classes, and their favorite teaching method was found to be ‘silent lectures.’ In this method, they introduced the topic, then silently wrote formulae and solved equations on the boards, and talked to explain after long pauses. During this whole time, students were expected to copy all the formulae word-to-word. The only time for the question-answer was in the last ten minutes of the class, which was also found to be dominated by teachers, who commonly asked follow-up questions.

Although some teachers of private BISE’s affiliated schools defined teaching as a knowledge transmitting activity, the majority perceived it as an ‘interactive

activity, where students and teachers interact with each other to make sense of the concepts of Mathematics. It was found that these teachers used group work and discussion in their teaching. Some teachers were also found to use inquiry in teaching different concepts of algebra, and demonstration to teach trigonometry. The discussion was found to be very popular among these teachers. Instead of writing formulae and equations on the board, teachers were found to introduce the topic followed by a set of questions. Students were required to discuss in groups for three to five minutes, then share their thoughts on the questions with the whole class. Teachers wrote their thoughts in the form of mathematical formulas on the board, which then were further discussed. Teachers kept providing prompts to the students to keep the discussion on track. To reach a commonly agreed conclusion, the teachers kept providing prompts. More importantly, most of these topics were given in advance to the students as homework with supporting material. Thus, the discussion became relevant to the students, and a majority of them actively participated in these discussions.

Learning Approaches of the Students in the Provincial and Private BISE's Affiliated Schools

The students of provincial BISEs were found to define learning as 'remembering Mathematics formulas,' and 'applying the formulas to the new problem.' When asked to give more information on the latter definition, the students suggested that they remember the formulae and recall these when some similar problems (with different mathematical values) were presented to them. In line with their teachers' teaching approaches, the students of provincial BISEs were found to observe the teachers' lectures silently, and religiously copy teachers' notes from the board. They were found not to ask many questions in the classes. When asked what they do if they have any confusion about any mathematical concept, students said that they usually referred to the notes provided by the teachers, or the notes and guidebooks which were readily available in the market. Some students were found to have joined private tuitions.

On the contrary, the students of private BISEs were found to be highly active in the classes. When asked to define Mathematics learning, they highlighted the constructivist aspects of learning. For them, learning Mathematics is to involve mathematical thinking, linking Mathematics concepts with the real world, and applying mathematical formulae to other disciplines. In line with their teachers'

teaching approaches, they were found to be highly active in knowledge construction, particularly in the discussion. They were found to use the homework as an opportunity to take control of [their] learning. They were found to use different learning aids, including teachers' provided supporting material. However, their primary support source was the internet, particularly the use of YouTube for video lectures. They were found to be more informed on specific topics than their teachers, which was not surprising as they had been given freedom and encouragement by their teachers to explore the concepts from different angles using different sources.

Perception of the External Examination

Surprisingly, teachers and students of both boards have similar perceptions of the external examination, i.e., a target to achieve successfully, and a motivation to study. The teachers of both boards gave the highest priority to the external examination and considered students' high scores in these examinations as an essential indicator of their success. The teachers of provincial BISE's affiliated schools considered external examination as the topmost priority of their teaching. For them, the results of the external examination were essential as it was the only way they and their schools would maintain their legitimacy. Although the teachers of private BISE's affiliated schools considered learning Mathematics as an interactive and constructive activity, it is not beyond [external] examination said by a teacher in private BISE's affiliated schools. Another teacher of private BISE's affiliated schools said it [interactive teaching approach] is of no use if my students fail in the examination.

Likewise, as per the results of the analysis, it is suggested that the students of both boards were external-examination driven. The students of provincial BISE's affiliated schools were found to have collected many notes, unsolved examination papers, and guess papers — a guide which was a list of expected questions to be repeated in the upcoming examination, and provided pre-prepared notes to the students for the examination preparation (Rind & Mari, 2019). Although the students of private BISE's affiliated schools were using innovative learning strategies, their main focus was to achieve good grades in the external examination. "I use all these strategies because these will help me get good marks eventually" said a student of private BISE's affiliated school. The other student highlighted that innovative learning strategies result in innovative and unique ways of explaining different Mathematics concepts, which were rewarded in the external examinations. In her

words, “At the end of the day, I will eventually get good marks if I write different, better, effective, and most importantly with newly updated examples.”

Formative Assessment

The use of formative assessment was prevalent among the teachers of both boards. Although the formative assessments used by the teachers of both boards were external-examination oriented, the nature of formative assessment was quite different from one other. The teachers of provincial BISEs’ affiliated schools were found to use formative assessment in the form of unseen class tests, which were prepared based on the items copied from the past examination papers. The purpose of the formative assessment was to practice and prepare for the external examination.

On the contrary, teachers of private BISE’s affiliated schools were found to prepare the innovative formative assessment, which included an unseen class test based on the scenario-based descriptive items. Most of these descriptive items were selected from the internet and customized by the teachers to match the Pakistani context. Presentation, demonstrations, and group-open-book assignments were also frequently used by the teachers of private BISE’s affiliated schools. However, the focus and purpose of these formative assessments were also to prepare students for the external examination.

Final Preparations of the External Examination

The teachers and students of both boards were found to be highly serious about the final preparations of the external examination; however, both groups used different strategies. The teachers of provincial BISE’s affiliated schools were found to prepare a list of the important topics, which they prepared after carefully analyzing the past examination papers and identifying the item repetition trends. They also prepared notes and model answers for these topics and provided these to the students for examination preparations. Their primary focus remained on these so-called essential topics for the external examination preparation. Besides, the teachers also identified the chapter coverage in the pass examinations and dedicated the last four weeks before the examination for the revision of these so-called important chapters.

The students of provincial BISE's affiliated schools suggested that they practice the important topics. However, based on our observations, it was found that they mostly remember the pattern and expect the same topic to repeat in the examination. Some students expected that the core of the expected items would be the same; just values might be changed. Thus, remembering formulae and equations would help them to get good grades.

Whereas, the teachers of private BISE's affiliated schools were found to prepare innovative scenario-based descriptive word problems and help students to practice these in the class. At the same time, teachers instructed students to prepare similar problems and practice these themselves. Students were found to focus more on understanding and applying different concepts of Mathematics instead of only remembering.

Discussion

The cross-analysis of the findings of the first and second phases shows a strong association between the external examination and teachers' teaching approaches. For example, the teachers of provincial affiliated schools were found to define the teaching of Mathematics as the knowledge transferring activity, where the teachers' job was to transfer the bookish knowledge among the students. This was reflective of their teaching practices. They were found to use the silent lecture as a preferred teaching method. With this method, they silently solved the mathematical equations on the boards, and expected students to copy this word-to-word, and remember them for the formative assessments. This strategy was found to be feasible for these teachers for two reasons. Firstly, the examination of the provincial BISE assessed students' memorization and comprehension skills only, thus remembering the teacher-solved equations and copying this word-to-word in the examination helped students in getting better marks in the external examination. Secondly, considering that good grades in the external examination were the key indicator of teachers' performance, all the stakeholders including teachers themselves were found to be happy with their teaching approaches. To maintain this so-called satisfactory performance, teachers kept students' high scores in the external examination as to their key target. To ensure that students get the maximum marks in the external examination, teachers systematically analyzed the past examination papers to identify the repetition trend of the items and the chapter coverage. Thus, they focused on these so-called important topics and chapters in

their teaching. These findings are consistent with the previous research studies of Rind and Mari (2019) and Rehmani (2003).

Similarly, the external examination trends influenced the teaching strategies of teachers of private BISE's affiliated schools. Like the teachers of provincial BISE, the teacher of private BISE kept external examination as their main priority. However, their teaching strategies significantly differ from the teachers of provincial BISE, mainly because of the examination pattern of private BISE, which emphasized more on assessing students' comprehension, application, and analytical skills. Thus, the teachers had to use discussion as a teaching strategy to develop students' comprehension skills. The emphasis was not on one right definition of the Mathematical concepts; instead, students were required to come up with multiple explanations of the same concepts. Since unique explanations were appreciated and rewarded by the examiners, both teachers and students inclined to construct new conceptual understanding of the same concepts. Teachers were found to use demonstration as a teaching strategy as it helped students to apply different Mathematical concepts in real-life situations. This was also linked with the examination of private BISE, which introduced descriptive items based on the real-life situation to assess students' comprehension of different Mathematical concepts. The use of inquiry and problem-based teaching strategies were also influenced by the external examination, as the examination papers had the descriptive items based on a given problem, where students were required to use different Mathematical concepts to solve it. As the item repetition trend was significantly low in the examinations of the private BISE, and within the repeated items, there were hardly any items that were repeated as it is, complementing the study of Rind (2017). This significantly influenced teachers' choices to select learning material for the students. Teachers were found to use the internet to find the supporting material, and to use innovative methods for customizing the material in class activities and formative assessments. Hence, the quantitative-qualitative integration indicated that repetition of items is another way whereby external examination influences teaching and learning because same topics are emphasized in classroom practices as are most repeated in external assessment. The findings complement the study of Aftab et al. (2014) who also found that teachers and students prepare for test-oriented content only.

Although previous research suggests a direct influence of external examination on the students' learning strategies (Rind & Malik, 2019), this study found that external examination influence students' learning through teachers' teaching strategies. It was found that students' learning strategies were more teacher-driven and comparatively less examination-driven. The teachers consistently reminded students about the importance of good grades in the external examination. These constant reminders made good grades as a top extrinsic motivation for the students to study. This strategy worked well for the teachers of provincial BISE's affiliated schools, who legitimized their teacher-centered approach among students, parents and school administration. Unaware of the outcomes, students follow teachers' line of thought to get better grades, and unconsciously ended up being equipped with lower-order learning skills. Research suggested that such students, with high grades, badly fail in the university entrance tests, which were based on the higher-order learning items (Bhatti & Anwar, 2012).

Research also found that secondary and higher secondary students struggle in the higher education institutes where teaching, learning, and assessment were all informed by Course Learning Outcomes (CLOs) designed to enhance students' higher-order learning skills. Therefore, it can be inferred that external examination influenced teaching learning practices in private examination board at secondary level of education in terms of encouraging and discouraging same level of learning in classroom practices as encouraged or discouraged in examination papers, confirming the findings of Khatak (2012).

Likewise, endorsing the findings of Omer and Jabeen (2016) the students of private BISE's affiliated schools were more active in the classes mainly because of the teachers rather than external examinations. Teachers promoted group discussion, demonstrations, and inquiry mainly because these teaching strategies complement the external examination; whereas, students became active in these classes mainly because of the teachers' push and support. Students brought different conceptual definitions of the same concepts and even sometimes contradicted or challenged the teachers mainly because the teachers allowed them to do so. Teachers understood the importance of these skills of students from the perspective of external examination; however, students perceived the importance of these skills necessary from the perspective of teachers' approval and appreciation in the class, complementing the study of Soomro and Memon (2016).

Conclusion and Recommendations

This study attempted to highlight the influence of external examination on teaching and learning of Mathematics. In the first phase, it assessed the quality of items in the examinations of Mathematics conducted by infamous provincial BISE and reputed private BISE, and in the second phase, it examined the ways in which these examinations shape the teaching and learning in the affiliated schools. The findings of the second phase showed some strong washback effects, both positive and negative, of external examination on teachers' teaching strategies. Whereas, it was found that students' learning strategies were primarily influenced by the teachers. For example, the examinations of provincial BISE assessed remembering and understanding skills of the students, confirming the hypothesis made for quantitative part. Thus, encouraged teachers to adopt those teaching strategies which only promote these skills among students. Students memorized different concepts taught by teachers and reproduced them in the class participation, formative assessment and external examination. The accurate reproduction was rewarded in the form of teachers' appreciation and better grades in the external examination. Similarly, the examination of the private BISE emphasized on application and, to some extent, analytical skills motivated teachers to use interactive teaching strategies. The use of innovative items in the examination of private BISE also drove teachers to be innovate in developing teaching material. Students became active in the knowledge construction process mainly teachers allowed them to do so. Their innovative ideas and alternative explanation were rewarded by both teachers in the classes and the examiners in the external examinations.

The findings of the first phase raise some interesting questions that require further investigation. Firstly, it was found that either board primarily assessed students' understanding (i.e., L2) skills, along with memorization (in the case of provincial BISE), and application (in the case of private BISE). In contrary, the National Curriculum of Mathematics expected students to develop higher-order learning skills including analysis, evaluation and creation. Thus, the examinations of either board failed to meet the expectation of the National Curriculum. This raises the question that why examiners of either board assess lower-order learning skills. Secondly, it was found that many items were repeated in the examinations of provincial BISE. Considering that the prescribed text book, not revised for last ten years, was devotedly used by examiners, there were obvious chances of item repetition. However, when the items were repeated without any changes, it raises

questions on the qualification and skills of the examiners, who seemed to simply copy-paste items from the past papers. Thirdly, it was found that some chapters from the prescribed textbooks were given high priority, and others were ignored by the examiners of both boards. And most importantly, this was done in a similar pattern by the examiners of both boards. Why have the examiners given high and low priority to different chapters? All these questions demand voice of examiners, which was out of the score of this study, thus requires further investigation.

The study proposes various recommendations for different stakeholders i.e. examination boards, policy makers, curriculum developers, school administration, teachers, parents and students. The recommendations are suggested as under.

- i. The study found both positive and negative washback effects on teaching learning practices of mathematics, therefore, the examination boards should set clear cut directions for papers setters so that they should avoid repetition of items.
- ii. The findings suggested that the focus of provincial examination board papers were replete with lower order cognitive learning level item, therefore, the board needs to promote higher order skills so that students can be equipped with practical applications of mathematics.
- iii. The positive washback effects in private examination board suggested that examination and teaching learning practices were directly proportional to each other, therefore, the standard of classroom practices can only be improved by enhancing the quality of assessment.
- iv. The curriculum developers should generate mechanism that ensures its alignment with assessment, since the study found a yawning gap between curriculum and assessment
- v. The findings contradicted the National Curriculum in terms of implanting the prescribed high standards; therefore, it is a prime duty of examination boards as well as school administration that they should make the teachers and papers setters aware of the outcomes, standards and teaching methods proposed in the curriculum to achieve the learning objectives.
- vi. Even in the age of multiple intelligences, it is a common standard of

our society to judge efficiency of a child through his/her academic achievements which indirectly generates pressure on different stakeholders to strive for high grades. Therefore, the study recommends to the external examination boards to include certain advanced indicators in the result card to measure students' performance.

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