Science teacher training within the education system in Lesotho and the realities on the ground

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ABSTRACT
In this paper the author describes the current situation of science teacher training within Lesotho's education system and some practicalities faced by science teacher educators and teachers. Some empirical evidence of the disparities between science teachers' training and what prevails in the world of work is drawn from the study conducted in 2013 in which the challenges faced by mathematics and science teachers at both primary and secondary levels were investigated. The challenges were generally those that had to do with teacher's subject content knowledge, pedagogical knowledge and pedagogical content knowledge with its inherent components. The author focuses mainly on the curriculum and the professional development of science teachers that enable enactment of teacher knowledge. The paper concludes by proposing some probable broad means that could be considered to better meet the national educational aspirations through the teaching and learning of science.

KEYWORDS
Science teacher, teacher training, ground realities

RÉSUMÉ
Dans cet article, l'auteur décrit la situation actuelle concernant la formation de professeurs d'écoles en matière scientifique dans le système éducatif au Lesotho ainsi que les problèmes que font face les éducateurs et professeurs de science. Pour ce qui est des épreuves empiriques montrant les disparités entre la formation de professeurs de science et la réalité sur le terrain, on se base sur l'étude entreprise en 2013 où les défis que font face les professeurs de mathématiques et de science au niveau primaire et secondaire sont discutés. De manières générales, les défis avaient un rapport avec la maîtrise du contenu par le professeur, la maîtrise de la pédagogie et la maîtrise du contenu pédagogique avec ses éléments. L'auteur se focalise principalement sur le cursus ainsi qu'à l'avancement de professeurs de science qui leur permet d'acquérir des compétences professionnelles. L'article conclut par proposer quelques moyens approximatifs par lesquels on peut répondre aux aspirations éducatives nationales à travers l'enseignement et l'apprentissage de la science.

MOTS-CLÉS
Professeur de science, formation de professeurs, réalités sur le terrain

INTRODUCTION

It is inevitable in this era of rapid advancement in science and technology and their evident impact on countries' economic growth that science and technology are placed among the top priorities in Lesotho. In its vision, the Ministry of Education and Training (MOET) states: *"Basotho shall be a functionally literate society with well-grounded moral and ethical values; adequate social, scientific and technical knowledge and skills by the year 2020"* (Kingdom of Lesotho Education Sector Strategic Plan 2005-2015, 2005). The aspired literacy and functionality can be achieved through relevant education and practice. Hence, the Ministry of Education and Training in the same Sector Strategic Plan goes further under its broad policies stating one of them as; *"Reforms of the curriculum at all levels of schooling and training shall be part of quality improvement and the strengthening of developmental relevance of the education system"* (p. 26). The national curriculum reform has been currently manifested by the production of the policy framework for the integrated curriculum developed for the ten years of basic education and the move from Cambridge Overseas School Certificate (COSC) to Lesotho General Certificate of Secondary Education (LGCSE) that has been examined in all schools for the first time at the end of 2014.

In the effort to guide and ensure that education serves its purpose, the Council on Higher Education (CHE) was established in 2004 with the appointment of its members in 2008 to regulate the effective functioning of the institutions of higher learning. CHE has within it the Higher Education Quality Assurance Committee (HEQAC) as its executing arm to ensure quality (Council on Higher Education Strategic Plan 2010/11-2014/15, 2010).

In this paper we describe the current situation of science teacher training within Lesotho's education system and some practicalities faced by science teacher educators and teachers. For the purposes of this paper, science teacher includes the ones teaching mathematics as well. The paper starts with the description of the general education system. Then, within the system the paper discusses teacher training institutions and their programmes, the pool from which candidates training as science teachers are drawn, and some empirical evidence of the prevailing circumstances within the education system reflecting some realities faced by science teachers and teacher educators. Finally the paper suggests some probable broad means that could be considered to better meet educational aspirations through the teaching and learning of science and mathematics.

LESOTHO EDUCATION SYSTEM

After attaining its independence from Britain in 1966, the Kingdom of Lesotho, commonly called Lesotho, embarked on a number of reforms in its education system in order to meet its apparent needs. However, basically, the influence of the British system still abounds. The simplified illustration of the system showing the mainstream education could be depicted as in Figure 1.

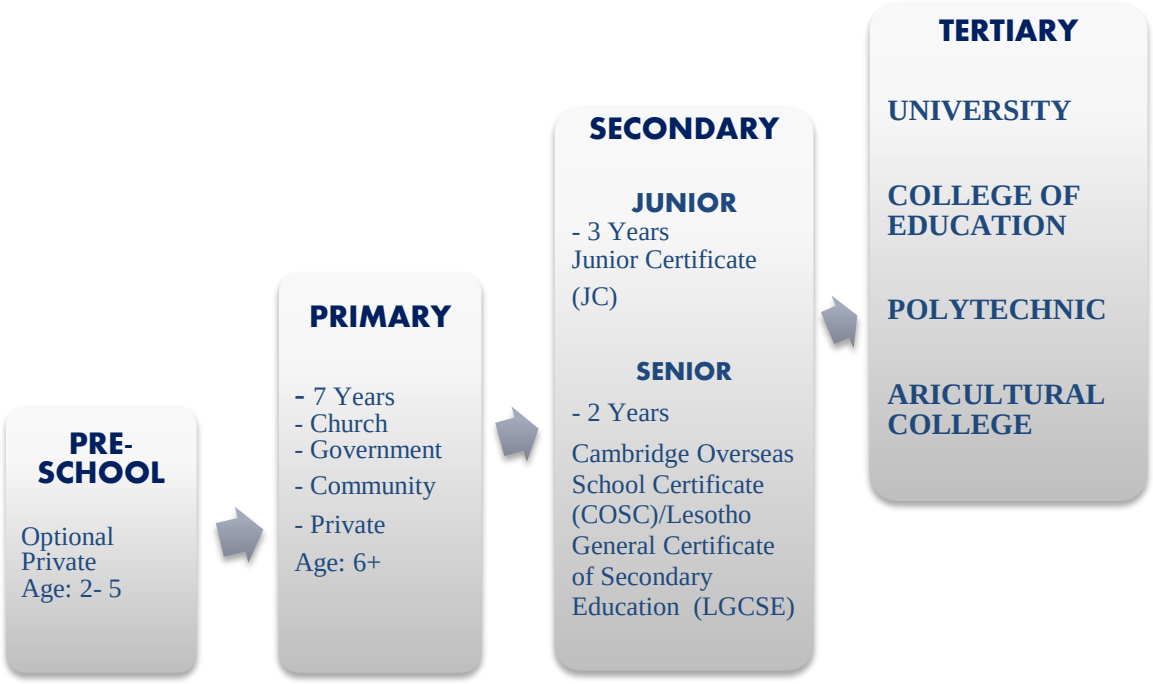
The Lesotho's main formal levels in the mainstream of education have always been Primary, Secondary and Tertiary. The Primary Education that a child starts at age 6 takes seven years at the end of which pupils sit for national examinations, Primary School Leaving Examinations (PSLE). Most schools are owned by the churches with the increasing number of government and community schools. There is a significant number of privately owned schools. The government introduced Free Primary Education (FPE) in 2000 while payment of fees still holds in private schools. At this level, four of the subjects that the pupils study are considered as

core subjects which a pupil must do and pass in the terminal national examinations. These are Sesotho, English, Mathematics and Science.

The secondary education which the child is expected to start at age 13 comprises three years of junior secondary and two of senior secondary. At this level students pay fees in all schools. Still at this level the four subjects remain compulsory, science comprising biology, chemistry and physics. At senior level, the students are expected to do at least one science subject which with the Cambridge Overseas School Certificate (COSC) would be a combined science which could be coupled with an optional pure science. Again, mathematics, Sesotho and English remain compulsory. A credit in English has been a prerequisite for most courses especially at the University, gradually changing with programmes some of which consider candidates with a pass. With the phasing out of COSC replaced with LGCSE, the science offered is physical science (physics and chemistry) and biological science.

The pre-school education has gained significant recognition by the Ministry of Education and Training in the recent years while the Early Childhood Care and Development (ECCD) unit in the Ministry had been established for quite some time. However, education at this level is still left optional for the children and run as a private enterprise though of late the MOET has set the amount of fees to be paid. For the pupils/students who do not manage to go into junior or senior secondary education, and into tertiary education there are some vocational schools and technical institutions.

FIGURE 1

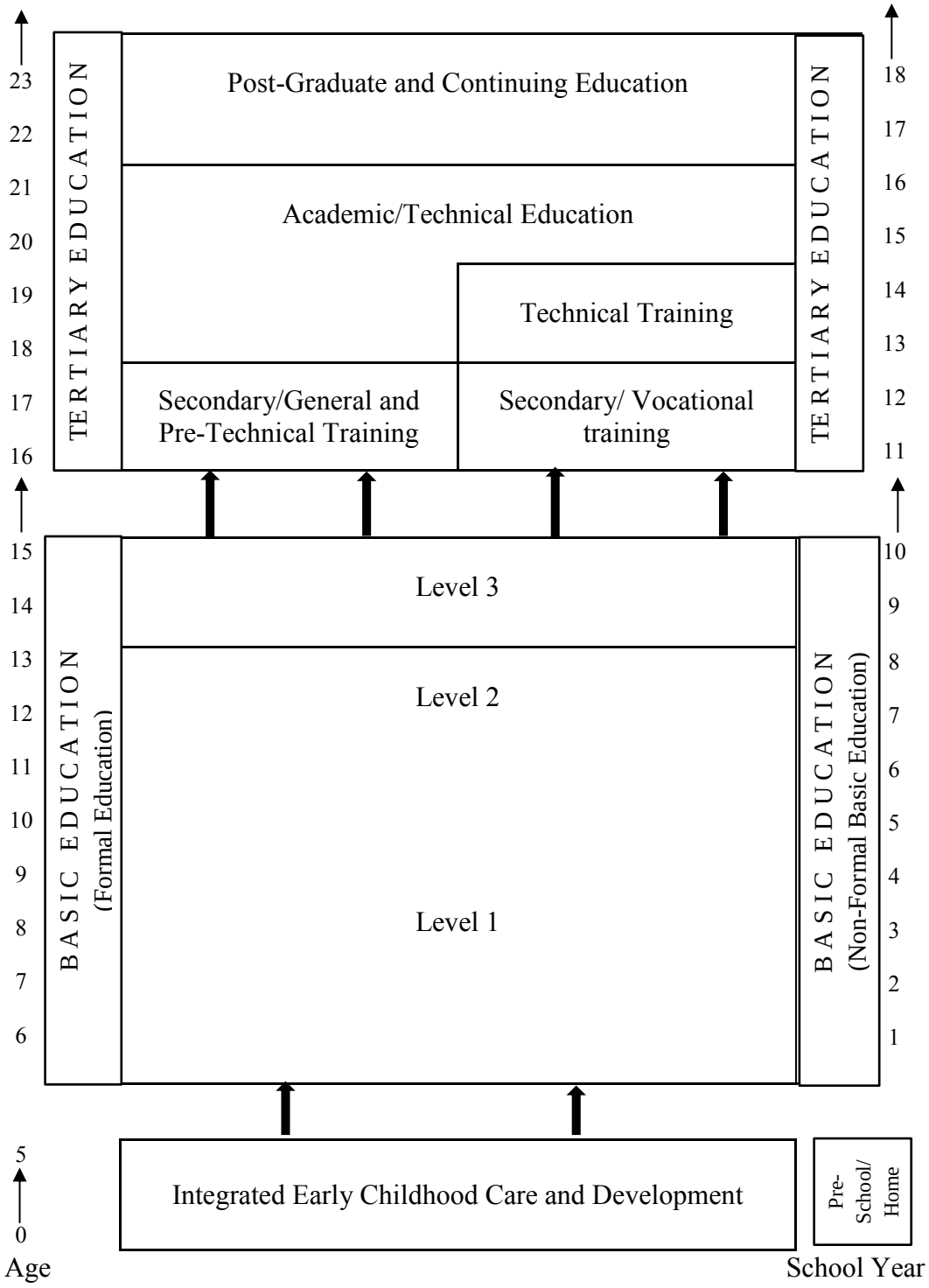


Basic Mainstream Education System in Lesotho

The new integrated curriculum that rolled out into all schools in 2013 involved the three first grades at the primary level. This new dispensation has, however, not changed the basic structure of the system but teases out the categories of the units within the system, thus being more elaborate and comprehensive. The illustration of the system in Figure 2 is one of the two options,

adopted from the Curriculum and Assessment Policy (Kingdom of Lesotho Ministry of Education and Training, 2008) and it relates more closely to what has been prevailing in the system.

FIGURE 2



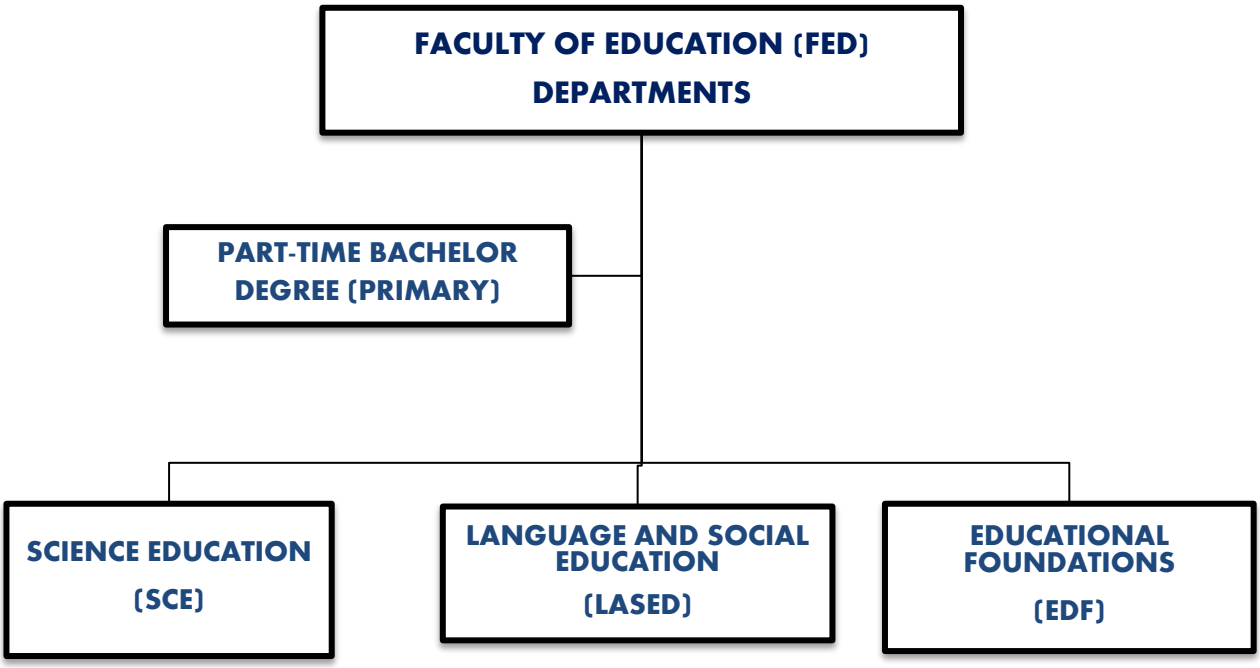
Education System in Lesotho: Adopted from Appendix 3A (Option 1) in the Curriculum and Assessment Policy (2008)

SCIENCE TEACHER TRAINING

Teacher training institutions

In Lesotho there are two teacher training institutions, the National University of Lesotho (NUL) and the Lesotho College of Education (LCE). The Faculty of Education (FED) at NUL is responsible for the training of teachers mainly for senior secondary education. It offers both undergraduate and post-graduate programmes. It, however, also handles the teaching of part-time primary school teachers doing the Bachelor of Education (Bed-Primary). The faculty comprises three departments (see Figure 3), viz: Science Education (SCE), Language and Social Education (LASED) and Educational Foundations (EDF). Most undergraduate programmes are of a four year duration, with the post-graduate programmes ranging from the duration of two years for Diploma and Masters degree and the possibly 3^{+} years Doctoral degree. Teaching Practice (TP) for undergraduate student teachers comes in the last semester of the final (4^{th}) year of training. The schools identified for practice are only among those located in the accessible areas in the Lowlands and Foothills in the seven out of ten districts of the country.

FIGURE 3

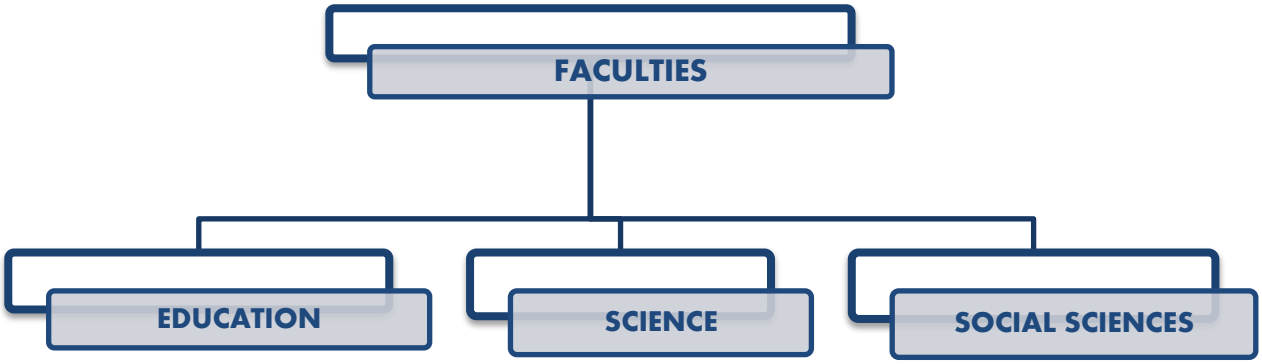


The Departments of the Faculty of Education at NUL

LCE produces teachers for pre-school (Early Childhood and Care Education), primary and junior secondary education. The College runs both pre-service and a distance mode in-service training. The programmes take three years. The first year exposes student teachers to intensive content and methodology courses in preparation for teaching practice. Teaching practice takes place in the second year of study, placing teacher trainees in primary and secondary schools throughout the country. In the third year student teachers come back to the College to complete their programmes. The part-time teacher trainees are most of the time on the job and come for

residential courses at intervals during the school vacations. As an independent institution of Higher Education, LCE has faculties as depicted in Figure 4.

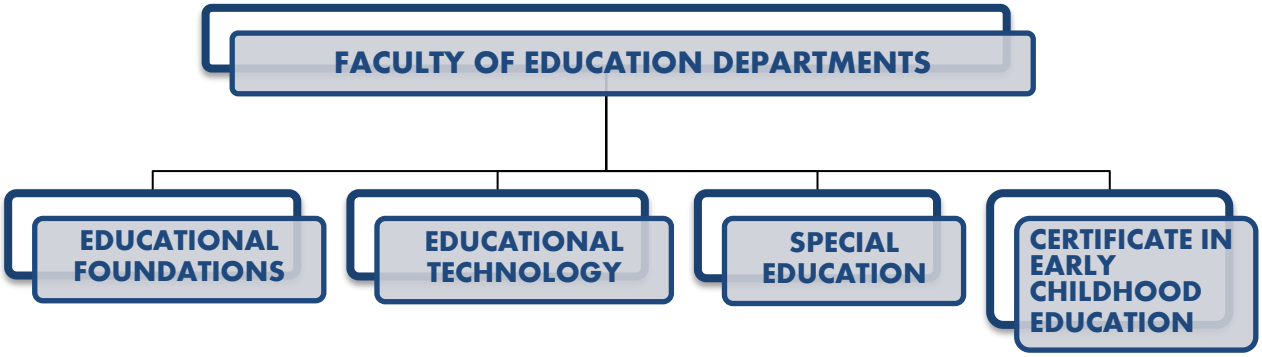
FIGURE 4



Faculties of the Lesotho College of Education

Just as FED at the University has departments, LCE Faculty of Education comprises three departments as shown in Figure 5. Unlike at NUL where student teachers take subject courses from non-education sister faculties, at LCE the services are provided within the teacher educational context by the same staff.

FIGURE 5



The Departments of the Faculty of Education at LCE

As a common practice in teacher education programmes worldwide, the science teacher training programmes at NUL and LCE offer subject content, pedagogies and educational theories courses as the knowledge believed the prospective teachers need for teaching and how it could be taught. The content courses are intended to ground student teachers in the knowledge of the concepts in the subjects they would be teaching in schools. The educational foundations/professional studies knowledge considers general aspects of philosophy, history and sociology of education and educational psychology, the knowledge underpinning the processes of teaching and learning. The pedagogies are to enable student teachers to teach the subject matter for students to understand and appreciate what is being learned. Coupled with the theoretical knowledge is practice teaching in schools. Important to note is that at each pre-tertiary level of education with

the exception of pre-school education, science is one of the core subjects and therefore compulsory. Even with the new integrated curriculum, science is not only compulsory, but it is also a contributing subject in all learning areas.

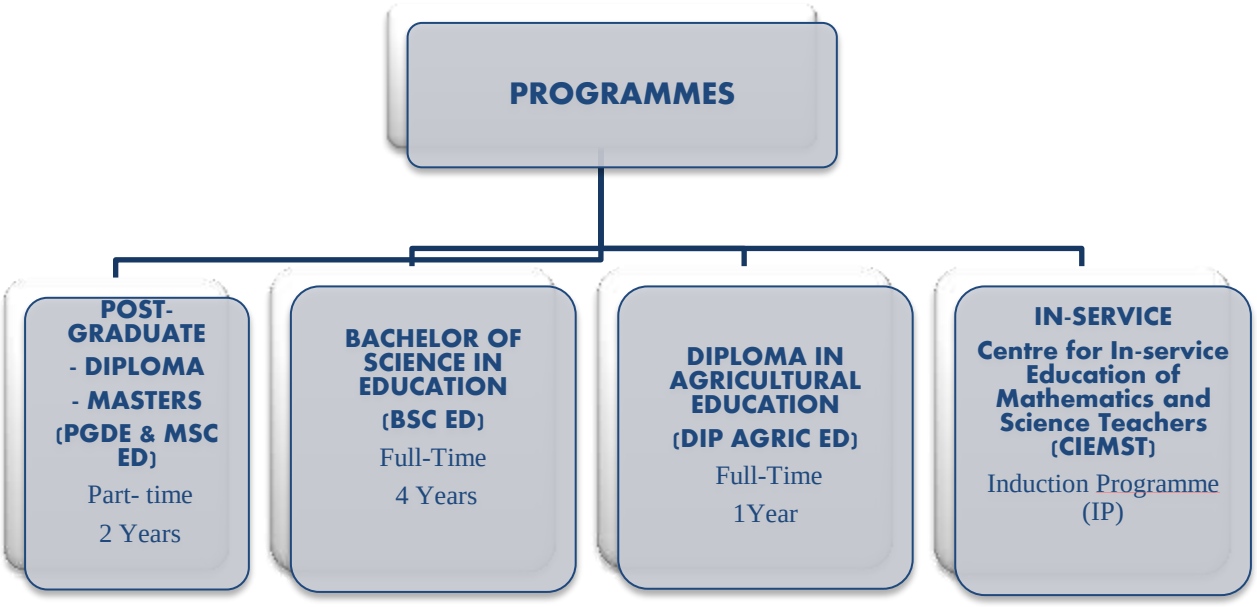
Science teacher training at NUL

The department of Science Education is responsible for conducting subject curriculum studies courses for the one year Diploma in Agricultural Education (Dip. Agric. Ed.), four years Bachelor of Science in Education (BSc Ed), two years part-time Postgraduate Diploma in Education (PGDE) and two years part-time Master of Science in Education (MSc Ed). The general courses in foundations are handled by the department of Educational Foundations of FED. The department runs an Induction Programme through the Centre for In-service Education of Mathematics and Science Teachers (CIEMST). The general science content in different disciplines is offered in the Faculty of Science and Technology (FOST) where the student teachers attend the same lessons and do laboratory practicals with general degree students while the general educational courses are offered by EDF to all education student teachers. This general knowledge of subject matter, pedagogies and theories are "contextualized" (Kirk, 1986) in the curriculum studies courses in which the focus is on the teaching of specific subject school content. The science curriculum studies courses start in the third year of training. In Year I each student teacher takes three science subjects (Biology, Chemistry and Physics), Mathematics and English. In the remaining years a student teacher selects and studies two subjects that s/he intends teaching. The SCE staff also teach general courses in science and curriculum studies to the BEd (Primary) trainees who are accountable to an independent unit within FED as depicted in Figure 3.

Programmes

The programmes offered by the Science Education Department are depicted in figure 6.

FIGURE 6



Programmes offered in the Science Education Department at NUL

Science education candidature

Students enrolling in the science education programmes as presented under the Faculty of Education in the University Calendar 2007/08 (National University of Lesotho, 2007) come through varying entry points. For diploma and undergraduate programmes the candidates are drawn from the following sources:

a) Direct entry - from high school; to have a pass with credit in Mathematics as well as a credit in an approved Science subject including a pass or equivalent in English Language;
b) Dip. Sc. Ed. holders - to have passed all courses required for Year II of the NUL BSc Ed programme;
c) Secondary Teacher's Certificate (STC) and Diploma holders - from the College, LCE; with at least a second class pass and has majored in Science and Mathematics;
d) Lesotho Agricultural College (LAC) students - who aim at a career in teaching and have undertaken the first two years of study at LAC following the same programme with all Diploma in Agriculture students, to do the final year of study at NUL.
e) Any other equivalent qualifications as approved by the National University of Lesotho.

For Postgraduate programmes the candidates enter through the following routes:

a) Post-Graduate Diploma in Education (PGDE) - a one-year full-time or two-year part-time programme offered to non-education degree holders from a recognised university who among other requirements has at least two years teaching experience.
b) Master of Science in Education (MSc Ed) - a two-year full-time or part-time programme for degree holders with some background in education.

Science teacher training at the Lesotho College of Education

The Lesotho College of Education in its vision as with other sectors of the MOET, targets the development of the nation and its mission is to *"...produce competent teachers for the school system of Lesotho"* (Lesotho College of Education Calendar, 2013-2014, p. 6). The College further stipulates its functions amongst which it participates *"as needs and opportunities arise, in research, consultancy and evaluation work relevant to the education system, in the formulation of educational policy" (p. 7).*

Programmes

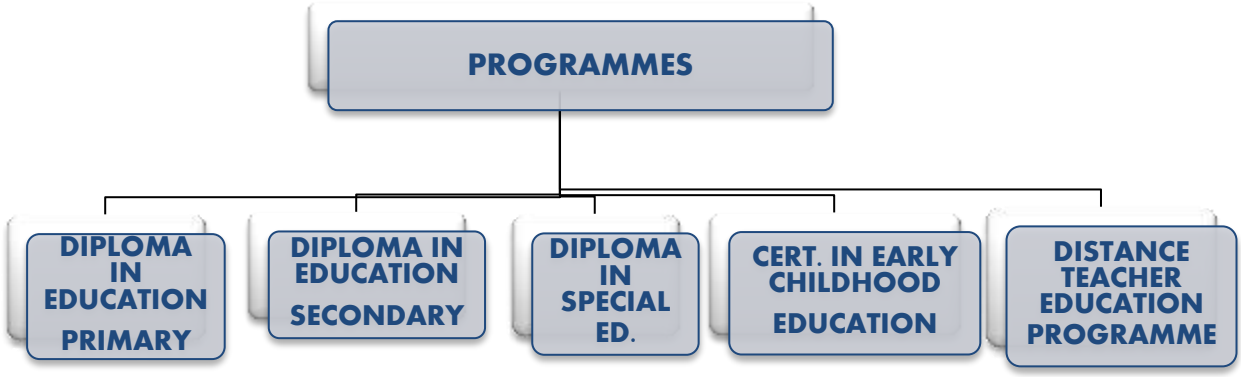
There are five main programmes offered at LCE. These are: 1) Diploma in Education Primary preparing teachers to teach at all levels of primary, 2) Diploma in Education Secondary which prepares teachers for junior secondary level teaching, 3) Certificate in Early Childhood Education (CECE), 4) Advanced Diploma in Special Education and 5) Distance Teacher Education Programme (DTEP). The programmes are of three years duration. Excluding DTEP trainees who come to the College for residential courses at intervals, other trainees do the first and third year on campus while the whole of second year is devoted to Teaching Practice out in schools throughout the whole country. The programmes of the College are illustrated in Figure 7.

Teacher trainees for primary level teaching take all the basic subjects; English, Sesotho, Mathematics, Science, Home Economics, Agriculture, Physical and Health Education, Social and Development Studies and Religious Education – 9 subjects. This is due to the fact that as it obtains in the education system, teachers at primary school level are expected to teach all subjects. With the new integrated curriculum, the practice tends to be more important to expose the prospective teachers to all subjects. Even with the introduction of specialisation in three subjects at LCE, either in the sciences or languages, trainees still take some subjects as minors and others

as electives to ensure that they get exposed to the full spectrum of the subjects essential for the 'learning areas'. Teacher educators who teach in a subject handle both primary and secondary teacher trainees. The trainees following the DTEP are taught by a different staff who serve in the in-service unit of the College.

The Diploma in Education Secondary allows student teachers to specialise with 2 major subjects which they concentrate on and get prepared to teach at secondary level. At the junior secondary level, however, science comprises the three disciplines (Biology, Chemistry and Physics). The trainees pick the other discipline as an ancillary. Mathematics is one of the basic subjects for the subject combinations for the science teacher trainees. The science teacher trainees do general education courses with the rest of the College trainees for primary and secondary levels while in addition they get supporting methodology from the science courses to enhance and focus the teaching in specific science subject.

FIGURE 7



Programmes offered at the Lesotho College of Education

Science education candidature

Basically, for direct entry to the College a student should have passed the subjects of intended specialisation with a credit. Another entry point is that for unqualified and underqualified teachers. For entry to Early Childhood and Care Certificate the candidates need to have a General Certificate of Education (GCE) at O'Level or a 2nd Class pass at the Junior Certificate (JC) level. The candidates for Advanced Diploma in Special Education need a diploma in education or teaching certificate with at least two years teaching experience.

PRACTICES IN EDUCATION AND REALITIES FOR SCIENCE TEACHERS AND TEACHER EDUCATORS

The MOET initiates reforms in education for making it better meet the needs and development of individuals and the whole nation, also making it achievable for those involved. If the challenges identified in the study carried out in 2006 still abound when yet another study is done in 2013, this should be a cause for concern. Some empirical evidence of the disparities between science teachers' training and what prevails in the world of work is drawn from the study conducted in 2013 in which the challenges faced by Mathematics and Science teachers at both primary and secondary levels were investigated. The challenges were generally those that had to do with

teacher's subject content knowledge, pedagogical knowledge and pedagogical content knowledge with its inherent components (Kingdom of Lesotho Ministry of Education, 2006; UNESCO, 2013). These forms of knowledge form the basis for teacher performance. With the shortcomings that are observed and acknowledged by the members in the system who are both directly and indirectly involved in teaching and learning, it could be expected that the outcry with poor student performance in Mathematics and Science will remain ever perennial.

Some of the findings from the 2013 study among other issues clearly indicate that teachers at both levels have a problem to interpret the syllabus hence a failure to plan the lessons geared towards the attainment of aims and objectives of teaching science and specific topics. This definitely would lead to inappropriate activities and assessment strategies, therefore leading to no meaningful learning, ultimately poor performance in examinations inhibiting going further with learning in the sciences and failure for its application in daily life activities. The few that manage to go through with the shaky foundation eventually end up in the classroom teaching science to younger generations. The author focuses mainly on the curriculum and the professional development of science teachers that enable enactment of teacher knowledge.

With the aspiration of the MOET for relevant curricula and training, one would believe that there would be well established structures within the whole education system to ensure their successful fulfilment. The 2013 findings when the new syllabi had been introduced at both primary and senior secondary level reveal detrimental factors around introduction of new reforms. One primary school teacher who was teaching the new syllabus remarked *"since we got training, we have not seen anyone who shows concern whether we got things right or not"* (M4 at NNPS). While other teachers in the study schools also noted that the workshops held to introduce the new syllabus to them were too few (F4 and M4 at NNPS) and too brief (F5 at MPS). Teacher M4 went further to suggest that *"workshops for every teacher should start now"*. The view that was shared by teachers in other study schools who felt they should be informed even before they get directly involved, again as a way to enable them to assist those who were already handling the syllabus.

At the secondary level the principal from one high school attested: "... *you see people who have been called to design the new syllabus, they were hurried, then even teachers who are to implement the new syllabus are hurried with training'* (P at LHS)". Under such circumstances, it is not surprising to get it from the same implementers of the curricula that their understanding and use of the syllabus as a guiding tool for planning and teaching pose some problems. Teacher F1 at MzHS attested: "*...it is hard to know what to do when learning outcomes just use expressions such as students must explore and understand a certain process*". The statement might be pointing out to the need for unpacking the demands of the curriculum which could be done during both pre- and in-service training.

Although NUL trains science teachers to teach at senior secondary level, in reality they teach even at the junior level which challenges some teachers as teacher M3 at LHS stated: "*...it really gives me a hard time, this going backwards and forwards. There are also some necessary and manageable ideas that are left out of certain topics. The way the chopping or loading of topics was done does not make sense to me*". There was no mention of the aims and objectives of the syllabus except the mention of learning outcomes in schools even in the primary schools such as SJTPS, MEPS and NNPS. Teacher M4 from NNPS proclaimed; "*At school (college) we are not taught about the syllabus, there should be special courses about the syllabus*". And one from SJTPS also claimed: "*We don't quite understand it (*syllabus*)*" (F2 at SJTPS).

Materials and programmes that contribute to the teaching and learning are part of the curriculum and their proper use form teacher's pedagogical content knowledge (Magnusson,

Krajcik & Borko, 1999). Primary and secondary teachers in the study schools acknowledged the role played by the Lesotho Science and Mathematics Teachers Association (LSMTA) especially with the use of the Mathematics and Science kits provided the primary schools by the MOET which the officer in the office of the Inspector-Primary confirmed. This move if well supported and coordinated could be one way of answering the concern by teacher M4 at NNPS who asserted: "*We have Maths and Science kits, but we don't know what they contain and what those contents are used for. We were never taught about the kits that is why we ignore the practical side of the syllabus*". The view that was echoed by the Education Officer saying: "*Our teachers are not very comfortable with teaching Mathematics and Science concepts… Even with the help of the Science and Mathematics kits, they come out of College and they do not know them (*kits*)…*".

With just these few cited examples of teachers' views about the teaching of science, a number of issues come to the surface that point to some factors that influence their practice. Among them is the impact of the pre- and in-service training especially with regard to the implementation of the curricula. If science teachers do not understand the curriculum, and as a result fail to implement it as intended, who is answerable? Could it be proper to leave it to the intellectual capability of individual teacher educators and teachers?

The curricula advocate learner-centred methods of teaching and this confirms Mtika & Gates (2010) and Schweisfurth (2011) attesting that in the Sub-Saharan Africa this is a common notion in education but which faces contextual challenges. The pupils/students in the study schools proclaimed that they enjoyed and learned better when they were made to actively take part in their learning. But in practice, teachers still employ teacher-centred methods even when they would be thinking they were intending to involve learners meaningfully, most of what they describe as involving learners would be teacher-driven, nothing close even to guided inquiry.

Both science teacher educators and teachers have representation in the functional organs that have to do with curriculum, assessment and policy formulation. But has this representation been beneficial to the wider teaching force? They are actually the individuals who benefit and stand a chance to better understand the demands of the developments (UNESCO, 2013). If a larger population of practitioners in education are less informed, how could the educational goals be achieved? This in a way is likely to lead to a situation that Al-Qahtani (1995) cited in Schweisfurth (ibid) terms 'cycle of recrimination' where "*teachers blame policy-makers and administrators for unsuitable policy and lack of support, and policy-makers blame teachers for not implementing it*" (Schweisfurth, 2011, p. 430). Some of the highlighted quotes in this text might have a bearing to this effect.

The education policies clearly have a great potential of meeting the needs of the nation. The Ministry of Education and Training is aware of and striving to meet some of the challenges. The unpacking of the education system structure could reveal the complexity of the educational endeavours hence enable critical thinking about how best to keep things directed, efficient and effective. Considering the various entry points for teacher training candidates, one gets overwhelmed of what it calls for from the teacher educator to meet the learning needs of such a wide spectrum of experiences and knowledge. Would the administrators at say, NUL, with seven faculties each with a number of departments ever understand the requirements for science education? Probably it might be worth exploring some avenues to better enable the improvement in science education, which does not only involve teachers in schools but all stakeholders. The Inspector-Field in the 2013 study proposed induction and regular refresher workshops for in-service providers, which one would say should go for teacher educators. In Lesotho as it is an

observation raised by researchers (Berry & Van Driel, 2012; Loughran, Korthagen & Lunenberg, 2005), there are no formal training programmes for teacher educators.

Measures were taken to meet challenges as observed with the introduction of for example the Lesotho Pre-Entry Science Course (LESPEC) in the MOET to enhance student preparation for entry into the university science and science education programmes; the Accelerated Mathematics and Science Teachers Improvement Programme (AMSTIP) introduced in 1980 at NUL for meeting the shortage then of secondary level Mathematics and Science teachers, and lately the Distance Teacher Education Programme (DTEP) at LCE. In the Southern African Development Community (SADC) region, for example, to meet the shortage of science teachers, Zimbabwe introduced institutions of Higher Learning such as Bindura University of Science Education (2012). Could it not be a thinking along those lines that could meet some of the challenges faced by both science teachers and educators? Within a contextualized environment there might be higher chances of collaboration and coordination bringing to evident practice of education centres, professional learning communities, material generating centres etc. However, this idea would be contradicting the move towards merging the faculties at the time of restructuring of NUL where the proposal was to merge the faculties, mainly in the interest of cost containment (Mahao, 2003). The underpinning factor for a different thought concerning how best teacher education could be made to get to the root of effective teacher preparation and practice is the complexity of teacher learning (Spalding et al., 2011).

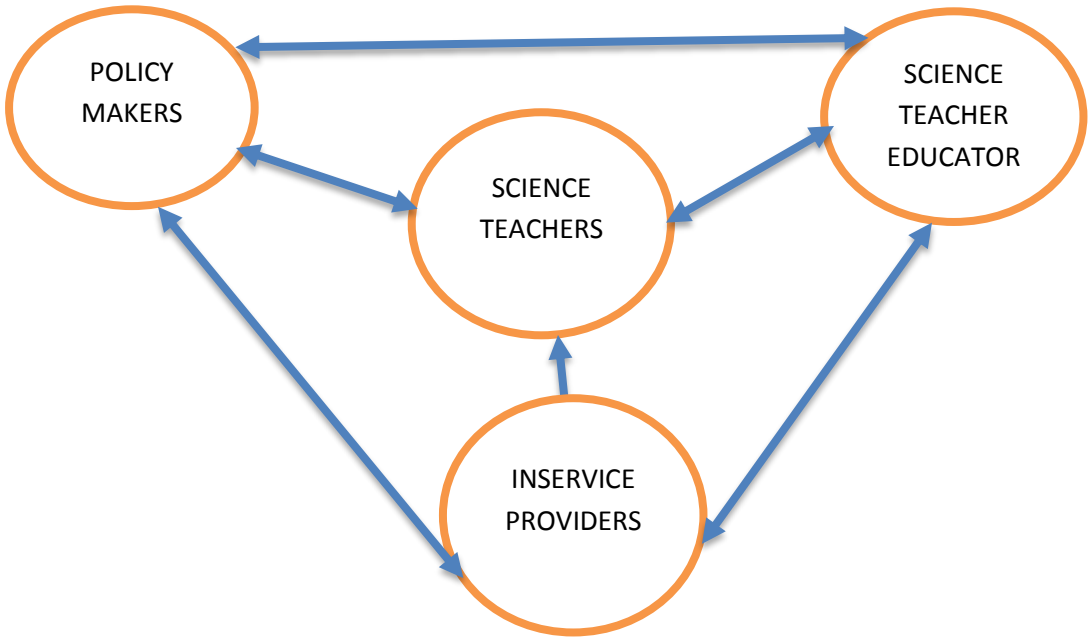
CONCLUSION

Taking mathematics and science as core subjects at both primary and secondary levels throughout the years, and as both core and supporting subjects in the learning areas of the new integrated curriculum for basic education, it becomes unavoidable that serious measures should be considered for improvement of science teacher professional development in training and practice. Teachers play a vital role in education, hence deserve to be placed at a critical position as a pillar expected to uphold the structure. They are rightly implementing practitioners of the powerful theoretical policies. Should they be practically wholly consumers of the 'theoretical' product? For instance, what is expected if the integrated curriculum was piloted in 2012 and rolled out in 2013, but teacher educators get introduced to it in 2014? The Inspector – Field during 2013 study had not been informed about the demands of the curriculum then, yet their office is to support teachers in schools. What is our route to the intended destination? How are prospective teachers on teaching practice and the newly employed to cope within the system that already has ever-existing challenges?

From the observed shortcomings with teacher educators' classroom practice (Ntoi & Lefoka, 2002), one would wonder how, without timely dissemination of educational reforms and close collaboration between stakeholders the impressive national and institutional aspirations could yield the desired outcomes. With marginal in-service training as revealed in that study, how do they, together with the veteran teachers pick up on what they missed during pre-service training? To avoid shifting the blame, there is dire need for collaboration and coordination of efforts within the education system of Lesotho. Hollins (2011) considers collaboration as one of the factors that gives integrity to a programme indicating appropriateness of practices relative to underpinning theories and philosophies. This perception holds for the whole education system. With the disintegrated and uncoordinated organs of the system the chances of success are very slim. It might help to consider the collaborative model depicted in Figure 8 indicating the vital

bodies and their links. The paper thus concludes by proposing some probable broad means that could be considered to better meet the national educational aspirations through the teaching and learning of science.

FIGURE 8



Proposed Collaborative Model among Science Educationists within the Education System in Lesotho

This kind of collaboration might lead members within the system to reflect on their individual, understanding, perceptions, conceptions, beliefs and practices (Garcia & Roblim, 2008) which could extent to the level of a unit and the whole system resulting in probable common understanding, hence improved and relevant training and practice within the education system. It might result in no such utterances as that made by an Education Officer as an in-service provider during the 2013 UNESCO study saying: "*Decision makers do not consult the right people. I am the one visiting the schools regularly and knowing the situation, but you will be told that a certain decision has already been made*". Every stakeholder in the system is an expert in his/her own right and therefore a living source of expertise that should be respected, tapped and utilised for the good of others.

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