Science Education Quarterly, 2026, Vol. **3**, Iss. 3, pp. 92–113 10.55056/seq.1067

Competence-based pedagogical strategies for effective science teachers preparation in Tanzanian diploma teacher colleges

Angelina Kanyabwoya, Huruma Olofea Bwagilo and Tumaini Samweli Mugaya

Department of Psychology and Curriculum Studies, College of Education, The University of Dodoma, Benjamini Mkapa Rd., 41218 Iyumbu, Dodoma, Tanzania

Abstract. This study examined the implementation of competence-based pedagogical strategies in developing science teachers' competencies during their preparation in diploma teacher colleges. It adopted a multiple case study design. Interviews, focus group discussions, documentary review and classroom observation generated data from 66 participants, which were analysed thematically within an interactive framework of data reduction, data display, and conclusion drawing and verification. The findings show that implementing competence-based pedagogical strategies in science lessons strengthens the development of science teachers' competencies. Only a few science tutors used such strategies, however; most relied on the teacher-centred approach of lecturing. This minimal use stemmed from inadequate skills, poor classroom infrastructure, large classes, heavy teaching workloads, teaching and learning materials that were both insufficient and delivered late, tutors' reluctance to change their practice, and limited administrative support. The study concludes that, despite government efforts to improve teaching and learning environments, competence-based pedagogical strategies remain marginal in science lessons in Tanzanian diploma teacher colleges, leaving science teachers' professional competencies inadequately developed. It recommends the consistent use of competence-based pedagogical strategies, adequate administrative support, the provision of in-house training, and the timely purchase of teaching and learning materials.

Keywords: competence-based pedagogical strategies, implementation, science teachers' competencies

1. Introduction

Global and national commitments to education – Sustainable Development Goal 4 among them, with its insistence on quality education for all children and on the advancement of science and technology – depend on a supply of competent science teachers [20, 39, 42, 46]. Science teachers shape students' mastery of subject matter, their competencies, their achievement and their well-being [13, 17, 21, 26, 35, 45], and it falls to them to equip learners with the knowledge, skills and attitudes that the demands of the wider world require [3, 13].

That dependence has produced a dense layer of policy. Alongside Sustainable Development Goal 4 sit training policies, competence-based curricula, the Teacher Education Support Project (TESP), the Language Support Programme (LSP) and retooling initiatives [20, 36, 39–41, 43]. Developed countries such as the United States of America, Australia and Finland, and developing countries such as Nigeria, Rwanda, Kenya and Tanzania alike, therefore stress the competencies science teachers must hold – mastery of content together with pedagogical and technological competence – if they are to carry out their duties in the workplace [14, 17, 24–26, 32, 35, 47].

Through science teacher preparation, the development of these competencies turns on several factors, among them the implementation of competence-based pedagogical strategies in science

0009-0006-1326-9895 (A. Kanyabwoya); 0000-0002-8336-3370 (H. O. Bwagilo); 0000-0002-9228-9678 (T. S. Mugaya)
kanyabwoyaangel@gmail.com (A. Kanyabwoya); olofeahuruma@yahoo.com (H. O. Bwagilo); samwelimugaya84@gmail.com (T. S. Mugaya)

Received	Accepted	Published	Version of record
2025-07-20	2026-04-07	2026-07-25	2026-07-25

Science Education Quarterly

lessons [23, 31, 37]. The strategies tutors use while preparing science teachers are central to what student teachers become able to do [14, 17, 38, 45]. Experimentation, demonstration, group discussion, projects and think-ink-pair-share (TIPS) put student teachers in contact with one another and with teaching and learning materials, and it is that contact which makes their learning meaningful [7, 20, 29, 39].

1.1. Competence-based pedagogical strategies in Tanzania

The implementation of competence-based pedagogical strategies in Tanzania shows a mixed pattern. Teachers are aware that the curriculum has shifted, yet their classroom practice remains largely traditional – a gap commonly attributed to limited in-service training, inadequate teaching resources and large classes. Progress in policy and in teachers' understanding has therefore not been matched by progress in practice, which systemic constraints continue to hold back.

The Ministry of Education, Science and Technology (MoEST) and the Tanzania Institute of Education (TIE) are the principal drivers of this reform. Through them the government trains science teachers and instructors, articulates the policy statements and directives that underpin competence-based pedagogy, develops competence-based curricula and guidelines, equips teaching and learning environments with resources, extends infrastructure and ICT facilities in schools and institutions, addresses the teacher–student ratio and operates quality assurance mechanisms [20, 36, 39, 43]. What is sought in return is a skilled labour force able to meet national and global market demand, competent science teachers and lower unemployment.

Despite these efforts, implementation remains difficult and, in many classrooms, ineffective [4, 30, 34]. The teacher-centred approach persists in science lessons [6, 15, 22], ICT is integrated only patchily, and teaching and learning materials are either absent or used improperly. Teachers do attempt learner-centred methods such as project-based learning, group discussion and problem-based learning, but few report feeling confident in the principles behind them. Murithi and Yoo [27], surveying 351 Kenyan primary teachers, traced part of this shortfall to its material base: teachers judged ICT facilities inadequate, and that inadequacy obstructed the technology integration a competency-based curriculum assumes.

Teachers' preparation is a second constraint. Some are familiar with the principles of a competence-based curriculum, but have only a limited grasp of what those principles demand in practice, so their classrooms still run along content-based, teacher-centred lines. Neither teacher training colleges nor in-service and pre-service provision has equipped teachers and instructors adequately in competence-based methodology, and many consequently teach without confidence in it. Resources compound both problems: science textbooks, teaching aids, apparatus and models are in short supply, classrooms are overcrowded and physical infrastructure is insufficient – conditions under which the learner-centred, individualised approach that the competence-based curriculum requires cannot easily be sustained.

Existing studies report that the implementation of competence-based pedagogical strategies falls below expectation, leaving learners with theoretical knowledge but without the competencies they are meant to acquire [15, 21, 26, 35]. Those studies, however, treat the question in general terms, and their findings carry contextual, methodological and theoretical limitations. They concentrate on curriculum design and on the theoretical apparatus of competence-based education, and say little about how science tutors and student teachers in Tanzanian diploma teacher colleges actually work: the practices tutors adopt in classrooms and laboratories, the constraints they meet, and the part institutional and administrative support plays in what becomes possible.

Qualitative inquiry is suited to precisely that. It can show how the strategies are used in real teaching settings and how their use shapes the competencies science teachers develop during preparation. This study therefore examined the implementation of competence-based pedagogical strategies in science lessons in diploma teacher colleges in the Iringa, Dodoma, Tabora and Tanga regions, which existing studies have largely passed over, with a view to informing teaching practice, policy formulation and teacher preparation programmes through policy makers, curriculum developers, college administrators, science tutors and other educational stakeholders.

1.2. Theoretical framework

Social constructivist theory holds that learning arises from social interaction – among learners themselves and between learners and their cultural environment. It emphasises students' active involvement, the building rather than the receiving of knowledge, and collaborative learning. Two of its concepts organise this study. The zone of proximal development (ZPD) is the distance between what a learner can do independently and what the same learner can achieve with guidance; scaffolding is the temporary support that a "More Knowledgeable Other" (MKO) supplies to carry the learner across that distance, and which is withdrawn as mastery develops [1, 2].

In a science college, this account casts learning as active and collaborative: knowledge is constructed through social interaction and through hands-on work in laboratories, particularly work connected to day-to-day experience. New information is interpreted through the mental frameworks a student teacher already holds rather than simply absorbed. Prior knowledge therefore matters to the development of competencies, and student teachers need strategies that let them carry out practical activities and share what they know with peers before a tutor intervenes.

Social constructivism also describes the learning environment as one in which teachers organise activities that let learners draw on prior knowledge and work with their hands, developing critical skills, problem-solving skills and curiosity. Competence-based pedagogical strategies such as experimentation, group discussion and demonstration are the practical form this takes, giving learners the opportunity to engage actively in creating knowledge and so to develop their competencies. Tutors' assistance remains important throughout, and especially when they guide student teachers through practicals and projects [1, 2].

The theory was adopted here because it treats learning as a socially mediated process in which knowledge is constructed through interaction, collaboration and practical engagement – the commitments that also underlie competence-based pedagogical strategies in science lessons, with their emphasis on active learning and on professional competencies. The study accordingly examines the implementation of strategies such as experimentation, group discussion, demonstration and projects in science lessons, and what their use contributes to science teachers' competencies in Tanzanian diploma teacher colleges.

1.3. Research objectives and questions

The following objectives guided the study:

1. To examine science tutors' skills of using competence-based pedagogical strategies in science lessons
2. To assess the practice of using competence-based pedagogical strategies in science lessons
3. To examine colleges' administrative support for the use of competence-based pedagogical strategies in science lessons

The study was guided by the following questions:

1. How skilled are science tutors in using competence-based pedagogical strategies in science lessons?
2. How are competence-based pedagogical strategies applied in science lessons?
3. How does college administration support the use of competence-based pedagogical strategies in science lessons?

2. Methodology

2.1. Research approach and design

This study adopted a qualitative research approach to gain an in-depth understanding of the competence-based pedagogical strategies used in the preparation of science teachers in public diploma teacher colleges in Tanzania. As Creswell [9] puts it, qualitative research is an approach for exploring and understanding the meaning individuals or groups attribute to a social or human problem. A multiple case study design was employed to examine participants' experiences, practices and perceptions within their real institutional contexts. The approach yielded rich descriptive data through interviews, focus group discussions (FGDs), classroom observations and documentary reviews, and so permitted the triangulation on which the credibility of the findings rests [9].

Fieldwork was carried out in 2024 in four public diploma teacher colleges in the Iringa, Dodoma, Tabora and Tanga regions. To preserve anonymity the colleges are identified throughout as Colleges A, B, C and D, and participants are referred to by their professional roles. Interview and focus group extracts are reproduced as transcribed.

2.2. Sampling and sample size

Creswell [9] and Denzin and Lincolin [11] define the sampling procedure as the process of selecting participants from the population to be studied. Here that procedure followed from the nature, purpose and interpretivist orientation of the research. Because the study sought to understand how the implementation of competence-based pedagogical strategies in science lessons shapes the development of science teachers' competencies, non-probability sampling was employed, which allowed the researcher to select information-rich participants directly involved in science teacher preparation and quality assurance.

Sample size, again following Creswell [9], is the number of participants drawn from the target population in order to answer a study's research questions. It was determined here by data saturation: participants were recruited until no new themes or significant information emerged. Such an approach belongs to qualitative traditions that prioritise depth of understanding over statistical representation, and it yielded rich contextualised data on the experiences of 66 participants across the four colleges.

Purposive criterion sampling selected four college principals, who oversee college management, policy implementation, resource allocation and the creation of an enabling teaching and learning environment. The same technique selected four academic deans, who coordinate academic activities, supervise curriculum implementation, monitor teaching and learning and support tutors and student teachers academically, and four college internal quality assurers, who monitor and evaluate teacher education programmes against the standards and guidelines set by the relevant authorities.

Expert and criterion purposive sampling selected sixteen science tutors, who teach science content and pedagogy, facilitate practical work, integrate educational technologies and mentor science student teachers during training. Criterion purposive sampling selected 38 second-year science student teachers serving as class representatives in the four colleges. As the primary beneficiaries of the training programmes, their learning experiences, perceptions and interactions within the college environment offer a vantage point on how the implementation of competence-based pedagogical strategies in science lessons bears on the development of science teachers' competencies.

2.3. Research instruments

Four instruments were used: semi-structured interview guides for college principals, academic deans, college internal quality assurers and science tutors; a focus group discussion guide for science student teachers; classroom observation schedules covering both tutors and student teachers; and documentary review schedules. Drawing on several instruments enabled data triangulation and so strengthened the credibility and trustworthiness of the findings.

2.4. Data analysis procedure

Analysis followed the interactive framework of Miles, Huberman and Saldaña [19], a systematic and recursive way of making sense of qualitative data [33] built on three interrelated and concurrent activities: data reduction, data display, and conclusion drawing and verification [18, 19, 33]. The framework suits an interpretivist study of how the implementation of competence-based pedagogical strategies in science lessons bears on the competencies science teachers develop.

Data reduction involved organising, selecting and condensing the material from semi-structured interviews, FGDs, non-participant observations and documentary reviews. Audio-recorded interviews and FGDs were transcribed verbatim, and field notes from observations and document reviews were read closely. Irrelevant material was set aside; meaningful segments were coded and categorised against the study objectives and the issues emerging from the data, which brought the significant patterns in the implementation of pedagogical strategies into view.

Data display organised the reduced material into matrices, tables and thematic summaries, making interpretation and comparison possible across data sources and across the four colleges. Set out visually, the data revealed relationships, similarities and differences among participants' perspectives and observed practices, and the thematic matrices supported triangulation of interviews, FGDs, observations and documentary evidence.

Conclusion drawing and verification involved interpreting the displayed data to generate themes, meanings and explanations bearing on the study objectives, working from recurring patterns, consistencies and contradictions across sources. Conclusions were verified continuously against raw data, cross-checked between methods and tested by revisiting field notes and documents. Because the framework is recursive, analysis proceeded alongside data collection, which strengthened the trustworthiness, dependability and accuracy of the findings.

2.5. Trustworthiness

Trustworthiness was pursued through the four criteria proposed by Lincoln and Guba [16] – credibility, transferability, dependability and confirmability – which suit qualitative research conducted within an interpretivist paradigm and help ensure that findings represent participants' experiences faithfully.

Credibility rested on the use of several data collection methods: interviews, FGDs, non-participant observation and documentary review. This methodological triangulation allowed findings from one source to be cross-checked against others. Prolonged engagement in the field and repeated observation of the same science tutors on different days helped capture routine rather than staged practice, probing questions during interviews and FGDs elicited detail, and reflexive field notes kept potential biases in view.

Transferability rested on thick description of the study contexts, participants, data collection methods and analytical procedures. Detailed accounts of the colleges, of participants' roles and of the educational environment let readers judge how far the findings apply to other settings, in teacher education within Tanzania and beyond.

Dependability rested on clear and systematic documentation: records of research design decisions, data collection procedures, instrument development and the analytical steps taken under the Miles, Huberman and Saldaña [19] framework. A pilot study at Morogoro Teacher College refined the instruments and procedures before the main study. Together these constitute an audit trail through which other researchers can follow, and potentially replicate, the study process.

Confirmability rested on grounding the findings in the data rather than in the researcher's assumptions. Bracketing was employed throughout to limit researcher bias, interpretations were checked continuously against raw data such as interview transcripts, observation notes and reviewed documents, and the triangulation of sources and methods demonstrated that findings recurred consistently across different forms of evidence.

2.6. Ethical considerations

Ethical considerations were observed throughout the study, to protect participants' rights, dignity and wellbeing and to uphold academic and professional research standards. The study adhered to accepted ethical principles governing educational research involving human participants [5, 8, 10].

Permission to collect data was obtained as stipulated by the University of Dodoma Research Ethics Committee. Research clearance letters from the University of Dodoma (Ref. No. MA.84/261/76/72) were secured before fieldwork began and submitted to the college principals. Each principal was first approached verbally and then given a letter requesting access to the college for data collection (Ref. No. MA.84/261/76/250; Ref. No. MA.84/261/76/251; Ref. No. MA.84/261/76/252; Ref. No. MA.84/261/76/253).

The researcher then met the participants, explaining the purpose of the study and how it would be conducted, and consent was obtained after a debriefing session. Participants were told that they were free to decide whether to take part and whether to be recorded during interviews and classroom observations, which encouraged them to speak freely; consent was sought separately for interviews, FGDs and observation sessions.

Confidentiality and anonymity were treated as of the utmost importance and were set out in the agreement letter. Participants were assured that the data would be handled so that no one but the researcher could identify its source, that no one else would have access to the raw data, and that the material would be kept confidential and used only for the purposes of this study. To that end the colleges were designated by letter and participants were referred to by their professional roles.

The right to withdraw at any time was respected and explained to each participant beforehand. In the event, all agreed to provide data and none withdrew.

3. Results and discussion

Data from college principals, academic deans, college internal quality assurers, science tutors and science student teachers converged on three issues: science tutors' skills in using competence-based pedagogical strategies, the practice of using them in science lessons, and the administrative support available for that use. Table 1 summarises the findings across the four colleges.

Table 1: Implementation of competence-based pedagogical strategies in lessons (source: field data [12]).

Theme	Finding across Colleges A, B, C and D	Supporting evidence from interviews, observations and documents
Skills in using competence-based pedagogical strategies in the classroom	A few science tutors had the skills to use competence-based pedagogical strategies in lessons.	• These tutors engaged student teachers actively in their own learning through discussion, projects and hands-on activities. • They guided student teachers in sharing knowledge through peer interaction, promoting collaborative learning. • They drew on varied teaching approaches – demonstration, TIPS, group discussion and experimentation – to encourage exploration and inquiry-based learning directed at the intended competencies. • They set practical tasks and problem-solving scenarios that connected learning to real-life situations and prompted student teachers to reflect on their own experience and learning, fostering critical thinking and self-assessment.

Continued on next page

Table 1 – continued from previous page

Theme	Finding across Colleges A, B, C and D	Supporting evidence from interviews, observations and documents
	The majority lacked these skills and relied mainly on the lecture method.	• These tutors used traditional techniques, directing the learning process and supplying the context and interpretation of the material themselves. • They were the primary source of information and expertise: during science lessons student teachers listened and took notes, with limited engagement. • There was no room for student teachers to interact and share their knowledge and experience during teaching and learning.
	Skills in using competence-based pedagogical strategies differed from one science tutor to another within a college, and from one college to another.	• Tutors' command of these strategies was uneven both within and between the four colleges.
The practice of using competence-based pedagogical strategies	A few science tutors used competence-based pedagogical strategies – demonstration, portfolio, experimentation, TIPS and collaborative group discussion – supported by classroom infrastructure, class size, teaching workload, the availability of teaching and learning materials and their own willingness to change.	• They engaged student teachers actively in the teaching and learning process. • Their classrooms were well equipped, with sufficient unfixed chairs and tables, a power supply and space enough for the class. • Those classrooms held teaching and learning materials: books, models, chemicals, apparatus, specimens, projectors and computers. • They taught small classes that the classrooms could accommodate. • Their teaching load matched the syllabus recommendations. • They were willing to change their ways of teaching science subjects.
	The majority did not use these strategies and relied mainly on the lecture method, given limited support from classroom infrastructure, class size, teaching load and teaching and learning materials, together with their own reluctance to change.	• They had inadequate skills in using the strategies. • They taught large numbers of science student teachers. • Science tutors were too few for the numbers enrolled. • Classrooms were too small for the classes, and some lacked the facilities and materials that competence-based strategies require. • Their teaching load was heavy, in contrast to the syllabus-recommended load reported by other tutors. • They were reluctant to change their established ways of teaching science subjects.
Administrative support for the use of pedagogical strategies	A few college administrations supported the use of competence-based pedagogical strategies in several ways.	• They purchased teaching and learning materials, including chemicals, specimens and internet bundles, when science tutors requested them. • They arranged maintenance of teaching and learning materials. • They provided a moderate amount of in-house training for science tutors.

Continued on next page

Table 1 – continued from previous page

Theme	Finding across Colleges A, B, C and D	Supporting evidence from interviews, observations and documents
	Most college administrations provided little support, and some none at all, given the limited budgets they received and the late arrival of government funds.	• Teaching and learning materials were inadequate, and those requested – chemicals, specimens and internet bundles – arrived late. • Some materials were in poor condition and needed maintenance. • In-house training for science tutors was absent.
	Administrative support differed from one college to another.	• The support provided was not the same across the four colleges.

3.1. Skills of using competence-based pedagogical strategies in science lessons

Tutors' own command of competence-based pedagogical strategies proved to be one of the factors governing whether those strategies reached the classroom at all. Interviews, classroom observations and document reviews agreed on the pattern set out in table 1: a few science tutors possessed the necessary skills, the majority did not, and the level of skill varied both between tutors within a college and between colleges. One tutor described a lesson sequence that illustrates what the skills look like in practice:

> When I'm teaching a physics lesson in the classroom, I set clear, specific learning outcomes at the beginning of the lesson. I provide an outline of the competencies that my student teachers are expected to develop by the end of the lesson. Then I put them into groups to share their prior knowledge and complete the task I set. I then allow group presentations and discussions. After that, I provide hands-on activities incorporating real-world problems, case studies, and simulations to help student teachers apply theoretical knowledge to practical situations. Finally, I allow student teachers to reflect on their learning by asking oral questions and setting an assignment related to the concepts learnt. (Interview with science tutor, College B, 2024)

An academic dean, whose remit includes lesson observation, corroborated this from the supervisory side:

> As academic dean, I oversee the entire teaching and learning process by observing lessons. I also review teaching and learning documents, such as schemes of work and lesson plans, to assess the pedagogical strategies and materials employed to ensure that science student teachers are permitted to learn by doing. I have noticed that some science tutors engage their student teachers in various activities such as arranging and storing chemicals and apparatus, preparing standard solutions and dissecting rats, frogs and cockroaches. Some science tutors also gave their student teachers tasks to discuss in groups and present their answers to the class and asked a few of their student teachers to demonstrate simple experiments to others. (Interview with academic dean, College B, 2024)

Student teachers in the College B and D focus groups described being set projects, preparing solutions and bench reagents, dissecting living organisms, making teaching aids for microteaching and presenting tasks to the class. The schemes of work and lesson plans of these tutors named competence-based strategies, and classroom observation confirmed that a few tutors used the demonstration, TIPS and group discussion their plans specified.

Where the skills were present, then, student teachers learned by doing. That matters for science in particular, because working through hypothesis, experimentation, observation and conclusion is how student teachers become critical thinkers and problem solvers. It also gives tutors something to reflect on: by weighing which strategies worked, and how student teachers responded to them, they can judge what to change in the next lesson.

Adequate pedagogical training is, on the evidence of Muchira et al. [25], a condition of any competency-based curriculum (CBC) succeeding. Teachers who are well prepared pedagogically align their instruction more closely with the CBC's emphasis on critical thinking, problem-solving and practical application, and so help learners acquire twenty-first-century competencies rather than rehearse rote memorisation. Momanyi and Rop [23] shows the converse in Kenyan early-grade classrooms: teachers persisted with teacher-centred approaches instead of the discovery methods through which learners can draw on their own interests and talents, and most struggled to prepare schemes of work and lesson plans consistent with the CBC, including the specification of learner and teacher activities that would deliver the intended competencies.

The skills at issue are those of subject matter, curriculum, learners and pedagogy. Opiyo [31], working with student teachers and school practice advisors in Kenyan schools of education, found that command of these domains is what gives student teachers confidence in their teaching methods, and that mentorship is where it is built or lost. Murithi and Yoo [27] adds the material qualification: among 351 Kenyan primary teachers, inadequate ICT facilities blocked the technology integration a competency-based curriculum assumes, so skills alone did not translate into practice.

Tutors who hold these skills can therefore implement science lessons as intended. They employ a range of competence-based strategies and prompt student teachers to interact, sharing knowledge and experience, and it is in those exchanges that student teachers develop the competencies they will need as science teachers.

Most tutors, however, lacked those skills, as table 1 records. One described a lesson built entirely around the tutor's own exposition:

> In my class, I usually do the following: when I enter the classroom, I present new concepts by explaining theories, definitions and principles in detail. Then I perform a simple experiment in front of the class and allow my student teachers to observe. After that, I set a few problems or activities related to the lesson content and guide the student teachers through solving them while walking around and marking their exercise books. Finally, I ask oral questions related to the lesson and provide answers and explanations, especially for incorrect responses, to ensure comprehension. (Interview with science tutor, College A, 2024)

A second academic dean put it in terms of who owns the lesson:

> Through classroom observations, I have noticed that most science tutors take ownership of their lessons by introducing the lesson themselves, explaining scientific concepts, asking student teachers questions, clarifying contradictory matters, setting quizzes and exercises, marking them and drawing conclusions. (Interview with academic dean, College C, 2024)

Internal quality assurers across the four colleges had reached the same conclusion from their own observations: most science tutors own the teaching and learning process and leave student teachers little room to interact. Student teachers in the College A and C focus groups confirmed it from the receiving end, describing tutors who explained concepts and principles, demonstrated simple practical work and solved the problems they had set.

The documents told a different story from the lessons. Schemes of work and lesson plans in all four colleges named demonstration, experimentation, question and answer, and group discussion; classroom observation found those methods absent when the lessons were actually taught.

The gap between plan and practice follows from the missing skills. Tutors who have not mastered competence-based strategies lack the confidence to attempt them, and without that attempt student teachers have no occasion to interact or engage, which is where meaningful learning would otherwise arise. Kunanbayeva [15] reports the same dependency: where teachers have not mastered competence-based methods, they do not adopt them. Mirza, Teymoori and Mirza [21], surveying Algerian teachers about their readiness for competence-based reform, identifies the mechanism as a lack of practical training, which leaves teachers without confidence in the approach.

The consequence for a teacher college is compounding. Tutors fall back on lecturing, which does not engage student teachers actively; the student teachers, in turn, are not learning to teach science any other way than the way they are being taught.

3.2. The practice of using competence-based pedagogical strategies in science lessons

Skill is necessary but not sufficient. Turning to what tutors actually did, the data from principals, academic deans, internal quality assurers, tutors and student teachers show a few tutors using experimentation, portfolios, projects, TIPS, group discussion and demonstration, while the majority lectured (table 1). Five conditions separated the two groups: classroom infrastructure, the number of student teachers in a class, teaching workload, the supply of teaching and learning materials, and tutors' own readiness to change their practice. Each is taken in turn.

3.2.1. Classroom infrastructure

Where classrooms were well equipped – movable chairs and tables, a power supply, a blackboard, ventilated windows and other resources at hand – competence-based strategies were feasible, and a minority of tutors used them. Most classrooms were not so equipped. A chemistry tutor explained what movable furniture makes possible:

> I find it easy to use strategies such as demonstrations, group discussions, experiments and TIPS when teaching chemistry because my classroom has movable chair which make easier for my student teachers to move. For instance, during my teaching, I instruct my student teachers to seat in groups then I provide a task to work on it then I invite them to come in front of the class to demonstrate their work they prepared. (Interview with science tutor, College C, 2024)

A physics tutor reported a similar set-up:

> My classroom set up is favourable for me to use TIPS and demonstrating simple experiments to my physics student teachers, chairs are not fixed, the classroom has electric power and is large enough to accommodate my student teachers. For example during my teaching I do introduce concepts of subject matter to my students then I instruct them to think and share the concepts in pairs then with the whole class. Not only that but also sometimes I do give them simple task on practicals and ask them to perform in groups then I ask them to share their findings with all student teachers in front of the class. (Interview with science tutor, College D, 2024)

Student teachers in College C recognised such lessons from their own side of them, block teaching practice (BTP) preparation included:

> During science lessons, some of our college's science tutors engage us in teaching and learning activities in groups such as preparing standard solutions, storing chemicals and apparatus, and writing practical reports. They also give us activities on how to prepare and improvise teaching and learning materials and ask us to present in front of class, as well as performing single lessons and micro teaching during BTP preparation and present the lessons in front of classes. (Focus group discussion, College C, 2024)

Monitoring visits by academic deans and internal quality assurers turned up the same practices: practical work, the preparation of teaching aids and project work. Lesson plans and classroom observation put the number of tutors involved at a few in each college, using experimentation, portfolios, projects, TIPS, group discussion and demonstration as their plans specified. Observation also recorded which rooms made this possible: those with movable chairs and tables, a power supply and a blackboard.

What the well-equipped classrooms and laboratories had in common was furniture that could be rearranged, power, water and writing surfaces – the physical preconditions of any strategy that asks student teachers to work in groups or at a bench. Kunanbayeva [15] found the same relation between provision and practice: classrooms, chairs, blackboards, power systems, computers and projectors, where available, encourage the use of competence-based strategies. Waweru [45] reports likewise from Kenyan primary schools, where well-planned, well-resourced classrooms shaped teachers' choice of competence-based methods.

Read through Vygotsky's account of mediated activity [44], the improvised apparatus recorded in these observations served as the cultural tools through which student teachers reached practical understanding: plastic beakers cut from water bottles and funnels folded from stiff paper in Colleges A and C, models of human body systems built from local materials in Colleges B and D, made for experiments and exhibitions. Because tutors set up and supervised this work while student teachers improvised tools and prepared teaching aids for microteaching, single lessons and BTP preparation – as observed in Colleges B and D – it also operated within the zone of proximal development, with peer interaction and tutor scaffolding carrying tasks that student teachers could not yet complete alone.

Rooms of that kind were the exception. A biology tutor working in a more typical one was explicit about what followed:

> I usually teach my biology student teachers using lecturing method, I found it easier and comfortable because my class have fixed chairs and tables. In addition, I used the method because other methods will force me to make student teacher in groups or interact in any ways of which this will not be possible due to inflexibilities of chairs and tables. (Interview with science tutor, College A, 2024)

Student teachers reported what those lessons consisted of:

> During our learning, some of our science tutors used lecturing method to teach us, they just stand in front introducing lessons, explaining science concepts and sometimes asking oral questions and lastly they just giving as quizzes and mark the tasks. (Focus group discussion, College B, 2024)

Quality assurers and academic deans alike reported the predominance of lecturing, and classroom observation traced it to the rooms themselves: most classes were held in spaces with fixed chairs and tables.

Fixed furniture was the norm. Where benches could not be regrouped, tutors had no practical way to run group discussion, TIPS or bench work, and student teachers correspondingly had few opportunities to explore scientific concepts by testing their ideas against one another's. In Kenyan schools, Mugambi and Chepkonga [26] attribute the same obstruction to classrooms with insufficient resources and an unsuitable layout. Mkimbili and Kayima [22], working in Tanzania's teacher training colleges, report educators struggling to use learner-centred strategies where the room lacks what those strategies require, and Kihwele and Mwamakula [14] traces the same limit on pre-service teacher education in Tanzania.

Social constructivist theory presumes an environment in which social interaction can take place at all. In classrooms with fixed chairs and tables, observation found tutors occupying the central role and student teachers given no opening to interact or share what they knew – the conditions for meaningful learning were simply not there to be used.

3.2.2. Class size

Class size divided the sample sharply. Tutors teaching small groups – physics tutors, for the most part – used demonstration, TIPS, group discussion, projects and experimentation; those facing large biology and chemistry classes lectured. A physics tutor put the matter simply:

> I have a small number of student teachers in my physics class. This allows me to use various teaching methods such as demonstrations, TIPS, group discussions, projects and experimentation, this makes the class manageable. Their number enables me to follow all the teaching procedures and the teaching and learning materials accommodate them. (Interview with science tutor, College A, 2024)

Focus groups in all four colleges described the same pattern, singling out physics tutors whose classes were small, and lesson plans recorded the modest enrolments; classroom observation confirmed that these were the tutors using group discussion, projects, experimentation, demonstration and TIPS. Small classes let student teachers learn by doing, grasp science concepts and develop problem-solving skills, which is why Mwakyobwe and Shawa [28] finds class size to be among the conditions encouraging interactive methods in Tanzanian teacher colleges.

For the majority, the numbers pushed the other way. One tutor set out the arithmetic:

> To be honest, I always use the lecturing method in my biology lessons. There are several reasons for this. First of all, I have a class of 86 student teachers studying biology. Another reason is the inadequate resources in my classroom. Materials like Manila sheets and models are inadequate compared to the number of student teachers I have. Also, I only have six biology textbooks and all of these challenges hinder my teaching. (Interview with science tutor, College A, 2024)

An internal quality assurer had put the question to tutors directly:

> My work is to monitor teaching and learning process at the level of college, through classroom observations I have noticed that most science tutors used lecturing and rarely question-and-answer method. When I asked them why not employing strategies which are competence-based, they claimed to have large number of student teachers in their classes and that they get challenge in managing the teaching and learning processes. (Interview with internal quality assurer, College B, 2024)

Student teachers themselves identified class size as an obstacle to learning science, adding that they received little individual assistance from tutors during lessons. Academic deans reported the prevalence of lecturing, and observation and lesson plans together confirmed the association: the tutors with the largest classes were the tutors who lectured.

Large classes thus close off the activities through which problem-solving, critical thinking and collaborative skills are acquired. Mirza, Teymoori and Mirza [21] identifies overcrowding as one of the six obstacles teachers themselves name when asked about competence-based reform.

Scaffolding is the casualty here. It requires a More Knowledgeable Other to be available to the learner at the point of difficulty, yet observation found tutors lecturing to classes too large for interaction of any kind – between student teachers, or between student teachers and tutor. Whatever lay within these student teachers' zone of proximal development stayed there, for want of anyone able to reach them individually.

3.2.3. Teaching workload

Workload worked in much the same direction as class size. Tutors carrying the load the curriculum envisages used competence-based strategies; those carrying a heavy one did not. The difference is chiefly a matter of unallocated time, as a physics tutor made clear:

> As a physics tutor, I have a light teaching workload of four periods per week. On the days when I don't have periods, I plan my lessons and suggest teaching and learning methods that will help my student teachers grasp physics concepts such as group discussion, project, TIPS and experimentation. (Interview with science tutor, College D, 2024)

A chemistry tutor described the opposite position, and traced it to the number of subject combinations, or options,[1] in which chemistry is taught:

> To be honest, I have a heavy teaching workload because there are only a few of us who teach chemistry at our college, and a large number of student teachers taking chemistry subject as one of their subject option. Taking me as an example, I have five options in which chemistry is taught such as CB, PC, CM, GC, PEC and each option has more than 45 students. I treat each option as a single class, which makes my timetable consist of twenty periods per week. This means I have lessons every day of the week, leaving me no time for planning and preparing for the next lesson. I also have to struggle to cover the syllabus, which forces me to use a lecturing method in my teaching. (Interview with science tutor, College B, 2024)

An academic dean connected the two subjects' staffing to what happened in their lessons:

> Through my classroom observations, I found that chemistry and biology tutors failed to use teaching methods such as demonstrations, experiments, projects, TIPS and group discussions; instead, they used lecturing method. I also found that the ratio of tutors to science student teachers taking subjects like chemistry and biology is imbalanced. Thus, there are few chemistry and biology tutors in diploma teacher colleges compared to the number of student teachers taking chemistry and biology subjects. (Interview with academic dean, College D, 2024)

Internal quality assurers in all four colleges reported the same imbalance in the tutor–student teacher ratio for chemistry and biology: most science tutors carry many options, whereas physics tutors have smaller classes and fewer options, such as PM, PC and PB. Student teachers noticed the asymmetry too, and the reviewed lesson plans bore it out – chemistry and biology tutors teaching more options and larger classes than their physics colleagues. Classroom observation added the corollary: those tutors also had the most periods.

The pattern is consistent. Tutors with few student teachers and few periods used competence-based strategies; tutors with many of both lectured. Under a heavy load there is no time in the week to prepare interactive lessons, so student teachers are given content to memorise and settle into passivity, which is precisely how scientific skills fail to be acquired. Mirza, Teymoori and Mirza [21] finds overcrowding and a heavy curriculum load among the obstacles teachers report to competence-based practice; the present study locates the same pressure in tutors' timetables.

3.2.4. Teaching and learning materials

The supply of materials operated as the fourth condition. Tutors whose classrooms held what a science lesson requires used competence-based strategies; those without them lectured. A biology tutor inventoried a well-stocked room:

> My classroom has a fixed projector and also blackboard, it also has adequate tables and chairs which are not fixed, wall charts, models and 56 biology text books. The class also has electricity power source. All these makes me comfortable to use any of the

[1] Subject combinations offered in diploma teacher colleges are designated by letter codes standing for the subjects they comprise – for example C for chemistry, B for biology, P for physics, M for mathematics and G for geography – so that one tutor may teach the same subject to several such options.

> teaching and learning methods to teach my student teachers. For instance, in my lessons sometimes I used group discussions, TIPS, demonstrations or experimentation to teach my student teachers as well as lecturing method for integration purposes. (Interview with science tutor, College C, 2024)

A chemistry tutor counted what was missing:

> For me I have a challenge of teaching and learning resources in my class, first of all I don't have enough chemistry text books, I have only 13 copies which are not enough for my student teachers, secondly Manila sheets, stick notes, cards, models and manuals are not enough in regard to the number of student teachers I have in my class. So, what I do is to use lecturing method and sometimes make demonstrations of simple experiments in front of class so that all student teachers can just observe. (Interview with science tutor, College D, 2024)

Fifty-six textbooks in one room and thirteen in another indicate how uneven provision was. Focus groups confirmed that materials existed but that their adequacy depended on the college and on how many student teachers were enrolled; academic deans and internal quality assurers said the same, and added that monitoring found most tutors lecturing. The lesson plans made the shortfall visible in another way: some named resources that classroom observation then failed to find in the room.

Where materials were present, tutors used competence-based strategies and student teachers worked with the materials directly. Where they were absent – the more common case – tutors lectured, or demonstrated at the front while the class watched, and student teachers were left with neither the materials nor each other to learn from. Scarcity of resources is one of the six obstacles Mirza, Teymoori and Mirza [21] elicited from teachers directly. The shortfall at issue here is not the room's fittings but its consumables and texts – what a science lesson uses up or hands round – and it is this that Mugambi and Chepkonga [26] and Kihwele and Mwamakula [14] identify as limiting practical teaching in Kenyan schools and in Tanzanian teacher education.

This is the point at which the theoretical account bears most directly on the findings. Constructing knowledge requires interaction with others, with the teacher and with the materials to hand, and competence-based strategies – group discussion, demonstration, experimentation, think-ink-pair-share – are the means by which that interaction is organised. Observation found most tutors in the four colleges using none of them, so neither kind of interaction took place.

3.2.5. Tutors' readiness to change their practice

The four conditions considered so far lie outside the tutor. The fifth does not. Tutors who used competence-based strategies were willing to change their established ways of teaching science subjects; those who did not use them were reluctant to, as table 1 records.

The evidence for it is the mismatch already noted in §3.1: tutors' schemes of work and lesson plans named competence-based methods that the observed lessons did not use. Whatever else constrained those tutors, they had committed the strategies to paper and then taught otherwise.

The reluctance is not simply obstinacy. Tutors who have never acquired confidence in a method have reason to avoid it, and a full timetable leaves little room to try. Yet the distance between planned and enacted pedagogy indicates that the external constraints do not account for the whole of the shortfall, and it identifies where in-house training and academic supervision might do most: not in telling tutors which strategies exist, since their plans already name them, but in supporting them through the change in practice those plans imply.

3.3. Administrative support for the use of competence-based pedagogical strategies in science lessons

Behind the classroom conditions stands the college administration, which decides what is bought, maintained and organised. Here too the pattern was uneven (table 1): a few administrations supported the use of competence-based strategies, while most were unable to. A tutor in one of the supported colleges described what that support amounted to:

> I do receive support from my college principal and academic dean especially when I requested some materials for teaching purposes. For instance, whenever I need teaching and learning materials for lesson preparations they give me and when I report the materials which are not in good condition they provide maintenance. Not only that but also our college principal do provide with us in-house training if he found that tutors are not doing well in some areas. (Interview with science tutor, College A, 2024)

A principal described that provision from the other side of the desk:

> I do support the use of learner-centred strategies in my college by providing teaching and learning materials whenever needed and by allocating science student teachers to large classes such as halls and theatres to allow science tutors use the relevant teaching and learning strategies which are competence-based when teaching. I also do coordinate in-house training to science tutors though not adequate. (Interview with college principal, College C, 2024)

Academic deans described the same provision, though limited in extent: science materials such as chemicals, apparatus, specimens, projectors and computers supplied on request; items in poor condition repaired; and some in-house training arranged within the college. Classroom observation found such resources and specimens present in some classrooms and laboratories.

The logic of this support is straightforward. Materials in working order, and training available when tutors need it, are what allow interactive strategies to be attempted at all; student teachers then work with the materials and with one another, and acquire both pedagogical competence and command of the content they will teach.

For most colleges, however, support fell well short, and principals attributed the shortfall to the size and timing of their budgets. One tutor recounted what happened on asking:

> Taking me as an example, I received little support from college administrators when I requested teaching and learning materials such as apparatus and chemicals, Manila, mark pens, flip charts. Sometimes I received no response, and sometimes the response was delayed. I also reported teaching and learning resources that needed maintenance and received no response. This hindered my teaching. (Interview with science tutor, College A, 2024)

Principals in all four colleges said as much: purchasing materials, maintaining resources and providing in-house training all founder on inadequate funds and budgets that arrive late. Academic deans catalogued the consequences – insufficient chemicals, apparatus, specimens, projectors and computers, poorly maintained equipment and too little in-house training – and classroom observation confirmed both the shortages and the disrepair.

The line of causation runs from the budget to the classroom. Administrations that cannot buy materials, repair what breaks or train their tutors cannot underwrite competence-based teaching, and most tutors are accordingly left unable to sustain experimentation, demonstration, portfolio work or projects. For some, inadequate skills and inadequate materials compound one another, and neither can be remedied at the tutor's own initiative.

Comparable findings are reported elsewhere. Rahman, Tambi and Anny [34] shows that without administrative backing for continuing professional development, interactive methods do not take hold in classrooms, and Mkimbili and Kayima [22] observe learner-centred pedagogy failing in Tanzanian teacher training colleges for want of institutional support. Mgaiwa [17], reflecting on teacher education practice in Tanzania, identifies inadequate administrative support in diploma teacher colleges specifically, while Kunanbayeva [15] treats administrative support as one of the conditions on which a competence-based approach depends at institutional level.

Table 2 sets these findings alongside evidence from Tanzania, the wider region and other systems.

Table 2: Comparative findings analysis on competence-based pedagogical strategies implementation in lessons (source: reviewed literature [14, 15, 17, 21–28, 31, 32, 34, 38, 45, 47]).

Tanzania	**Kenya**	**Uganda**	**Rwanda**	**Sub-Saharan Africa**	**High-income contexts**
Teaching and learning resources constraints					
In Tanzania, studies report insufficient teaching and learning resources, few instructional materials and time constraints on instruction, all of which limit learner-centred practice	In Kenya, legal and policy frameworks for resourcing exist but are weakly implemented, leaving shortages of textbooks, digital infrastructure and science materials that funding and oversight gaps sustain	In Uganda, teacher shortages and shortfalls in qualification impede quality education and training, with limited professional development support	Rwanda's experience with curriculum reform shows teachers struggling to translate policy into practice, partly because of inadequate resources despite formal support efforts	Across sub-Saharan Africa, scarcity of resources – infrastructure, materials and qualified personnel – persists, limiting quality instruction and teacher training	In higher-income contexts, studies find variation in teacher professional development systems: resources are generally greater, but effectiveness depends on design and follow-up, so resource adequacy alone does not guarantee quality outcomes
Policy enforcement					
Tanzania shows challenges in aligning educational reforms with classroom practice: policies for learner-centred pedagogy often do not translate into practice	Kenya's policies are comprehensive but hindered by weak enforcement, capacity limitations and misalignment with actual school needs	Uganda's policy ambitions face similar obstacles in implementation, owing to financial and human resource constraints	Rwanda's structured implementation of the competence-based curriculum includes training strategies, but still faces practical challenges in translating curriculum intentions into classroom action	Across sub-Saharan Africa, misaligned priorities hinder policy enforcement, leaving persistent gaps in teacher training and educational quality	International comparisons show that even where policies are well formulated, enforcement varies, and professional development programmes may not deliver effective practice without robust accountability and support structures

Continued on next page

Table 2 – continued from previous page

Tanzania	**Kenya**	**Uganda**	**Rwanda**	**Sub-Saharan Africa**	**High-income contexts**
			Classroom and laboratory settings		
Classroom interactions in Tanzania often follow traditional transmission models, with limited practical and laboratory work for want of resources and skills	Studies from Kenya emphasise infrastructural and resource deficits in classrooms, affecting inclusive and practical instruction	Uganda's educational challenges also encompass insufficient infrastructure, which constrains learning environments and limits practical experience	Rwanda's teacher training context also faces constraints in fully supporting competence-based approaches, owing to limits in classroom and laboratory facilities	In sub-Saharan Africa more broadly, inadequate facilities and limited access to laboratory and modern tools are common barriers to quality pedagogy	In developed contexts, while physical infrastructure is stronger, studies highlight that integration of facilities with pedagogical innovation and teacher professional development remains essential for effective learning environments
			Administrative support		
Administrative support in Tanzania often falls short in continuous professional development, resources and the structural backing that pedagogical reform requires	In Kenya, weak oversight and coordination limit administrative capacity to enforce resourcing and support at institutional level	Uganda shows similar human resource and administrative challenges, tied to policy implementation and to the support mechanisms available to teachers	Rwanda's systemic support includes structured reform mechanisms, yet administrative effectiveness varies across institutions	Across sub-Saharan Africa, limitations in school and teacher education administration – in professional development provision, mentorship and support structures – constrain the translation of policy into practice	International literature links administrative support that combines evidence-based practices, mentoring and sustained professional development to better teaching outcomes, underlining the systemic role of leadership

4. Conclusions and recommendations

Science tutors' skills in using competence-based pedagogical strategies are limited in diploma teacher colleges. A few tutors used demonstration, experimentation, group discussion and TIPS; the majority lacked the skills to do so and lectured instead. Skill levels varied from tutor to tutor within a college and from college to college. Where the skills were missing, student teachers had no occasion to work with one another or with the materials the college holds, and meaningful learning did not follow.

The use of the strategies is correspondingly limited. Five conditions separated the minority who used them from the majority who did not: classroom infrastructure, class size, teaching workload, the supply of teaching and learning materials, and tutors' own readiness to change their practice. Inadequate skills and limited administrative support bore on all five.

That support was itself in short supply. Principals could not reliably purchase materials, repair what had broken or mount in-house training, given inadequate budgets and government funds that arrived late. The classroom consequence is that student teachers have few opportunities to learn science practically.

Taken together, these findings support a single conclusion: despite government efforts to improve teaching and learning environments, and despite the willingness of some tutors, competence-based pedagogical strategies remain marginal in science lessons in diploma teacher colleges, and student teachers are consequently at risk of leaving preparation without either mastery of science subjects or the pedagogy to teach them.

Five recommendations follow. The government, through the teacher colleges, should strengthen the implementation of competence-based pedagogical strategies in science lessons. Science tutors should employ learner-centred, practically oriented approaches consistently, promoting active participation, problem-solving and hands-on laboratory work. College administrations should provide continuous professional development that equips tutors with the skills for competence-based instruction and for integrating educational technology. They should also secure adequate teaching and learning resources, functional laboratories and institutional conditions that make competence-based pedagogy practicable. Finally, academic supervision and quality assurance mechanisms should be strengthened, so that curriculum objectives, teaching practices and competence-based assessment are brought into alignment.

5. Limitations of the study

Several limitations should be acknowledged. First, the study is qualitative and covers four public diploma teacher colleges. This allowed competence-based pedagogical strategies to be explored in depth, but the findings cannot be generalised to all teacher education institutions in Tanzania.

Second, the interviews and focus group discussions yielded self-reported data from science tutors, student teachers, college principals, academic deans and internal quality assurers, which may be shaped by participants' perceptions, recall bias or a wish to give socially desirable answers. Triangulation with classroom observation and documentary review was used to moderate this.

Third, classroom observation took place within a limited time frame and may not have captured every variation in teaching practice across topics or academic periods. Some planned observations could not be conducted for logistical reasons, which further narrows the observational record.

Finally, the study focused on the college environment and pedagogical practices within diploma teacher colleges, without tracking graduates into actual school teaching contexts. As a result, the long-term impact of competence-based pedagogical strategies on classroom performance in secondary schools was beyond the scope of this study.

Despite the limitations, the use of multiple data sources and methods enhanced the credibility and trustworthiness of the findings.

Acknowledgments

Angelina Kanyabwoya: This study draws in part on data collected in 2024 for a PhD study in the Iringa, Dodoma, Tabora and Tanga regions of Tanzania. I thank my supervisors at the University of Dodoma and the Government of Tanzania for enabling me to pursue doctoral study. I also thank the respondents who voluntarily gave their time to provide the data on which this work depends.

Declaration on Generative AI

During the preparation of this work, the authors used DeepL Translate and ChatGPT in order to check grammar and spelling. Claude Opus 5 was subsequently used for language editing and consistency checking of the manuscript prior to publication. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of this publication.

References

[1] Adam, I., 2017. Vygotsky's Social Constructivists Theory of Learning. Available from: https://web.archive.org/web/20220223075340/https://mmls.mmu.edu.my/wordpress/1161403286/wp-content/uploads/sites/35482/2017/09/Vygotsky%E2%80%99s-Social-Constructivists-Theory-of-Learning.pdf.

[2] Akpan, V.I., Igwe, U.A., Mpamah, I.B.I. and Okoro, C.O., 2020. Social constructivism: Implications on teaching and learning. *British Journal of Education*, 8(8), pp.49–56. Available from: https://www.eajournals.org/wp-content/uploads/Social-Constructivism.pdf.

[3] Ally, M.S. and Libent-Mabagala, D., 2022. Examining the effectiveness of mentoring process in developing teaching competencies of secondary school novice teachers: A case of Mbeya region in Tanzania. *European Journal of Education and Pedagogy*, 3(3), pp.156–159. Available from: https://doi.org/10.24018/ejedu.2022.3.3.355.

[4] Assey, E.S. and Babyegeya, E., 2022. The challenges facing effective teaching, learning and assessment in community-based secondary schools in Tabora region. *American Journal of Education and Practice*, 6(2), pp.1–17. Available from: https://doi.org/10.47672/ajep.1084.

[5] Biggam, J., 2021. *Succeeding with your Master's Dissertation: A step-by-step handbook*. 5th ed. New York: Open University Press/McGraw-Hill Education.

[6] Chenagosi, M.J., 2020. Teachers Preparedness on Implementation of Competence Based Curriculum in Lower Public Primary Schools in Kilifi and Nandi Counties, Kenya. *International Journal of Scientific Research and Management*, 8(4), pp.1292–1303. Available from: https://doi.org/10.18535/ijsrm/v8i04.el04.

[7] Cheruiyot, J.B., 2018. Teacher Factors that Influence the Choice of Teaching Methods Used by Early Childhood Development Education Teachers in Keiyo South District. *Africa International Journal of Multidisciplinary Research*, 2(1), pp.7–17. Available from: https://philpapers.org/archive/CHETFT-2.pdf.

[8] Cohen, L., Manion, L. and Morrison, K., 2017. *Research Methods in Education*. 8th ed. London: Routledge. https://tinyurl.com/3ax4b2v4, Available from: https://doi.org/10.4324/9781315456539.

[9] Creswell, J.W., 2012. *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*. 4th ed. Boston, MA: Pearson Education. Available from: https://eclass.uoa.gr/modules/document/file.php/ECD433/%CE%91%CE%BD%CE%AC%CE%BB%CF%85%CF%83%CE%B7%20%CE%B4%CE%B5%CE%B4%CE%BF%CE%BC%CE%AD%CE%BD%CF%89%CE%BD%20%CE%BC%CE%B5%20%CF%84%CE%BF%20SPSS/%CE%92%CE%B9%CE%B2%CE%BB%CE%B9%CE%BF%CE%B3%CF%81%CE%B1%CF%86%CE%AF%CE%B1/John%20W.%20Creswell%20-%20Educational%20Research_%20Planning%2C%20Conducting%2C%20and%20Evaluating%20Quantitative%20and%20Qualitative%20Research%2C%204th%20Edition%20%282011%2C%20Addison%20Wesley%29.pdf.

[10] Creswell, J.W. and Poth, C.N., 2018. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. 4th ed. Thousand Oaks, CA: SAGE Publications.

[11] Denzin, N.K. and Lincolin, Y.S., 2005. *The SAGE Handbook of Qualitative Research*. 3rd ed. Thousand Oaks, CA: SAGE Publications. Available from: https://doi.org/10.1108/17465640610666642.

[12] Kanyabwoya, A., 2024. Field data.

[13] Keiler, L.S., 2018. Teachers' roles and identities in student-centered classrooms. *International Journal of STEM Education*, 5(1), 34. Available from: https://doi.org/10.1186/s40594-018-0131-6.

[14] Kihwele, J.E. and Mwamakula, E.N., 2023. Factors Influencing the Implementation of the Lesson Study Approach in Pre-service Teacher Education in Tanzania. *East African Journal of Education and Social Sciences*, 4(1), pp.1–14. https://eajess.ac.tz/index.php/eajess/sw/article/view/292, Available from: https://doi.org/10.46606/eajess2023v04i01.0251.

[15] Kunanbayeva, S.S., 2016. Educational Paradigm: Implementation of the Competence-Based

Approach to the Higher School System. *International Journal of Environmental and Science Education*, 11(18), pp.12699–12710. Available from: http://www.ijese.net/makale/1740.html.
[16] Lincoln, Y.S. and Guba, E.G., 1985. *Naturalistic Inquiry*. SAGE Publications.
[17] Mgaiwa, S.J., 2018. Emerging Fundamental Issues of Teacher Education in Tanzania: A Reflection of Practices. *Educational Process: International Journal*, 7(4), pp.246–264. Available from: https://doi.org/10.22521/edupij.2018.74.3.
[18] Miles, M.B. and Huberman, A.M., 1994. *Qualitative Data Analysis: An Methods Sourcebook*. 2nd ed. Thousand Oaks, CA: SAGE Publications.
[19] Miles, M.B., Huberman, A.M. and Saldaña, J., 2014. *Qualitative Data Analysis: A Methods Sourcebook*. 3rd ed. Thousand Oaks, CA: SAGE Publications. Available from: https://www.metodos.work/wp-content/uploads/2024/01/Qualitative-Data-Analysis.pdf.
[20] Ministry of Education and Vocational Training, 2013. *Curriculum for Diploma in Teacher Education Programmes in Tanzania*. Dar es Salaam: Tanzania Institute of Education. Available from: https://rtei.okfn.org/documents/Curriculum_for_Diploma_in_Teaching_Programme_in_Tanzania_2013.pdf.
[21] Mirza, C., Teymoori, H. and Mirza, H., 2023. Teachers' Perspectives on the Competency-Based Approach: Assessing Readiness for a New Educational Reform. *International Journal of Learning, Teaching and Educational Research*, 22(9), pp.241–260. Available from: https://doi.org/10.26803/ijlter.22.9.13.
[22] Mkimbili, S. and Kayima, F., 2022. Preparing secondary school science teachers for learner-centered teaching in Tanzania's Teacher Training Colleges: Educators' perceived challenges and perspectives. *African Journal of Teacher Education*, 11(2), pp.80–100. Available from: https://doi.org/10.21083/ajote.v11i2.7011.
[23] Momanyi, J.M. and Rop, P.K., 2019. Teacher Preparedness for the Implementation of Competency Based Curriculum in Kenya: A Survey of Early Grade Primary School Teachers' in Bomet East Sub-County. *The Cradle of Knowledge: African Journal of Educational and Social Science Research*, 7(1), pp.10–15. Available from: https://tinyurl.com/46kaa5f7.
[24] Mosha, M.A., 2018. Students' Attitudes and Motivation towards Learning Literature in English in Zanzibar Secondary Schools. *International Journal of Educational Studies*, 1(3), pp.206–220. Available from: https://doi.org/10.53935/2641-533x.v1i3.89.
[25] Muchira, J.M., Morris, R.J., Wawire, B.A. and Oh, C., 2023. Implementing Competency Based Curriculum (CBC) in Kenya: Challenges and Lessons from South Korea and USA. *Journal of Education and Learning*, 12(3), pp.62–77. Available from: https://doi.org/10.5539/jel.v12n3p62.
[26] Mugambi, M.M. and Chepkonga, S., 2024. Teachers pedagogical content knowledge and implementation of competency based curriculum in schools in Kenya. *Journal of Research in Humanities and Social Science*, 12(11), pp.198–207. Available from: https://www.questjournals.org/jrhss/papers/vol12-issue11/1211198207.pdf.
[27] Murithi, J. and Yoo, J.E., 2021. Teachers' use of ICT in implementing the competency-based curriculum in Kenyan public primary schools. *Innovation and Education*, 3(1), pp.1–11. Available from: https://doi.org/10.1186/s42862-021-00012-0.
[28] Mwakyobwe, V.C. and Shawa, M.C.K., 2023. Pedagogical and Assessment Practices towards Competency-based Education in Tanzania Teacher Colleges. *Asian Journal of Education and Social Studies*, 40, pp.1–12. Available from: https://doi.org/10.9734/ajess/2023/v40i2867.
[29] Nassor, H.A., Ephrem, A. and Mbaula, W., 2025. Teachers' pedagogical competencies on the utilization of instructional materials for teaching history subject in public secondary schools in Zanzibar: A case of Pemba North Region. *Educational Dimension*. Available from: https://doi.org/10.55056/ed.800.
[30] Ngao, A.I. and Xiaohong, T., 2020. Teacher Education in Tanzania: Pre-Service Teachers Preparation for the 21st Century. *Journal of Education and Practice*, 11(11), pp.61–69. Available from: https://doi.org/10.7176/JEP/11-11-09.
[31] Opiyo, R.A., 2022. Teacher Education Students' Pedagogical Content Knowledge: Retooling the

Mentorship Process Within Schools of Education in Kenya. *African Journal of Teacher Education*, 11(1), pp.27–55. Available from: https://doi.org/10.21083/ajote.v11i1.6771.

[32] Popova, A., Evans, D.K., Breeding, M.E. and Arancibia, V., 2022. Teacher Professional Development around the World: The Gap between Evidence and Practice. *The World Bank Research Observer*, 37(1), 02, pp.107–136. Available from: https://doi.org/10.1093/wbro/lkab006.

[33] Punch, K.F. and Oancea, A., 2014. *Introduction to Research Methods in Education*. 2nd ed. London: SAGE Publications Ltd.

[34] Rahman, S., Tambi, F. and Anny, N.Z., 2020. The importance of enhancing pedagogical skills through continuing professional development. *International Journal of Research in Business and Social Science*, 9(4), pp.121–129. Available from: https://doi.org/10.20525/ijrbs.v9i4.757.

[35] Saware, G.M., 2021. *Teachers' conceptions of competence-based curriculum and its implementation challenges in selected secondary schools in Ilala municipality, Dar es Salaam - Tanzania*. Master's thesis. Sokoine University of Agriculture, Morogoro, Tanzania. Available from: https://www.suaire.sua.ac.tz/items/8cd35e06-7a13-41c3-ac0b-4e9d1f768b97.

[36] Swai, C.Z., Nkaizirwa, J.P., Hugo, A.K., Mahenge, C.A. and Komba, P.S., 2022. Strengthening Teacher Education in Tanzania: Student-Teachers' and Tutors' Satisfaction with College Facilities and Environment. *Cogent Education*, 9(1), p.2070053. Available from: https://doi.org/10.1080/2331186X.2022.2070053.

[37] Tacconi, G., Tūtlys, V., Perini, M. and Gedvilienė, G., 2021. Development of pedagogical competencies of the vocational teachers in Italy and Lithuania: Implications of competence-based VET curriculum reforms. *European Journal of Training and Development*, 45(6/7), pp.526–546. Available from: https://doi.org/10.1108/EJTD-03-2020-0041.

[38] Temba, I. and Ouko, S.A., 2025. Assessment of the adequacy of legal and policy frameworks in management of education resources in Kenya. *European Journal of Education Studies*, 12(11), pp.597–612. Available from: https://doi.org/10.46827/ejes.v12i11.6310.

[39] The United Republic of Tanzania and Ministry of Education, Science and Technology, 2019. *National Curriculum Framework for Basic Education and Teacher Education*. Dar es Salaam: Tanzania Institute of Education. Available from: https://www.scribd.com/document/815525707/1568799160-National-Curriculum-Framework-for-Basic-and-Teacher-Education.

[40] The United Republic of Tanzania. Planning Commission, 1999. *The Tanzania Development Vision 2025*. Available from: https://media.unesco.org/sites/default/files/webform/r2e002/061eb2eed52b8f11b09b25a8845436f19d5ae0ad.pdf.

[41] UNESCO, 2011. *ICT in Teacher Education: Policy, Open Educational Resources and Partnership: Proceedings of the International Conference IITE-2010*. UNESCO Institute for Information Technologies in Education. Available from: https://unesdoc.unesco.org/ark:/48223/pf0000193658.

[42] UNESCO Office Bangkok and Regional Bureau for Education in Asia and the Pacific, 2016. *Diverse approaches to developing and implementing competency-based ICT training for teachers: a case study*, vol. 1. Paris, France: United Nations Educational, Scientific and Cultural Organisation. Available from: https://unesdoc.unesco.org/ark:/48223/pf0000246003?posInSet=1&queryId=f09fd5ca-3cc0-485e-bc2f-9dfa5a0f14b5.

[43] United Republic of Tanzania and Ministry of Education, Science and Technology, 2023. *Education and Training Policy 2014*. 2023rd ed. Dodoma: Ministry of Education, Science and Technology. Available from: https://web.archive.org/web/20250109094602/https://www.moe.go.tz/sites/default/files/EDUCATION%20AND%20TRAINING%20POLICY%202014%2C%202023%20EDITION.pdf.

[44] Vygotsky, L.S., 1978. *Mind in Society: Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press. Available from: https://w.pauldowling.me/rtf/2021.1/readings/LSVygotsky_1978_MindinSocietyDevelopmentofHigherPsycholo.pdf.

[45] Waweru, J., 2018. *Influence of teacher preparedness on implementation of competency based curriculum in public primary schools in Nyandarua North sub-county, Kenya*. Master's thesis. University of Nairobi, Nairobi, Kenya. Available from: https://erepository.uonbi.ac.ke/items/

8c589a00-7ec7-45cc-8f98-5473df9769e7.

[46] Yanuarto, W.N., Wahyuni, S., Suanto, E. and Hapsari, I., 2025. Education That Matters: Investigating the Quality of Secondary Schooling in Support of Sustainable Development Goal 4. *Educational Process: International Journal*, 18. Available from: https://doi.org/10.22521/edupij.2025.18.465.

[47] Zickafoose, A., Ilesanmi, O., Diaz-Manrique, M., Adeyemi, A.E., Walumbe, B., Strong, R., Wingenbach, G., Rodriguez, M.T. and Dooley, K., 2024. Barriers and Challenges Affecting Quality Education (Sustainable Development Goal #4) in Sub-Saharan Africa by 2030. *Sustainability*, 16(7), 2657. Available from: https://doi.org/10.3390/su16072657.