

O – Level Mathematics and Science Teachers' Alignment of STEM Skills Oriented Instructional Objectives with Assessment in a High Stakes Examinations Environment

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How to Cite: Matorevhu, A. (2020). O – Level Mathematics and Science Teachers' Alignment of STEM Skills Oriented Instructional Objectives with Assessment in a High Stakes Examinations Environment. *International Journal of Trends in Mathematics Education Research*, 3 (1), 1-7. DOI: 10.33122/ijtmr.v3i1.165

ARTICLE HISTORY

Received: 20 December 2019

Revised: 6 February 2020

Accepted: 25 March 2020

KEYWORDS

STEM;

Instructional Objectives,

High Stakes Examinations,

Assessment,

ABSTRACT

In any school context, teaching and learning should be guided by objectives developed, and used by the teacher. These objectives are benchmarks by which the learning process is assessed. The teacher plays a dual role of assisting learners to develop requisite skills for the world of work, and ability to obtain good grades in high stakes examinations. High stakes examinations are of critical importance to the learner, because they determine the future of the learner through grades which are awarded. The balance between satisfying the requirements of syllabus assessment objectives, and high stakes examinations depends on how the teacher develops and implements instructional objectives. In an attempt to gain insight, this study explored O-Level mathematics and combined science teachers' alignment of science, technology, engineering and mathematics (STEM) oriented objectives with assessment in a high stakes examinations environment. Data were collected through interviews, observations and document analysis involving 10 mathematics and combined science teachers. Results suggest that, while teachers were aware of Mathematics and Combined Science syllabus requirements of aligning STEM oriented objectives with assessment, they devoted considerable time to preparation of students for high stakes examinations. However, the quality of preparation was questionable, measured against Bloom's Taxonomy of educational objectives. Teachers tended to use drilling methods, the aim being production of high grades in high stake examinations, with little focus on understanding and application of knowledge in real life situations. It is recommended that teachers should include higher order STEM oriented instructional objectives aligned with assessment in order to prepare learners for the real world of work.

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1. INTRODUCTION.

The 21st century teaching and learning seeks to produce school graduates who have knowledge, skills and attitudes for competitiveness in development at individual, national and international levels. Global trends show increasing competition for political and economic supremacy among nations, with mathematics and science education as the bedrock for achieving success (Arani and Reza 2008). Central to a thriving economy are science, technology, engineering and mathematics (STEM) subjects (Science and Mathematics), hence they are essential components of good education (Liu, Du, and Liu, 2017; Science and Learning Group, 2010). Learning the STEM way has important functions like provision of essential knowledge and skills for everyday life, and decision making on personal, family and social issues (finance, health, politics etc). STEM learning also equip learners with exist competences needed in most jobs and pathways to STEM related careers (Gumede and Blyase, 2016). Therefore the current learning context requires facilitation of enrichment opportunities of STEM education outside the classro -

om, through practical and project work. STEM education opportunities beyond the classroom engage young people in science and mathematics, with experiences and skills needed in later study and employment. Therefore effective teaching and learning of STEM subjects should reflect scientific and mathematical attributes that these subjects require, which include diverse theoretical, practical, experimental and factual approaches to learning (Liu, Du, and Liu, 2017).

In line with ensuring that performance in mathematics and science education meets desired standards, many counties are making changes to mathematics and science curricula. Technology revolution of information and communication through the internet, and its attendant shrinkage of the world into a village, has a strong bearing on curriculum reform in mathematics and science education. This revolution has necessitated up-skilling and de-skilling in teaching and learning to keep abreast with current and emerging world trends (Ezeudu, Nkokeonye, Ezeudu, 2013). Obviously, this context justifies mathematics and science

curricula reform globally. In the People's Republic of China, several curriculum changes have taken place for basic education since the late 1970s, and they are on going to keep it up to date with current trends (Liu, Du, & Liu, 2017). Rapid economical, industrial and technological transformation in the past decades has caused unprecedented impact on Japan's cultural and social foundations, forming the basis of curriculum changes (Arani and Reza, 2008). Equipping learners with knowledge, skills and attitudes which are proportionate to 21st century needs, like social and cultural needs consistent with current information and communication age, and synchronisation of education programmes with daily developments are some of the reasons necessitating curriculum change in Japan (Lee, 2001; Monbusho, 2001; Kariya, 2000). Also, curricula changes in science in Canada, United States and Europe have been made to meet current needs as viewed through the STEM lens (McPherson and McDonnell, 2017). This has made Canada the world leader in sustained professionally driven education reform, as evidenced by good student performance, regardless of differences in socio – economic status, whether native Canadians or recent immigrants (OECD, 2010). Changes in education are ongoing due to new realities the education system should address in respective countries (Ministry of Education and Employment, 2012).

Similar changes in mathematics and science curricula have occurred in African countries. For instance, in South Africa (SA) curriculum changes sought to address apartheid created challenges through Curriculum 2005, also known as Outcomes Based Education (OBE), which focuses on the outcomes the learner should achieve. In this model regardless of race, ethnicity and cultural background no learner is better than the other, implying every learner is respected as an individual (Gumede and Blyase, 2016). The OBE has three components which are school wide evaluation, systematic evaluation and assessment in preparation for examinations. Mismatch between the intended curriculum and implemented curriculum has been reported in Africa, specifically in Tanzania, Uganda and Kenya, forming the basis of curriculum change. Whilst considerable effort has been made in updating the curriculum in respective countries, more needs to be done in order to be consistent with 21st century desired learner competences (Halal and Tenant, 2016).

In this 21st century, science and mathematics, which are STEM subjects, are tools for socio – economic development, through enhancing one's science and technological skills (Arani and Reza, 2008). School graduates with such knowledge and skills are better prepared to join the world of work or pursue science and technology related fields. Therefore mathematics and science have assumed high stakes status, hence instruction and assessment in these areas. Test scores in high stakes systems determine work prospects, position in society, and advancement of learners with education (Gumede and Blyase, 2016). This implies that the public, parents, employers and governments expect schools to demonstrate accountability through authentic performance of school graduates. Instruction and assessment play a crucial role in achieving accountability.

Instruction and Assessment

The extent to which mathematics and science education achieves national goals as guided by the curriculum, depends on the quality

of instruction, and the nature of assessment. Shumba (1993) observes that the extent to which both impact and consequence of science and technology permeate society is a function of how students experience it at school. Philosophies among others, currently guiding science instruction are existentialism, pragmatism and constructivism, positing that authentic knowledge comes from personal experience and construction of knowledge (Akinpelu, 1981). Progress in mathematics and science learning is measured through formative assessment, conducted by the teacher or school. Certification is achieved through summative assessment. However, both formative and summative assessment should assess the depth and breadth of the curriculum.

Research (Shumba, 1993; 1997; and Mellado, Bemerjo, Blanco and Ruiz, 2007) shows that most science teachers have problems in understanding the nature of science, hence some important aspects of mathematics and science instruction are omitted in their teaching. Other literature (Biggs, 2003; Laitsch, 2006) point to the notion that some mathematics and science teachers do not maintain the requisite balance in four components of science education, that is: standards, curriculum, instruction and assessment. In their article, Mansel and James (2009) content that public pressure on high performance in high stakes examinations, force some schools and teachers to adopt unorthodox approaches to drill the learners for high grades in high stakes examinations. On the contrary, observations made point that good grades in these examinations are not a guarantee that industry would accept them (Jenjekwa, 2013). Therefore high stakes accountability mechanisms result in questionable improvements and unintended negative consequences.

Importance of Instructional Objectives

Supporting the importance of instructional objectives in guiding teaching and learning, Science and Learning Group (2010) posit that assessment should follow the curriculum, rather than defining it. Assessment should enable proper testing of concept and content understanding through provision of extended responses to questions, consistent with instructional objectives as success benchmarks. Science and Learning Group (2010) further argues that delivering the best cannot be possible even for the best teachers, if curricula and assessment are not both empowering. Teaching, curriculum, assessment, and instructional objectives are inextricably interlinked in provision of education, such that if any of these is poor, educational outcomes are likely to be poor. Assessment, standards and curriculum, according to Supoviz (2010), and instruction as the fourth major curriculum component (Nastrom and Henricksson, 2008), should be aligned to reinforce each other. Therefore mathematics and science teachers should synchronise these four educational components.

Any school follows a curriculum which guides learners through desired learning experiences. Curriculum, defined as a course of study, guide and plan for teaching and learning (Squires, 2004), and learning experiences (Sheena, 1998) has specific goals. In the current study curriculum is defined narrowly as science education content articulated in syllabuses. In Zimbabwe science curriculum goals are stated in the curriculum documents like Curriculum Framework for Primary and Secondary Education 2015-2022 (MoPSE, 2015) and Mathematics and Combined science (Physics, Chemistry and Biology) syllabuses (Curriculum

Development and Technical Services, (CDTS), 2015).

Instruction and Assessment in Schools in Zimbabwe

In Zimbabwe, teaching and learning objectives are formulated within the context of attainment of 21st century skills by learners as exist competences. Therefore assessment should be designed to facilitate achievement of these skills. The current assessment specifically for mathematics and science education in Zimbabwe is guided by the Ministry of Primary and Secondary Education (MoPSE) Curriculum Framework for Primary and Secondary Education (CFPSE) 2015-2022 (MoPSE, 2015). The CFPSE shows the shift in assessment, which started after independence in 1980, and progressively changed over years to the present status (Nziramanga 1999 and Nkhonde, 2015).

The Zimbabwe Schools Examination Council (ZIMSEC) which was found through an act of parliament (ZIMSEC, 1994) started operating in 1995 with the responsibility of assessing candidates' performance, and certification at different levels of the school education system. Analysis of the O-Level Mathematics and Combined Science syllabus show that scientific knowledge should be taught through learner-centred practical approaches, to assist learners to acquire knowledge, skills and attitudes consistent with 21st century skills.

Purpose of the Study

National curriculum standards are clearly described in curriculum documents like the Curriculum Framework for Primary and Secondary Education 2015-2022 (MoPSE, 2015) and Mathematics and Combined science syllabuses (Curriculum Development and Technical Services, (CDTS), 2015). This study sought to find out how O-Level Mathematics and Science teachers align STEM skills oriented instructional objectives with assessment of teaching and learning in a high stakes examinations environment.

Research Questions

1. How do O-Level Mathematics and Combined Science teachers align STEM skills oriented instructional objectives with assessment of teaching and learning in a high stakes examinations environment ?.
2. Which assessment strategies of O-Level Combined Science teaching and learning can enhance achievement of STEM skills oriented instructional objectives, in a high stakes examinations environment ?.

2. RESEARCH METHOD

The purpose of the study was to gain insight (Mckenzie, 2007) on how O-Level Mathematics and Combined Science teachers align STEM skills oriented instructional objectives with assessment, so it was appropriate to use a qualitative approach. Semi-structured interviews (Gill, Stewart, Treasure and Chadwick, 2008; Gillham, 2000), document analysis and lesson observations were used to generate data required to answer research questions. Ten form four teachers, 5 teaching Mathematics and 5 teaching combined science, were purposively sampled, from Mutare urban mathematics and combined science teachers, who constituted the population. Form four mathematics and combined science teachers

were selected because they were teaching learners to achieve STEM skills oriented instructional objectives on one hand, and preparing learners for summative assessment through ZIMSEC examinations on the other. These examinations are highstakes because they determine learners' carriers or future studies in mathematics and science related fields. Therefore teachers chosen were assumed to have been seized with achieving STEM skills oriented instructional objectives, as well as assisting learners to get high grades in ZIMSEC highstakes examinations. Therefore, it follows that the proximity of these O-level mathematics and combined science teachers to data relevant for this study, was the rationale for purposively sampling them.

Documents that were analysed were O-Level Mathematics and Combined Science syllabus, Combined Science past examination question papers, Curriculum Framework for Primary and Secondary Education 2015-2022, Mathematics and Combined Science teachers' schemes of work, lesson plans and learners' progress records. To establish how science teachers implemented instruction to achieve STEM skills oriented instructional objectives, as well as prepare learners for high stakes ZIMSEC examinations, lessons observations were made. Multiple data sources enabled triangulation to authenticated data generated, hence findings.

As data was generated it was continuously reviewed consistent with the constructivist grounded theory (Luttrell, 2010). Mutual construction of meaning was employed, between participants and the researcher, during data generation in line with the constructivist grounded theory. Probing questions during interviews enabled derivation of meaning of what the Mathematics and Combined Science teachers felt and understood about alignment of STEM skills oriented instructional objectives with assessment of teaching and learning in high stakes examinations environment, and this formed part of the basis for interpretation of data by the researcher.

3. RESULTS AND DISCUSSION

Below findings on alignment of STEM skills oriented instructional objectives with assessment of teaching and learning in high stakes examinations environment are presented and discussed according to following themes.

- Focus of Teaching and Learning in Combined Science Lessons;
- STEM Skills Development versus High Examinations Pass Rate;
- Practical Work;
- Bloom's Taxonomy of educational objectives and High Stakes Assessment;
- Mathematics and Combined Science learning and Co-curricular Activities; and
- Individual Differences Guided Mathematics and Combined Science Teaching.

Focus of Teaching and Learning in Combined Science Lessons

Many mathematics and science teachers strive to produce good results at the expense of ensuring that the learner experiences the subject beyond achievement of high passes. With time and other resources being limited, teaching tends to focus on learners achieving high grades. While high grades need to be achieved, it is important to balance assessment with the breadth and depth students need to progress in these and other related subjects, in a

clear manner (Science and Learning Group, 2010). To enhance this, clarity of concepts taught should be interpreted from the learner's perspective rather than from the teacher's. In this study mathematics teacher B proved differently. During revision of a test on graphs, it was surprising to observe that mathematics teacher B reflected satisfaction with clarity of own explanations of concepts, yet students seemed not to understand.

This shows that clarity was being interpreted from the teacher's perspective, rather than from the student's. Learner's needs, among them understanding were not being attended to. If teachers in general could interpret understanding on the basis of both verbal and body language feedback from students, it could help in identifying learning challenges students face, and assist in modifying approaches to suit learners' preferred learning styles. This could promote understanding. It was also observed, in agreement with Science and Learning Group (2010), that mathematics teacher B focused on theoretical concepts related to examinations by frequently saying "If you are in an examination you should answer this question like this. There is no time a bell will be rung for you to start preparing for examinations, you have to start now". This clearly shows that passing examinations is an important objective in teaching Mathematics, in direct contrast to alignment of STEM skills oriented instructional objectives with assessment of teaching and learning.

In another lesson, for Combined Science which was purported to be practical as reflected in the schemes of work, the teacher used a practical past examination paper. During a discussion between the current researcher and combined science teacher C after the lesson, on why this approach was used during the lesson, the response was:

It is better to discuss practical past examination papers because there are no apparatus, so at least pupils experience the way they will be tested in the final examination. In addition using question papers allows more questions to be covered, hence wide preparation for examinations, which increases the chance of students passing with distinctions. This is good for the reputation of the teacher and the school as well as the student.

Combined Science teacher C revealed that examinations determined teaching and learning approaches as well as instructional objectives the teacher focused on. Combined Science teacher C's response suggests that what will be tested in examinations is what teachers focus on most. In this context, it is suggested that apparatus should be made available to enable practical work to be done. The purpose of aligning STEM skills oriented instructional objectives with assessment of teaching and learning is totally masked by the need to achieve high passes in high stakes examinations.

From all the lesson observations that were made, focus of teaching and learning was on preparing for examinations, with no apparent reference to instructional objectives. The emphasis put on high grades in high stakes examinations has potential to derail development of STEM skills in learners, contrary to the need for development of 21st century skills as exist competences of secondary school graduates.

STEM Skills Development versus High Examinations Pass Rate

Until recently both O – level and A – level schools in Zimbabwe were being ranked according to pass rates in descending order, and pass rate lists published in newspapers and on internet. In addition, schools gave teachers incentives for high pass rates and higher incentives for surpassing the school's previous subject pass rate. Rote learning through methods used by teachers to produce high grades was revealed by mathematics teacher A who said:

The ranking of schools according to pass rate and rewarding of teachers by schools for producing high number of distinctions which was stopped recently had increased the competition among schools for achieving high grades in examinations. Drilling as a way of producing high pass rate had gained currency in schools, although it pushed rote learning to astronomical heights.

This clearly shows a misalignment of STEM skills oriented instructional objectives with assessment of teaching and learning in high stakes examinations environment. It is clear from this quotation that development of skills relevant to the world of work is ignored, although it is one of the major goals of science education in Zimbabwe (Shumba, 1993; Nziramasanga, 1999; ZIMSEC; 2011; 2013). Mathematics teacher A also revealed that in practice the green books (these are ZIMSEC books which are green in colour with mathematics and science past examination question papers) have become the major teaching and learning aids saying:

Although syllabus assessment objectives are referred to during lesson planning, but in the actual teaching and learning process, reference is strongly made to the green books. Some mathematics teachers take the green books as the syllabus.

Mathematics teacher A's view was corroborated by observations made in a lesson in which a past examination paper was used for the whole lesson. Using past examinations papers rather than the syllabus restricts learning to those areas which will be tested, at the expense of development of skills and values (UBUNTU) which is the major goal of education in general (Nziramasanga, 1999). Clearly alignment of STEM skills oriented instructional objectives with assessment of teaching and learning is negated due to focus on obtaining high grades in high stakes examinations. This agrees with Science and Learning Group (2010) who found out in the UK that summative external assessment of GCSEs and A-levels shaped teaching and learning of mathematics and science in schools and colleges. As a result so much attention was put on these examinations, to the detriment of achieving intended instructional objectives. In order to succeed in STEM at higher levels (Science and Learning Group, 2010), learners must be assisted to develop generic skills, like effective language use, and ability to engage in long projects in collaborative teams.

In preparation for the world of work, mathematics teacher B said Mathematics and Combined Science as STEM subjects in Zimbabwe are prerequisites for consideration in getting a job or in some cases for further education. As such, the need for high passes in Mathematics and Combined Science has overshadowed alignment of STEM skills oriented instructional objectives with assessment of teaching and learning, a view corroborated by other teachers involved in the study.

With the aim of increasing probability of high grades in high stakes ZIMSEC examinations, some secondary schools screen Form 1 and Form 5 candidates, taking those they feel have highest potential of obtaining high grades in high stakes examination. In mathematics teacher E's view "... this is some form of discrimination through these bottlenecks". Another issue which mathematics teacher E lamented is that "... combined science teachers no longer give priority to learner understanding as they focus on covering the syllabus and drilling, in preparation for high stakes examinations". Alignment of STEM skills oriented instructional objectives with assessment of teaching and learning, according to combined science teacher D was challenging "...unless one has a class with bright students". The reasons being the need to teach for understanding and covering the syllabus in preparation for high grades in high stakes examinations Combined Science teacher D further said:

As a Chemical Engineering graduate, I try to relate my teaching to application in real life situations. However, reflecting on my school days, I never experienced this because the science teachers seemed to lack exposition to the world of work like application of the knowledge in industry. This suggests a relook by science teacher preparing institutions to find out if teachers are prepared in ways which are consistent with school curriculum requirements.

While combined science teacher D acknowledged the importance of teaching with examples from past examinations to help students understand how they will be tested in final examinations, but suggested that motivating pupils to learn science through activities like trips to industries, was necessary. Combined Science teacher D also revealed that getting distinctions does not mean understanding the subject matter and its application in life situations, a view corroborated by Nziramasanga, (1999). Reflecting on learning days, combined science teacher D said some university classmates could not present logical scientific arguments, despite that they had distinctions in four advanced level science subjects. The reason was that distinctions were obtained through drilling which is rote learning. It can be deduced that, while it is plausible to get high grades in high stakes examinations, it should not be viewed as an end to itself, but as a means to get involved in socio-economic development, both at individual and national levels. Quality of distinctions should be in form of imbued practical skills/ability to apply knowledge to solve life problem, rather than theoretical understanding of concepts.

Practical Work

The ultimate goal of science education is to develop in learners skills to apply knowledge to solve real life problems for individual

and national socio-economic development. Consistent with this, teachers H, I and J concurred that they were aware of Combined Science syllabus emphasis on doing experiments and science practical, seeking to develop in learners values and attitudes like objectivity, curiosity, perseverance, investigative skills among others. The teachers said they preferred to use strategies like question and answer, group discussions, and demonstrations, since classes were large and apparatus were lacking, however at the expense of alignment of STEM skills oriented instructional objectives with assessment of teaching and learning.

In some cases using strategies like question and answer, group discussions, and demonstrations, was due to lack of apparatus. Combined Science teacher F revealed that "...some kits for experiments which were provided by donors needed replenishment, but schools did not have money to afford". Therefore, shortage of teaching and learning resources caused combined science teachers to use approaches like demonstrations and lecture method. Shumba (1993) had similar findings on lack of teaching and learning resources, and comments that:

Given the current dearth of science teaching and learning resources, demonstration and lecture method are expected to be the predominant methods relied upon by science teachers during initial training and during their professional teaching career.

In this context, there is need to find ways of making science teaching and learning resources available to encourage use of teaching and learning approaches which develop practical skills, values and attitudes in learners, which are functional in the world of work (Shumba, 1993; Nziramasanga, 1999).

All the 10 Mathematics and Combined Science teachers said that preparation of schemes of work and lesson plans objectives were developed according to syllabus requirements, but in the actual teaching and learning process, instructional strategies choice was influenced more by the desire to achieve high passes in examinations. Therefore the unstated, but implemented (de facto) objective as observed in the lessons is achieving high grades in high stakes examinations, and this tipped the learning process in this direction of achieving high passes in high stakes ZIMSEC examinations. Therefore from the issuing evidence, it can be safely deduced that O – level combined science teachers involved in the study were not using assessment strategies which enhance achievement of STEM skills oriented instructional objectives in high stakes examinations environment.

Bloom's Taxonomy of Educational Objectives and High Stakes Assessment

STEM skills oriented instructional objectives are consistent with Bloom's Taxonomy of educational objectives, therefore this link should be conspicuous by its presence in both schemes of work and delivery of Mathematics and Combined Science lessons. However, an analysis of Mathematics and Combined Science teachers' lesson plans revealed that assessment objectives for tests set, were mostly low order which did not encourage deductive reasoning, analysis and application of knowledge in real life situations. This raised questions about the quality of teaching

and learning, when measured against Bloom's Taxonomy of educational objectives. Teachers tended to drill and model how to answer examination questions with the aim to produce high grades in high stake examinations, with little focus on understanding and application of knowledge in real life situations.

Mathematics and Combined Science syllabuses analysis showed that values and attitudes sought to be developed in learners include integrity, objectivity, skills of inquiry, curiosity among others, through hands-on investigative approaches, which is congruent to development of STEM skills. It appears there are competing objectives. On one hand there is the stated (de jure) objective of developing skills relevant to the world of work and on the other the unstated (de facto) objective of producing many high grades in high stakes examinations. Nziramasanga (1999) identifies the discord between the school curriculum and the needs of industry making it questionable whether high grades in high stakes will be a guarantee that one will be accepted by industry. Taking into account this, it is logical to argue that a balance between teaching and learning for the world of work as reflected in syllabuses, and preparation for examinations should prevail, rather than the current dichotomy. This is an area which needs further research.

Mathematics and Combined Science learning and Co-curricular Activities

When asked whether it was possible to cover Mathematics and Combined Science syllabuses guided by STEM skills oriented instructional objectives aligned with assessment of teaching and learning, all 5 mathematics and 5 combined science teachers said it was possible if sporting activities were not taking some of the teaching time. This indicates that sporting activities are perceived as a peripheral subject which interferes with the teaching and learning process to prepare for examinations. This ignores the fact that sporting activities help in development of learners, physically, socially and emotionally, complimenting intellectual development through Mathematics and Combined science content learning.

Responses by the 5 mathematics and 5 combined science teachers indicate the need to review the Mathematics and Combined Science syllabuses to see whether they are too long to be completed with the inclusion of a lot of learner – centred activities as well as sporting activities. Lawton (1975) defines curriculum as "... a selection from culture...", hence not everything should be taught. In this vein there is need to select what is really necessary if the Zimbabwe O-Level Mathematics and Combined Science syllabuses are surely too long. This will create space on the timetable to accommodate co-curricular activities. However, if the syllabus review process shows that the Mathematics and Combined Science syllabuses are not long, then science teachers might be in need of in-service training to develop competences to teach these subjects respectively.

Individual Differences Guided Mathematics and Combined Science Teaching

Bybee (1986) observes that due to different backgrounds Mathematics and Combined Science teachers meet students with many differences which need to be recognized and attended to, in order to assist learners to meet their aspirations through

exploitation of their full potential. This according to Jenjekwa (2013) is a measure of quality of an educational system, which is consistent with the global view of inclusive education which seeks to accommodate diverse needs of learners, by adapting educational programmes to learners' needs through modifications in content and approaches.

The Zimbabwe Curriculum Development and Technical Services (CDTS) (2015) Mathematics and Combined Science syllabuses identify investigative group work and problem solving, as examples of teaching and learning approaches that must be used when implementing science curriculum in Zimbabwe. However, findings from the 10 Mathematics and Combined Science involved in the study suggest a totally different view. The teachers said positive perception of those who produced high grades in high stakes examinations juxtaposed by the negative perception of those who produced low grades by society, caused mathematics and science teachers to aim achieving high grades in high stakes examinations. The issues of catering for individual differences and inclusivity are overshadowed by too much focus on preparation for examinations, so rote learning dominates.

4. CONCLUSION

The study concludes that although teachers were devoting considerable time preparing students for high stakes examinations, the quality of that preparation was questionable, measured against Bloom's Taxonomy of educational objectives. There was misalignment of STEM skills oriented instructional objectives with assessment of teaching and learning in high stakes examinations environment. Mathematics and Combined Science teachers tended to use drilling methods with the aim to produce high grades in high stake examinations, with little focus on understanding and application of knowledge in real life situations. It is recommended that Mathematics and Combined Science teachers should align STEM skills oriented instructional objectives with assessment of teaching and learning in high stakes examinations environment. Experiments, practical work and STEM skills oriented instructional objectives should be included in the teaching and learning process in order to prepare learners for the real world of work. There is need to create a teaching and learning environment which balances teaching and learning for the world of work as reflected in syllabuses, and preparation for examinations, rather than the current dichotomy. Further research is suggested to find ways of removing the dichotomy between preparing school graduates for the world of work and preparation for high stakes examination.

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