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An Exploratory Study on Teaching and Learning Situation for STEM Education in Five African Countries

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Abstract: *The purpose of this study was to examine the teaching and learning situation for science, technology education and mathematics in five African countries. The study adopted an exploratory research design. This design aimed atexporing the perception of teachers regarding the teaching and learning situation for science, technology education and mathematics in five African countries, including the following: Cameroon, Côte d'Ivoire, Ghana, Kenya, and Senegal. The study sample involved teachers from 13 secondary schools who teach mathematics, science, or technology subjects. A total study sample size of 24 teachers was purposively selected from the 13 schools in five African Countries. Interview guides and focus group discussions were the major data collection instruments employed by the study. The data analysis procedure was based on qualitative content analysis using the Qualitative Data Analysis software MAXQDA. The results revealed that the teaching situation in Africa has improved in recent years, but many fundamental problems and challenges in everyday school life still prevail. Based on the empirical findings, the five fields of action for improving STEM education could be analyzed through: teacher framework, teacher training, school infrastructure, competence orientation, and educational equity for girls. Based on these results, it can be concluded that the quality of STEM education in the five countries involved has not yet reached an established and robust teaching line. There is a significant need for action regarding teachers and their training, school infrastructure, and students' motivation, especially among girls.*

Keywords: *Teaching situation, African countries, STEM education, Teacher training, School infrastructure, Offer situation.*

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INTRODUCTION

An important contributing factor to a country's growth is undoubtedly education. There is a correlation between investment in education and economic development, and it can be assumed that educational development and economic growth are reciprocally dependent (Tikly et al., 2018). Even if its implementation takes a long time, higher investment in human capital leads to significant economic improvements, especially in developing countries. Collin and Weil assume that, in this context, investments in better education are more cost-effective than investments in physical capital to achieve certain income targets (Collin & Weil, 2020). In the case of many African countries, one concern is to give young people an opportunity for education and motivate them to study science and technology subjects. In order to achieve this goal, high-quality education should be the centre of focus. Motivating and competence-oriented teaching in schools and universities should prepare future workers and managers with a solid foundation in mathematics, science, and technology to act competently with regard to social, professional, and individual issues. In terms of educational policy and economics, it is undisputed that STEM education (science, technology, engineering, and mathematics) can contribute significantly to addressing many of the world's most pressing problems, such as poverty, environmental degradation, contaminated water, lack of food security or energy problems, among others (Clynes, 2016).

In light of the outlined importance of STEM education for social and economic development and by considering the educational situation in Africa, described in the following section, the present paper investigates the situation of STEM education as directly perceived by African teachers in order to be able to derive substantiated suggestions for improving the educational situation. The purpose of this study is to first explore the supply situation for STEM education in five African countries from teachers' perspectives, then generate a systematic and connectable descriptive knowledge of the current teaching and learning situation and its implications for promoting STEM education in those five mentioned African countries.

For several years, many African countries have already faced education policy, economics, and implementation challenges. However, in the discourse, it is often assumed that the fundamental education problems in Africa have primarily political causes (Boyang, 2017). The political conditions in some African countries are essentially fragile, and education policy decisions tend to change continuously. They face various problems implementing education policy reforms (Otara, 2012). Thereby, curricula and pedagogical questions are often intermingled with economic and political decisions. In many cases, there is no

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connection, or only a weak tie, between the educational content being taught and the actual needs and substance of the economy (Gumede, 2017). The demographic change in many African countries, the relatively low spending on education, the lack of school infrastructure, and the absence of well-trained teaching staff are additional obstacles in improving the quality of education. Considering the ever-growing population in Africa, there is an alarming shortage of progress in education and literacy. Economic recovery and sustainable development in Africa depend on many factors, with education considered a crucial aspect for better individual and social opportunities (Otara, 2012).

Although STEM education is considered an essential pillar for school, and higher education in Africa, a fundamental need for optimization has been identified (Blom et al., 2016). Critical aspects here are an insufficient and unclear strategy in policy, a lack of connection between the content of the curriculum of STEM subjects and the actual needs in the professional and working world, inadequate professionalisation of teachers, and a shortage of teachers in STEM subjects (Zinn et al., 2019). Gender disparity and low research development are noted for the STEM sector (Blom et al., 2016). Problems also arise from the low pay of teachers, the educational output in STEM subjects, and the generally low acceptance of the subjects (Tikly et al., 2018). In the last two decades, the development of education in Africa has been characteried by remarkable progress at all levels of schooling: Africa has experienced a significant increase in enrolment rates (CESA, 2017). However, this optimism still hides the enormous inequalities and multiple deficits in the education system. These include inadequate infrastructure and classrooms and teachers, which unfortunately have not increased proportionally to the number of pupils. Significant school levels such as kindergarten, technical and vocational education, universities, and non-formal education are poorly developed, although their general importance increasingly attracts attention (CESA, 2017). Although transfer students from primary to lower secondary school have risen, declining completion rates and low transfer rates to upper secondary school indicate the prevalence of educational problems (Doyle et al., 2017).

One problem that has already been mentioned many times is the supply of qualified teachers at the secondary level. Half of the teachers in secondary schools are not sufficiently qualified (Chipindi & Chipindi, 2016). It is estimated that an additional 5.7 million teachers (2.1 million for primary and 3.6 million for secondary) are needed to achieve the Sustainable Development Goals for education and health in Africa, not including pre-primary teachers, trainers, and school managers (Tikly et al., 2018). Some African countries are trying to

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actively address the challenges in teacher education by structurally promoting STEM education at the higher education level as part of teacher education and training. This is the case, for example, for the Senegalese government, which has inaugurated several measures, such as establishing new research universities or implementing programmes specifically to promote science and technology courses (Doyle et al., 2017). In Zambia, where the shortage of teachers in mathematics and science is also a critical problem, the government initiated a Fast Track Teacher Education Programmes (FTTEP) with the support of development partners. The FTTEP aimed to increase the supply of qualified teachers promptly, particularly in critical fields such as engineering, mathematics, and science (Doyle et al., 2017).

Measures were taken to promote Information and Communication Technologies (ICT) for improving access, quality, and relevance of education and skills acquisition for Africa's development (CESA, 2017). In addition, educational policy measures are being implemented to promote vocational education and training. In South Africa, Egypt, Ghana, Tanzania, and Ethiopia, the importance of high-quality qualifications for teachers and trainees at vocational schools has been recognized. Hence, reform efforts have been made in vocational education (Everton & Arne 2020). These African countries have fundamentally updated their training and framework curricula. The government in South Africa aims to incorporate international standards concerning the development of vocational education and training curricula to raise the professionalisation of teachers and graduates of vocational schools to an internationally comparable level (Zinn et al., 2019). These brief examples of the initial situation clarify that Africa has adopted various initiatives to improve education in recent years. That progress has already been made in some areas. Nevertheless, there is still a fundamental need to improve education provision and implement international standards (Blom et al., 2016). In this context, this article deals with the current situation in schools from the perspective of teachers and the analysis of possible approaches to improve STEM education. The purpose of this study was to examine the teaching and learning situation for science, technology education and mathematics in five African countries.

METHODOLOGY

The study employed an exploratory research design. This design aimed at exploring the stem situation in the selected African countries. The study employed qualitative paradigm, which worked hand in hand with exploratory research design to produce quality and in-depth understanding on STEM education in five African Countries.

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The study sample consisted of teachers from 13 secondary schools (KII) who teach mathematics, science, or technology subjects. A total study sample size consisted of N = 24 teachers who willingly agreed to participate in the study. The sampled teachers were from the five African countries: Cameroon (n = 5), Côte d'Ivoire (n = 8), Ghana (n = 6), Kenya (n = 4) and Senegal (n = 1). Purposive sampling was used to obtain a diverse sample of participants to suit the aim of the study. The choice of this technique was based on the act that teachers are the key holders of the information required by the study. At the time of the interview, the interviewees were between 25 and 46 years old (M = 36.67 years; SD = 5.62 years). Their teaching experience is between 2 and 19 years (M = 8.25 years; SD = 5.76 years). More details about the participating schools and interview partners are given in Table 1.

In terms of data collection instruments, the study used semi-structured interviews, based on guiding questions to ensure good comparability of the individual interview statements and to meet the explorative character of the study. Due to the restrictions caused by the Covid-19 pandemic and research economic aspects, all interviews were conducted using phone calls with each participant individually. Interviews were conducted until data saturation was reached according to the theoretical sampling. The collected database includes 24 interviews with a total length of 17.4 hours, with an average interview length of 45 minutes (MIN = 32 min; MAX = 1h 29 min). After obtaining participants' consent, the interview conversation was recorded. The participants were informed that the interviews would be treated confidentially and that the results would be reported anonymously.

The data analysis procedure was based on qualitative content analysis, as per Mayring (2015). After transcribing the interviews, MAXQDA 11 (Qualitative Data Analysis Software) was used. Each category was formed in an iterative process, deductively based on the interview's main points of the guideline and inductively in the rating process. One thousand thirty-three (1033) codes were assigned in the three main deductive categories (context of teachers, classroom and teaching context, and school context) and 275 codes in the inductive category characteristic Challenges. This results in a total number of 1308 codes. In order to ensure the reliability of the coding, the interview data were analysed twice, and the reliability measures (interrater reliability) were determined in the individual categories. The agreement analysis made it possible to identify and reduce problems in the delimitation or definition of the categories at an early stage and to recognize differences in the approach of the coding persons. The matching analysis served as a tool for checking, securing, and improving the quality of the coding process. Throughout this procedure, agreement values between 69% and 87%

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were achieved for the categories, evaluated as acceptable to very good (Campbell et al., 2013).

RESULTS

Demographic Characteristics of the Respondents

All countries involved in this study require the successful completion of a teaching degree as a prerequisite for obtaining a teaching qualification. However, each country adapts these requirements to address the teacher shortage. All interviewees finished college with at least a bachelor's degree and completed a teacher training program.

Regarding the gender distribution of the respondents, 21 of them were male, while 3 of them were female. With reference to the type of school they taught, 16 of the respondents were from urban schools. Only 8 of them were from rural secondary schools.
About the age bracket, only two (2) KII were below the age of 30 years. Only 16 KII ranged in the age bracket of 31-40 years. The remaining group (8) was above 40 years.

With regard to the countries the respondents came from, 5 of them came from Cameroon, 8 came from Côte d´Ivoire, 6 came from Ghana, 4 came from Kenya, while 1 came from Senegal.

With reference to subject coverage, 10 of them teaches physics, 3 teaches Biology, 9 are for Mathematics, while only 1 is for computer sciences

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Context of Teachers

Due to the lack of teachers, the abundance of work, and the desire to change jobs, some teachers (n = 3, approximately 12.5%) have taken additional training in subjects other than their major subject, namely biology (Duration: 3 months), engineering (Duration: 3 years) and statistics (Duration: 1 year); No=103

In addition, 42% of the respondents regularly attend school-internal in-service training or individual external training programmes (Duration: 2 hours to 1 week) to develop their subject-specific and interdisciplinary competencies further.

> Every year, I go on a professional exchange organised by the University of Cambridge, where we have training programmes for teachers. In most of our

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> training programmes, we adapt our curriculum to the innovations: how to improve our teaching management, methodology, class management, building skills in STEM, improving exam content and form, student management, teacher-student buffers, trust between teachers (KII 16, 2022).

An analysis of the five countries shows that the surveyed schools in Ghana, for example, invest more in the in-service training of their teachers. Several teachers (n = 14, approximately 58.3%) call for more teacher training in their subjects, especially with regard to digitalization in education (n = 5, approximately 20.8%). Further, KII 16 had the following to say:

> I have found that the way we teach science subjects here in Africa is difficult for learners to understand. So if we have experienced and qualified teachers with good knowledge of [appropriate] teaching methods, we could make the subject more understandable for students (KII 16, 2022).

Whilst a good half of the teachers surveyed justify their (extrinsic) motivation to work in a secure job, good working conditions, and a teaching tradition in their own family, the rest (around 42%) of the respondents state that they are intrinsically motivated and have a strong passion for teaching and transmitting knowledge. One teacher from Kenya expressed his enthusiasm as follows:

> I want to help young people become important people for tomorrow's development. They come to school when they are young; they leave when they are older with at least some good knowledge. [...] Identifying natural talent: There are gifted students who are particularly interested in innovation. So if we are able to identify them, nurture them and help them, we will go far. (KII 22)

Some of the interviewees see their job as an opportunity to share their expertise and are passionate about educating students to become future actors and contributors to the development of their country. According to the following quote, teachers find it important to encourage students to engage in science education.

> Why did I decide to teach? To help the students improve their educational background or academic career, but also to make them understand the concepts. [...] I know that science is challenging for most of our students. I thought I

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> could figure out how we can best simplify the science topics to ensure students' understanding the best (KII 16, 2022).

Of the respondents, 58% note that there is generally a poor labour market situation in the education sector, coupled with low monthly salaries. The majority of teachers state that they are not paid sufficiently and cannot have a satisfactory standard of living with the relatively high living costs.

> Due to lack of job opportunities, there is no complete satisfaction. We do not get enough money for the work we do. Therefore, we try to cover our monthly financial needs through other jobs. Teachers choose to work in primary school because there are no other opportunities (KII 1, 2022).

Besides, the discrepancy between intrinsic motivation and personal satisfaction is illustrated by the following quote:

> After all, there is a big difference between passion and satisfaction now. As a person, I don't regret being a teacher, but of course, there are things about doing the job that lead to dissatisfaction, and if these things didn't exist, satisfaction would be complete. As a consequence, we try to balance the monthly income with other work (KII 2, 2022).

In addition, other demotivating factors identified include insufficient support from the education administration, limited cooperation between schools and government, lack of motivation, low pre-education level, and lack of basic skills among the students, in addition to infrastructural deficiencies. One participant with obvious intrinsic motivation claims:

> On the other hand, the level of the students is low, it is discouraging [...] and it is a tragedy when you see what these students write and produce, it is terrible [...]. Also, the students are not motivated to learn (KII 2, 2022).

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Furthermore, a discouraging factor for teachers is the lack of labour market opportunities for their learners after school:

> After finishing university, students trained in science and technology should have a good job, but we don't have enough industry to employ these students, so they do other jobs, like selling tomatoes in the market. I find it difficult and wonder about the purpose of our education. We need enough industry and businesses for our graduates (KII 17, 2022).

Teaching and Learning Situation for STEM Education

The study sought to investigate teaching and learning situation in 5 African countries. The situations investigated included the following: classroom and teaching context,
Classroom and teaching context; Context of the school

Classroom and teaching context

(Number of coding = 297)

When asked how teachers prepare lessons and which sources they use for this purpose, all respondents reported that they use official educational plans, which specify the educational content in different subjects by grade. Teachers work with textbooks, designing the teaching content through the official educational plan, and using internet sources for additional lesson conception. To the question: "Is the conception of lessons done alone or together with colleagues, also from other schools?", 35.5% of the teachers answered that they always prepare lessons with colleagues; 33% claimed they always prepare them alone, and 21% prepared with colleagues only when necessary. When asked why some teachers prepare lessons by themselves, the following reasons were given several times: busy timetable, lack of time, lack of teachers, dysfunction of the teacher collegial and lack of time for teamwork. Some teachers perceive themselves as very experienced and prefer to work alone.

The majority of teachers (84%) reported using student-centered teaching methods and motivational and competence-oriented approaches in their teaching. The topics covered in class are oriented according to a well-defined classical system. Specifically, one interviewee explained the general structure of his teaching:

> The learner is encouraged to mobilize his knowledge by touching his interests, which enables him to contextualize the acquired knowledge and understand its usefulness. The learner is an active subject in the teaching and in the creation of his own knowledge. [...] Therefore, the lesson always starts with an experimental

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> activity, and then a certain property of the activity is introduced. To check whether the message has been received, practical exercises are carried out (KII 1, 2022).

However, due to the workload also related to student-centered teaching methods and limited teaching time, a quarter of the respondents sometimes also apply teacher-centered teaching methods: this was approved by interviewee 20 who had the following to say: "…with our heavy workload, most teachers sometimes tend to use teacher-centered method, which cannot provide skills to the learners" (KII 20).

About one in six (16.7%) report that student's skills and learning backgrounds are often weak, and some students have cognitive learning disabilities. The following quote is given:

> Children's intellectual competence has clearly declined. The most difficult moments for me are when I correct exams; I ask myself whether I have conveyed the message. [...] Today, when I often think about giving up the profession of teacher, it's for this reason: you can't ask a child to clean a shoe, and he comes back with that shoe in worse condition (KII 2).

On further emphasis, KII 20 had the following to say: "The competence acquisition of the pupils is, to be honest, very low because the teaching method often does not allow them to be given more room to learn" (KII 20)

Teachers report that school examinations can be written, oral, and/or practical. However, the examinations are primarily conducted in writing due to a lack of materials. Half of the teachers (50%) almost give exclusively theoretical lessons without practical sessions because the required equipment is lacking. This is also reflected in the exams, which are mostly theoretical. A teacher comments as follows: "Teaching is more theoretical because the appropriate framework for practice is not available." (KII 8)

The other half of the teachers work in schools that do have the necessary equipment, so they give up to 40% practical lessons and also up to 40% for practical examination:

> ... each topic has a practical aspect (theoretical 60%, practical 40%). Due to the availability of premises and materials, all topics that have a practical aspect are carried out by the girls. We help girls to do practice phases on their own (KII 21).

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This group includes teachers who carry out project work (n = 10, approximately 41.7%) and excursions (n = 8, approximately 33.3%) with their students. They undertake projects on sustainability, food production, and current societal and regional problems, among others, also involving extracurricular learning sites (e.g., in Ghana, the Volta River Authority (VRA), nuclear power plants; hydroelectric power plants; lakes, and marine areas to study the marine ecosystem as well as companies in the food industry).

Context of the school

(Number of coding = 633)

The interviewees were also asked to indicate which spatial and material resources are available for their teaching in school and which resources they would like to see. The findings are diverse and show that private schools are well-equipped. In contrast, public schools, albeit with country-specific characteristics, state a need for spatial and material equipment optimization.

> In our school, we have all the resources. Our private school is well-equipped. In our public schools, however, there are many challenges. Some government schools do not have enough physics teachers, so they use their own math teachers to teach physics. Most of them lack equipment for teaching (KII 15, 2022).

Adding more weight on the same point, KII 20 had the following to say:

> We have enough resources and equipment in the laboratory. Our school offers a broad curriculum. For each technical subject, we have workshops for electricity, technology, woodworking and mechanics; for these workshops, students are allowed to use machines. We have computer labs (KII 20, 2022).

While interviewed schools, for example in Kenya, provide sufficient funds for the practical subjects and classrooms according to the teachers, the participating government schools, for example in Cameroon and Côte d'Ivoire, do not have the necessary funds to purchase learning materials and can work only in outdated laboratories, if present at all:

> We practically have almost all the equipment, but since it is very old, we don't use it too often, also because there is no laboratory and the time available for teaching is not enough. We just show the material to the students so that they get an idea of the lessons. In fact, when there is an opportunity, only teachers are allowed to do the experiment [due to resource constraints]. The students are spectators (KII 13, 2022).

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On more emphasis, KII 2 reported the following:

> Teaching technologies used are outdated or missing. If I talk to a child about the cell or the heart and cannot visualize it, it is difficult for the child. Of course, it would facilitate the understanding process if we had easy access to didactic teaching materials (KII 2, 2022)

In Côte d'Ivoire, for example, respondents mention that, although most public schools say they have laboratories and libraries, they are empty due to a lack of equipment. "…that is a serious problem. The lab exists, but it is empty. [...] But when students touch the equipment themselves and do experiments, they develop more interest in the course" (KII 13, 2022).

According to interviewees from rural schools, teachers often only have textbooks, chalk, and blackboards. Concerned teachers would like to have basic equipment, such as an adequate power supply and Internet access.

> There is no equipment in our school. So we just ask for the minimum to help children understand and encourage them. We need electricity. Even if a teacher comes with his equipment, a computer or a projector, he cannot work properly for lack of electricity in the classrooms (KII 7, 2022).

Regarding room resources, 75% of respondents would like a (better) equipped laboratory, 45.8% a school library, and 62.5% a computer room (including computers). Regarding material equipment, the following are mentioned: projector/smartboard (66.7%), printer (29.2%), and software (12.5%, e.g., CAD "Computer-aided design"). Furthermore, there is a need for sufficient electrical supply (25%), access to the internet (37.5%), and a fundamentally improved infrastructure (water, toilet, etc.) at the schools (25%), as well as more spacious classrooms (54.2%).

During the interviews, teachers (75%) repeatedly mentioned the lack of support from educational administrations in terms of providing school infrastructure and resources for teacher training and excursion support. Changing education policies and lack of investment in technical education are fundamental problems mentioned by the interviewees:

> …the government does not invest much in technical education. It promises a lot but does not realize it. I know that there is no way that a country can develop without science and technology (KII 17).

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Characteristic Challenges
(Number of Codings = 275)

Since it can be assumed that there are country and school-specific characteristics, the outcomes reveal school-specific difficulties between urban and rural schools as well as between private and public schools. Although urban schools have their characteristic challenges, such as high student numbers, lack of qualified teachers, it is also observed that they are better resourced than rural schools. For example, in Côte d'Ivoire and Senegal, it has been shown that rural schools are facing a broader range of challenges. The interviewee from Senegal noted that villagers are unfriendly to teachers and do not support girls to get further education up until university; on the contrary, they even discourage them. Several teachers in villages in Côte d'Ivoire mentioned that most students do not have books or notebooks; furthermore, they have fundamental linguistic challenges when dealing with the teaching language, which is a foreign language.

> Here in the village, there is already a problem with the language used in class. We use a foreign language to teach, which is less spoken in the region. [...] Grade 9 children still have difficulties in reading. Only a few of them do the written exercises with texts. They prefer numeracy exercises without text (KII 10, 2022)

In addition, rural schools do not have the necessary teaching materials, and the teachers are not supported. Table 2 details the challenges stated by the teachers, specific to urban and rural schools.

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Table 1

Challenges of the Individual Schools

	Challenges at the teacher level	Challenges in teaching	Challenges at the school level
Urban schools	Lack of teacher training Lack of inclusive teaching Lack of teaching skills Lack of qualified teachers Work overload Lack of motivation Lack of STEM knowledge (in CAD, simulation, IT...)	Lack of practical relevance Abstract education Lack of basic skills Lack of teaching and learning materials Poor learning backgrounds Poor teaching method	Lack of and/or outdated infrastructure Limited support from the government Lack of electricity/ internet in the classroom Limited education policy Small classrooms
Rural schools	The villagers are unfriendly to the teachers Including all the challenges listed in the urban schools	Linguistic difficulties Including all the challenges listed in the urban schools	Gender disparity Lack of electricity/internet in the classroom

A comparative analysis between public and private schools shows that even with certain challenges such as lack of teachers, work overload, and lack of government support, private schools provide much more comfort in high-quality education than public schools. All the private schools surveyed have a computer room, required teaching and learning materials, motivated teachers, training for teachers, etc. It should also be noted that all of them urban schools.

DISCUSSION

Based on the assumptions of the supply-use models in Figure 1, this study investigated and analyzed the current supply level - from teachers' perceptions of STEM subjects - which included: teacher's demographic information, Teaching and Learning context, and Challenges. The descriptive findings provide qualitative insight into the current teaching situation of STEM education in Africa and confirm the educational problems in Africa outlined in the initial situation. Furthermore, the results enrich the empirical state of the research and make it possible to identify four fields of action to address the teachers' issues and challenges to improve the situation in the participating schools.

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Teachers' professional framework: The study confirms that the teachers are predominantly intrinsically motivated to pursue their teaching profession but are dissatisfied because of the personal constraints within schools and, in particular, the inadequate financial compensation for their work. As a result, their primary focus on student education becomes limited in favor of another occupation covering their monthly financial needs. This finding is consistent with the existing research findings of Zinn et al. (2019), whose case study included South African teachers. If one follows the statement by Okeke and Mtyuda (2017) that job dissatisfaction arises when output and input (e.g., remuneration, framework conditions) are out of proportion, which is reflected in the teaching level, resignation of teachers and lower performance of learners are to be expected. The structures of the education administration, as well as the provision of financial and human resources for education, are perceived by teachers as insufficiently supported, not goal-oriented, not efficient, and disadvantageous, which is also reflected in the lack of educational equipment.

Teacher training: In terms of teacher qualifications, the study results show that all the teachers surveyed have professional training in their subject of instruction for secondary schools, besides a bachelor's or master's degree. It has also been found that, unfortunately, only a few schools provide teachers with sufficient in-service and professional development opportunities. Respondents call for systematically designed teacher training structures in order to be able to improve their profession-oriented competencies in the dynamically changing STEM skills in the context of digitalized education and heterogeneity in schools. These claims are supported by the state of research on teacher professional development. For example, Kwakman (2003) agrees that professional development in schools requires engaging teachers in activities to foster new knowledge, skills, and values to improve their teaching. Student learning success depends on teachers' professional development competencies (Everton & Arne, 2020; Phinias, 2021).

Infrastructure improvement: Teachers report that practical teaching phases are hardly possible due to the lack of available space and infrastructure, which makes teaching and learning difficult, all the more so for the students, for whom the lessons seem too abstract and not very tangible. They hardly see any connection between their education and the everyday problems of the world around them.

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Competence orientation and interest orientation in teaching: The teachers state in general that the quality of STEM teaching is inadequate in terms of learning content, teaching, and learning methods, which is a barrier to the acquisition of STEM skills. Moreover, the World Bank's report on STEM research in sub-Saharan Africa indicates that the quantity and quality of STEM instruction are far from well-developed (Blom et al., 2016). The teaching and learning process should foster students' critical thinking and creativity, ultimately serving their individual and social development. The study results indicate that, in most schools, the examinations are held in a way that only factual knowledge of students and no STEM skills are measured. Many exams are criticised for their "unchallenging" questions that only require students to recall facts (Tikly et al., 2018). The exams do not reflect the process-based learning goals of STEM education, such as advancing science and technology understanding along with improving problem-solving skills, but focus on the lowest range of demands. The findings indicate that the instructional offerings do not promote students' critical thinking and creativity to a sufficient degree, thus calling for a competency-based approach to the instructional propositions (Ngondi, 2021).

CONCLUSION

This paper examined the current situation of learning and teaching STEM subjects from teachers' assessments. Despite improvements in recent years, some fundamental challenges in everyday school life remain, which lead to the limited quality of learning and teaching scientific and technical subjects. Limited quality, however, has been linked with numerous problems bedeviling the education, such as non-motived teachers and students, poor learning and teaching materials, abstract scientific and technical education, no or poor in-service training for teachers, and lack of electricity/internet in the classroom. For active development of education, along with effective policy decisions, it is recommended to pay close attention to the teaching and the learning conditions, learning purpose, and learning outcome. The interviewed teachers welcomed and encouraged the ideas expressed in the discussion to support and improve the current quality of STEM education. Therefore, a greater emphasis on the promotion of teachers, including their in-service training, especially in STEM subjects (e.g., specialised teacher training), as well as the need to integrate STEM skills into the curriculum, is seen as crucial components of educational programs.

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