



Authentic Assessment and Competence Acquisition among the Undergraduate Science Students in Higher Education Institutions in Tanzania

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Abstract

This paper intended to find out the frequency of using authentic assessment tools with regard to competencies acquisition among the undergraduate science students. The study employed mixed method research approach with explanatory sequential design. The target population for the study was 650 undergraduate science students in two Higher Education institutions in Tanzania. The sample for the study involved 231 undergraduate science students who were selected by using stratified random sampling. Data were collected by using questionnaire comprising closed ended questions and interview method. Findings of the study indicated authentic assessment tools commonly used at the higher education institutions under study were portfolios, projects, seminar presentations, fieldwork and practical work. The frequency of use varied from one tool to another; on one hand there were tools which were used once per semester or once per year namely projects, fieldwork, and portfolios. On the other hand, authentic assessment tools namely practical work and seminar presentations were found to be used once per week for the entire semester. The study concludes that the frequency of using authentic assessment tools may determine competencies acquisition among the undergraduate science students. Basing on the findings some of authentic assessment tools were frequently used though the use was of summative nature leading to inadequate competencies acquisition among learners. The study recommends that the frequency of using authentic assessment tools by instructors should base on formative basis rather than summative.

Keywords: authentic assessment tool, competence acquisition, practical work, projects, higher education institutions, portfolio

1. Introduction

There has been an increasingly criticism by employers on the competencies of graduates from Higher Education Institutions (Abelha et al., 2020; Mutalemwa et al., 2020; Quansah et al., 2019; Sarkar et al., 2020; Thambusamy et al., 2014). Employers namely the government and private sectors on one hand are dissatisfied with the competencies possessed by the graduates in relation to the world of work (Sarkar et al., 2020; Thambusamy et al., 2014). They consider them to be incompetent in handling issues related to their work. On the other hand graduates particularly the undergraduate science students are not satisfied with the higher education system in that they consider themselves unfit to the world market (Fung, 2018; Thambusamy et al., 2014; Villarroel et

al., 2018). The criticism focuses on the nature of the courses offered and the form of assessment used at higher education institutions (Saher et al., 2022; Salema, 2017; Sanga, 2017). The courses and the assessment in Higher Education Institutions (HEIs) are considered not related to the labour market in terms of the products produced and what is required (Ajjawi et al., 2020; Quansah et al., 2019). The criticism from the stakeholders mentioned lead to concerns not only on the quality of higher education but also the process involved in the learning in general. Critics are raising issues which need answers in order to tell what is wrong with higher education system leading to the graduates to be considered inadequate in terms of professional competencies.

The point of concern for addressing such criticisms focuses on the frequency of using authentic assessment tools since it helps to tell if students are ready for the professionalism (Wyatt-Smith et al., 2022). Authentic assessment is defined as assessment which demonstrates competencies that will be used in future work places and involves using critical thinking or problem solving skills (Schultz et al., 2022). It involves the following characteristics namely the outcomes should be in the form of a performance, involve realistic context, ensures transfer of knowledge, and involves collaboration.

While some studies suggest the importance of authentic assessment tools in assessing students' mastery of the professional competencies (Colthorpe et al., 2021; Mattison et al., 2020; Swaffield, 2011; Zaim et al., 2017). Other studies suggest the role of authentic assessment in enhancing 21st century employable competencies such as collaboration, communication skills, integrity and decision making (Akbari et al., 2022; Mohamed & Lebar, 2017; Munandar et al., 2020; Pham et al., 2021; Villarroel et al., 2018; Zakiah & Fajriadi, 2020). Likewise, some studies consider effects of authentic assessment in learning (Karunanayaka & Naidu, 2021; Parwati et al., 2019; Wayan Suastra & Ristiati, 2019); and perceptions of individuals towards the use of authentic assessment (Gulikers et al., 2006; Imansyah et al., 2018; Schultz et al., 2022). Studies cited so far tend to focus on the importance, roles, perceptions and effects of authentic assessment tools to students learning in HEIs. However, there is scanty literature on the studies related to the frequency of using authentic assessment tools in HEIs in relation to competencies acquisition among undergraduate science students. The commonly used authentic assessment tools in HEIs include portfolios, projects, fieldwork or teaching practice, tutorials, seminars, practical work, and exhibitions. Again, the frequency of use of each tool on weekly, semester or annual basis is still unknown. Hence this study intended to reveal the frequency of using authentic assessment tools in relation to professional competencies acquisition.

2. Research Questions

The key research question was: How authentic assessment can be used for improving competence acquisition among the undergraduate Science students in Higher Education Institutions in Tanzania?

3. Theoretical Framework

The study was guided by the Social Constructivist Learning Theory (SCLT) which focuses on the acquisition of competence by learners through construction. SCLT was introduced by Vygotsky in 1978 (Liu & Chen, 2010; Molka-Danielsen, 2009; Pritchard & Woollard, 2010). It emphasises the role of others and all forms of social interaction in the process of constructing knowledge and understanding (Pritchard & Woollard, 2010). It also stresses the key role played by the environment and the interaction between learners (Scholnik et al., 2016). Social constructivists are concerned with the acquisition of competencies by actively constructing them through interaction between instructors, students and the learning environment. According to Ashford-Rowe et al. (2014), competence is perceived in terms of construction rather than mastery of skills. This means that SCLT focuses on the acquisition of competencies through construction rather than passively receiving them from instructors. The theory has the following key arguments;

- Knowledge is socially and culturally constructed;

- Learning is considered a social process;
- Learning occurs when individuals are actively engaged in learning; and
- Environment plays a significant role towards learning.

The key aspect of the theory according to Vygotsky is the Zone of Proximal Development (ZPD). This refers to a gap between the actual developmental level as shown by the learner's unaided performance and his/her potential level as shown by performance under adult guidance or in collaboration with more knowledgeable others (Pritchard & Woollard, 2010). This theory calls for the acquisition of competencies through the active involvement of learners in the learning process with the support of the instructor as a facilitator. It is concerned with deep understanding and higher-level cognitive skills to be developed as a result of the learning process (Shepard, 2000). In assessment, SCLT is concerned with the active involvement of learners in the authentic assessment tasks leading to the construction of competencies as they accomplish the given tasks.

SCLT is important in conceptualising models of assessment which support learning (Gipps, 1994; Shepard, 2000). SCLT is regarded as a theory that focuses on alternative assessment (Huyen, 2017; Shepard, 2000) differing from the Behaviourism Learning Theory which focuses on the traditional paper-and-pencil assessment (Shepard, 2000). SCLT has supported the establishment of authentic assessment by shifting a 'testing culture to a 'learning culture (Gipps, 1994). That being the case, HEIs are encouraged to use assessments to improve students' learning (Huyen, 2017). This is so because HEIs prepare the human capital for various fields. Thus, the use of authentic assessment is likely to help the students to acquire the desired competencies.

The other implication is that course instructors in HEIs need to strive for the students to be in a position to construct knowledge (Jackson et al., 2001). HEIs have to prepare learners or graduates with knowledge and skills and be able to use them in their real-life situations beyond graduation. Knowledge is regarded as a social product which results from the learning process (Shepard, 2000); hence the learning environment in HEIs needs to enable the learners to be in a position to construct knowledge. For knowledge to be constructed by students; the SCLT calls for HEIs to use authentic assessment which stresses knowledge construction. Likewise, SCLT stresses the instructors in HELs to involve the students in authentic tasks that lead to the construction of knowledge reflecting real-life experiences (Huyen, 2017). It is important therefore that the course instructors use authentic assessment to measure the ability of individual students in constructing knowledge and skills as they interact with the environment in real-life situations as professionals in their world of work.

4. Methodology

The study employed a mixed method research approach which involved integrating both quantitative and qualitative data in a single study in order to lead to comprehensive understanding of the phenomenon under investigation (Creswell & Plano Clark, 2018). The approach was used because is concerned with checking the frequency of using authentic assessment and reasons for use in terms of the individual undergraduate science students and instructors. Explanatory sequential design was adopted since the study focused on the use of qualitative data on reasons of using authentic assessment tools in order to clarify issues on quantitative

approach on the frequency of use. This design was suitable because it begins with quantitative method followed by qualitative methods designed to explain the quantitative findings in detail (Creswell, 2012). In this study the qualitative method was used to clarify the frequency of use of the authentic assessment tools (quantitative findings).

The target population for the study was instructors and third year undergraduate science students specializing in biology and chemistry subjects from the two HEIs in Tanzania. The sample involved 231 third year undergraduate science students specializing in two teaching subjects namely chemistry and biology. Third year students are the finalists who undertake the programme for Bachelor of Science with education that lasts for three years. The sample from the undergraduate science students was selected by using stratified random sampling as the concern was to get representativeness in terms of gender. In addition, three (3) instructors and six (6) undergraduate science students who were purposeful selected were included in the study. The instructors were selected basing on the area of specialization namely chemistry, biology and education particularly curriculum and instruction. While the undergraduate science students were selected basing on the uniqueness of the responses from the questionnaire.

Questionnaire with close ended questions was used to collect data from undergraduate science students on the frequency of using authentic assessment. Questionnaire was used because it is flexible and might collect objective information on the purpose of using authentic assessment among the undergraduate science students (Johnson & Christensen, 2014; Singh, 2006). Questionnaires, however, have the tendency of yielding low rate of return if mailed or posted. It was important, therefore, to ensure that they were administered personally.

Semi-structured interview was used to collect data on the uses of authentic assessment to three (3) instructors and six (6) undergraduate science students. Interview was used in order to get detailed explanation on how authentic assessment tools were used in higher education institutions. However, interviews have some weaknesses such as time consuming, open to interviewer bias hence hard to achieve objectivity, and interviewee fatigue (Cohen et al., 2007; Denscombe, 2010). These weaknesses were addressed in this study by good planning in terms of time. Appointment was made earlier with respondents to avoid time wastage and taking so long for interview session.

5. Findings

The findings of the study revealed some of the authentic assessment tools commonly used in the higher education under study and the frequency of using such tools. The findings are presented as follows;

5.1 The frequency of instructors using authentic assessment tools

The concern was to find out the frequency of use of authentic assessment tools namely portfolios, projects, practical work and teaching practice. The findings are presented hereunder;

5.1.1 The frequency of using projects by instructors

Project as one of the authentic assessment tools was reported by students to have been used by instructors for competencies acquisition. However, the frequency of use varied per semester, or per year as shown in Figure 1.

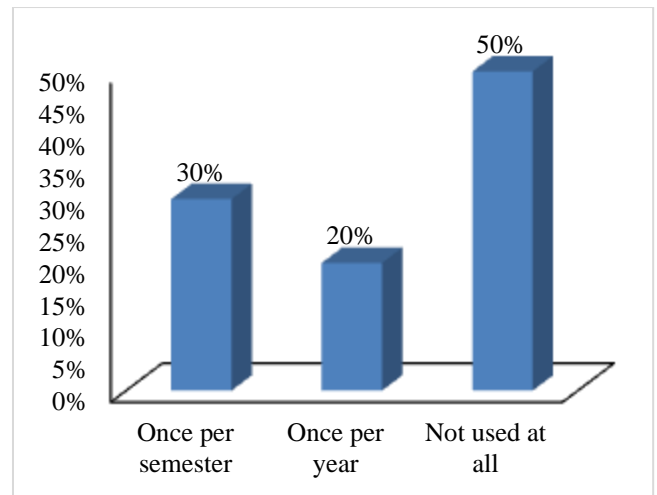


Figure 1: Frequency of using projects

The observations in Figure 1 shows that 30 percent indicated 30 percent used once per semester, 20 percent indicated once per year and 50 percent indicated projects not used at all. This shows that projects were not frequently used because most of the courses minimally used them. One instructor from institution A insisted that projects were used once per year in some courses. She said:

We also do projects once per year e.g. in the course of pedagogical issues in mathematics by providing students with work then they do investigation and are given time to present then given some grades. Also are given tasks of preparing or designing teaching and learning materials in line with subjects presented and graded accordingly (Instructor 1, Institution A, 8th April 2021).

The instructor from institution B insisted not providing projects at all to the Bachelor of Science with Education students rather to Bachelor of Science chemistry which was conducted once per three years. The instructor said; *“For BSC Chemistry they do projects only in the last year that is final year of the study while BSC.ED students do not do projects.”*

This implies that the frequency of using project in institution B was minimal among the undergraduate science students. Projects not being conducted as mentioned by the respondents might be the reason for the quantitative findings in figure 1 indicating 50 percent did not use it at all. The responses from both instructors and undergraduate science students were similar as they indicated projects to be used once per semester and once per year in some educational courses in institution A. Similarly, in institution B both instructors and students (undergraduate science students) indicated projects not used at all for the Bachelor of Science with Education degree programme.

5.1.2 The frequency of using portfolio by Instructors

Portfolios were reported by undergraduate science students to be minimally used. The frequency of use varied per semester, year, and not used at all as indicated in the Figure 2.

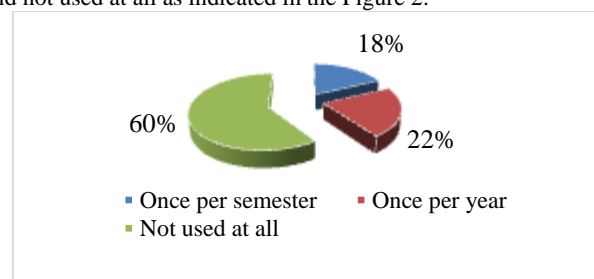


Figure 2: Frequency of using portfolio

The observation in Figure 2 shows that 18 percent indicated portfolios were used by instructors once per semester, 22 percent indicated portfolios were used once per year, and 60 percent indicated portfolios not used at all.

The findings imply that portfolios were not used at all in all courses in Biology and Chemistry subjects. In educational courses also portfolios were used in some of the courses such as teaching methods and courses related with curriculum and teaching. This shows the frequency of use to be minimal even in the courses which used portfolios in that they were used either once per semester or per year or not at all. The emphasis is made by one student from institution who said; *“Portfolios are used only in some education courses such as CT 100, CT 107, and CT 108 once per year. In other courses portfolios are not used”*.

Another student from institution B on the frequency of using portfolios B said; *“When it comes to portfolios not very often used it depends on the course it might be once per annum or twice per annum”*.

The respondents insist the same point on the frequency of using portfolios either once per semester or once per year in some education courses. With regard to the frequency of use of portfolios in Biology and Chemistry courses; one instructor from institution B indicated not to be used at all. She said;

....I rarely use portfolios in the Chemistry course I teach because there are other tools I use such as practical work and tutorials. They carry out practical work every week for almost 15 weeks, so I don't see the need for me using portfolios (Instructor 2, Institution, 4th May, 2021).

This instructor in Chemistry courses had the similar views in terms of frequency of use with other instructors in Biology courses;

We are using practical work, for example when teaching entomology they go to the field and collect insects. I'm using practical session as final product but on the way they are involved in doing tasks. Projects are used because the way they are writing might be similar to project. Portfolio not used at all (Instructor 2, Institution A, 8th April 2021).

The findings from the undergraduate science students and instructors were similar showing portfolios to be either used once per semester or once per year in some education courses while in Chemistry and Biology courses were not used at all. The findings indicated portfolios not to be used in science subjects namely Biology and Chemistry rather in some few courses in education. This means the frequency of using portfolios in both institutions 'A' and 'B' under study was minimal. The reason provided by instructors is that the nature of sciences courses does not require the use of portfolios.

5.1.3 The frequency of using practical work by Instructors

Practical work as one of authentic assessment tools was reported by undergraduate science students to be used accordingly. The frequency of use was once per week for almost 15 weeks in a semester as indicated in the Figure 3.

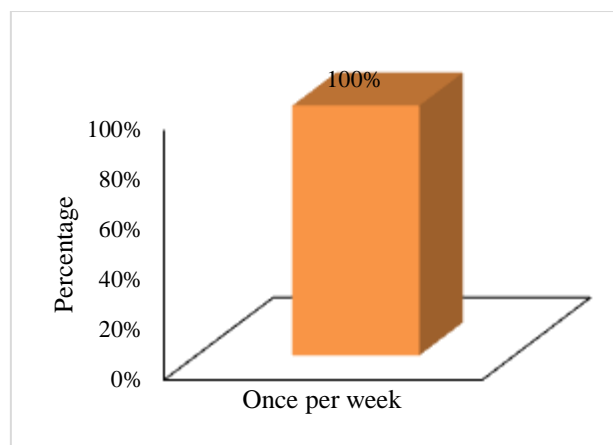


Figure 3: Frequency of using practical work

The observation in the Figure 3 indicates practical work to be used once per week. It was found that practical work was used once per week for the entire semester leading to several practical works being carried out per semester. For example instructors indicated practical work to be conducted each week both in Biology and Chemistry, however, from undergraduate science students' responses; practical work in Chemistry was found to be conducted as a course once in the first year. There were nine practical carried out in various chemistry areas such as organic chemistry, inorganic chemistry, physical chemistry etc. This implies different practical sessions were carried out per week in different chemistry fields in contrast to Biology. In Chemistry when the practical work as per findings was conducted then it was over (i.e. this had some summative aspects). To insist on the conduction of practical once for each field in Chemistry, an instructor from institution 'A' stressed the following;

.... We do conduct practical work to our students every week whereby they are given manuals to be used in carrying out practical work. So we allow them to study manuals then allow them to do practical by using the manuals once per week. After carrying out practical they have to write the report for grading purpose. This is done once per each week in a semester (Instructor 3, Institution A, 8th April 2021).

Another instructor from institution 'B' insisted on the use of practical work on weekly basis as follows;

For BSCED students they do practical work every week in the lab the experiments will be set they collect data and write the report, averagely out of 15 weeks of the semester we are going to have eight practical. There are 3 hours per week for practical work that requires students to be in the laboratory for such task (Instructor 2, Institution B, 4th May 2021).

Similar response was provided by the instructor in Biology from the same institution. He insisted that each course had a theory part and practical part conducted once per week in contrast to chemistry which had only one practical course per semester with different sessions per week. So the frequency of practical is that they were conducted once per week throughout the semester for both biology and chemistry subjects. This means the frequency of using practical was good as per each week one practical work was conducted in both institutions. On the side of the undergraduate science students; the response on the frequency of use was as per

the findings presented. One of the undergraduate science students at institution 'A' commented;

Here at our campus practical sessions are carried once in Chemistry –for first year. May I start with practical, each year practical is conducted once – nine practical or experiments per year. In case of Biology each course has a practical to be conducted on weekly basis followed by report writing (Student 1, Institution A, 9th April 2021).

From the responses it may be evidenced that the practical work for each field was done once then after report writing the grading followed. The frequency of conducting practical was per each week, however, the way were used was for grading purpose rather than improvement of learning.

In biology; practical works were carried out for each course linking the theoretical part covered in lectures with the actual practical in the field or laboratories. In biology also practical work were conducted on weekly basis though for separate courses.

The respondents from institution 'B' had similar views on the frequency of use of authentic assessment tools as presented by one of the undergraduate science student respondent;

...so the frequency of usage as I said before practical are conducted every week it depends if is chemistry this week next week might be biology but biology practical are having specific practical; when it comes to portfolios not very often depends on the course it might be once per annum or twice per annum. Teaching practice is conducted once per annum for first and second year students. For projects conduction is zero I'm confident to say so (Student 1, Institution B, 20th April, 2021).

The responses from both instructors and students were similar. They indicated that practical work was conducted on weekly basis for both biology and chemistry though in biology each course had its practical work while in chemistry there was only one practical course with several practical works.

5.1.4 Frequency of using teaching practice by Instructors

Frequency of using teaching practice was once per year for first and second year undergraduate science students. It was reported that the frequency of use was once per year conducted at the end of the second semester as indicated in the Figure 4.

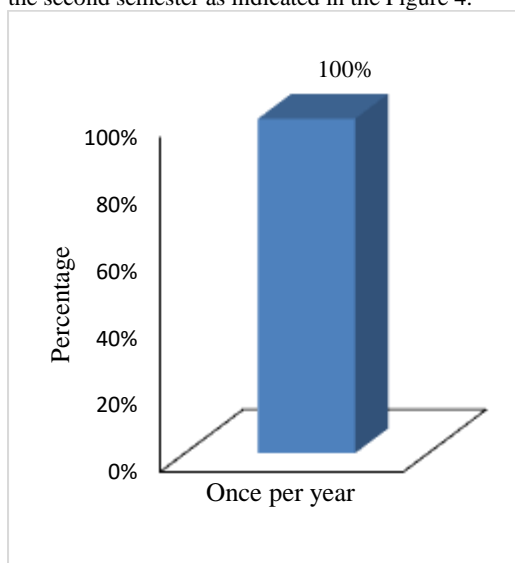


Figure 4: Frequency of using teaching practice

The findings indicated that 100 percent showed teaching practice to be used once per year. The respondents indicated that the

frequency of use of teaching practice was once per year. It was carried once per year after the end of second semester for the first and second year undergraduate science students. Findings indicated similar views among respondents concerning the frequency of teaching practice. For example in support on the frequency of use of teaching practice once per year; one instructor from institution A said; "Teaching practice is done once per year for those students taking BSC. Education and they do it in the first and second year".

The findings from instructors and undergraduate science students were similar. This may be evidenced from the response of one of the undergraduate science students who said; "Teaching practice is conducted once per annum for first and second year students".

The findings indicated that teaching practice was used only once per year for the first year and second year undergraduate science students. This means the frequency of using teaching practice for both institution A and B was the same as per responses.

6. Discussion of the findings

Basing on the findings; the frequency of use of authentic assessment varied depending on the authentic assessment tool. The variation on the frequency of use was once per week for practical, once per semester or year for project and portfolios, and once per year for the teaching practice. The findings on the variation in terms of frequency of use converge with the findings by M. Al-Zoubi (2019) in Jordan who found authentic assessment tools to be used in varying degrees basing on the nature of the task in question. However, the findings indicated some of the authentic assessment tools to be minimally used because the focus was on summative basis. This means that the authentic assessment tools were used only once at the end of learning unit for the sake of measuring learning achievement among learners. The findings are in line with the findings by Yüksel and Gündüz (2017) in Turkey who found authentic assessment tools to be dominantly used for summative purpose. They were used for the sake of measuring learners' achievement rather than improvement. The variation in the use of authentic assessment tools with more emphasis on summative use might have effect in terms of competencies acquisition among the undergraduate science students. They might not have acquired the stipulated competencies through assessment. For example, Ishaq et al. (2020) in Pakistan support the point on the weaknesses of summative assessment by pointing out that it may not enhance students growth in terms of competence. This means the frequency of use may have positive influence in the learning process hence competencies acquisition.

The frequency of using authentic assessment as per findings indicated variations from one tool to the other. For example, portfolios were found to be used minimally in some education courses once per semester and once per year depending on the nature of the course. Majority of the respondents, however, indicated portfolios were not used at all in science courses. This means the frequency of use with regard to portfolios was minimal even in some educational courses which found to be using them. The findings concur with the findings by Clarke and Boud (2018) and Klenowski et al. (2006) who indicated portfolios to be used minimally on summative basis. Likewise, Haliq and Sakaria (2019) in Indonesia indicated that portfolios were used for both formative and summative purpose leading to moderate use in terms of frequency. This is because they were used for the sake of improving learning and for measuring learning among learners.

Studies indicate the frequent use of portfolios to lead to enhancement in learning which in turn may lead to the acquisition of competencies among learners (Haliq & Sakaria, 2019; Holisah & Umam, 2021). Contrary to the findings of this study, Händel et al. (2020) found portfolios to be used frequently on weekly basis. They indicated that students who were exposed on the use of portfolios on weekly basis outperformed those who did not use portfolios on weekly basis. This implies that the frequent use of portfolios had positive effects. Furthermore, Tseng and Yeh (2019) in Taiwan supported the views on frequency of use of authentic assessment by claiming that; as the number of times on how the authentic assessment tools are used increases so does the competencies among learners. The exposure or frequency of use of authentic assessment tools may in one way or another motivate the undergraduate science students in the learning process which in turn may lead to competence acquisition (Mintah, 2003).

In case of frequency of using projects the findings indicated to be used once per semester and once per year depending on the nature of the course. For example, in some zoology courses such as entomology projects were used once per semester. Similarly in some educational courses such as pedagogical methods in science and mathematics were used once per semester. The frequency of use indicating once per year based on the research project which was carried once at the end of three years in chemistry. The findings are in line with some studies that indicate the positive influence of the frequency of using projects to the enhancement in acquisition of competencies. For example, Harris (2014) and Mahasneh and Alwan (2018) indicated the frequent use of projects to lead to the acquisition of competencies among learners. Teaching practice was found to be used once per year in the first and second year of study. The frequency of use was therefore once per year as the undergraduate science students were engaged in the teaching practice exercise only once per year. The findings concur with the findings by Amankwah et al. (2017) in Ghana; Kihwele and Mtandi (2020); Mahende and Mabula (2014); and Mungure (2016) in Tanzania who indicated teaching practice to be used once per year. In terms of competencies acquisition among learners; depend on how teaching practice is carried out. This means the concern is on the frequency of use and the way is carried out.

Furthermore, the agreement views of respondents on the frequency of using these authentic assessment tools by instructors indicate that for them to acquire the relevant competencies in the world of teaching profession (Morley & Jamil, 2021) the frequency of use matters. This is due to the fact that the frequency of use might indicate if they are used as part of supporting learning or as a tool of certifying learning. The authentic assessment tool may be used for the sake of grading or may be used for the sake of improving the learning process. However, for authentic assessment to lead to the competencies acquisition among the undergraduate science students; the frequency of use should focus on formative basis (Petty, 2009). This is because it might determine the exposure and effort put by learners in the process of learning (M. Al-Zoubi, 2019). The frequency of using authentic assessment tools might determine on one hand not only the time spend in doing the tasks but the efforts used by learners. On the other hand the frequency of using authentic assessment tools determines the learning involved which leads to the competencies acquisition among the undergraduate science students (Petty, 2009).

The study findings show that the frequency of using authentic assessment enables the undergraduate science students to

demonstrate the teaching professional competencies (Dahlback et al., 2020). This implies that if authentic assessment tools are used summatively, the number of times or frequency might not be adequate enough hence leading to inadequate competencies among them. From the findings, the frequency of using authentic assessment tools was not good enough due to some challenges involved (Manville et al., 2022; Sabri et al., 2019). That being the case the criticism from stake holders might still persist as the authentic assessment which is considered as an answer; is not adequately used rather they rely on traditional paper and pen tests. This statement is supported by Mkimbili and Kitta (2019) and Sewagegn and Diale (2020) who argue that some institutions do dominantly use traditional paper and pencil tests to assess learners rather than authentic assessment on formative basis. Similarly, Ozan (2019) comments that the frequency of using authentic assessment tools increases academic achievement among learners which in turn leads to competencies acquisition. However, from the findings the frequency of using authentic assessment is not good enough which might justify the criticism by the education stakeholders on the inadequacy of competencies among graduates.

7. Conclusions

The findings of the study indicated the use of authentic assessment tools vary per week, semester, and/or year depending on the nature of the course. The authentic assessment tools which were commonly used at the institutions under study included portfolio, project, practical work and fieldwork. Among the tools of authentic assessment used; the frequency of use varied depending on the field or course of study. For example, portfolios were minimally used in some of the education courses, projects were minimally used in both education courses and science courses, while practical work was used once per week in science courses namely biology and chemistry. Despite such variation, the frequency of use indicated the use of such authentic assessment tools to base on summative basis rather than on formative basis. The summative use of the authentic assessment tools might not lead to competence acquisition as expected since the exposure and emphasis of the learning might be minimal.

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