



## SUBJECT EXAMINATION CONTENT VALIDITY; CASE STUDY OF NATIONAL EXAMINATION CHEMISTRY PRACTICAL WITH IN-SERVICE CHEMISTRY TEACHERS IN DODOMA (M), TANZANIA

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### ABSTRACT

The present study assessed content validity of the National Examination Council of Tanzania (NECTA) Chemistry Practicals Examination for Secondary Education in terms of topics represented in the examination. The study involved 30 Chemistry teachers from 13 secondary schools in Dodoma (M), Tanzania. Data were gathered through questionnaires supplemented with focus group discussion, key informants, observation of 14 consecutive National Chemistry practicals examination past papers and examination format documents. Quantitative data were analyzed using SPSS and Excel packages to obtain data for computing Content Validity Ratio (CVR) according to Lawshe's method. The CVR was -0.816 (CVR varies between 1 to -1; negative value indicate that at least half the subject experts rated the variables as not fundamental, and vice versa for positive value). The study further noted that NECTA Chemistry practically examined topics is about 14.8% and 15.4% of the topics specified in the Chemistry syllabi for junior and senior secondary education respectively. Respondents recommend alternation of Chemistry topics in the national practical examination; to eradicate prediction of questions for next practical examination, provide students with relevant practical skills from various topics and enhances more teaching of science practicals in secondary schools. The study contributes to the understanding of laboratory-based teaching in secondary schools and topics which are examined in the NECTA Chemistry practical examination.

**Keywords:** Chemistry Practicals Examination; Chemistry Subject-specific Teachers; Content Validity; Examination format; Secondary Education; National Examination Council of Tanzania (NECTA).

### 1. INTRODUCTION

Laboratory experiment can be regarded as science teaching and learning activity in which learners work as individual or in groups with help of guided protocols or self experience to investigate, explore and acquire knowledge and skills. Laboratory practicals give students an opportunity to have direct contact with natural phenomena, provide concrete examples of complex concepts, increase understanding of technical apparatus, and verify predictions, theories or models (Revelian et al., 2017). Performing practicals as classroom activities is very important in construction of knowledge (Kang & Wallace, 2005). Laboratory practicals also motivates students and increase understanding (Chiaverina & Vollmer, 2005). Learning practically is

characterized by participation, involvement of theory in practice, integrity, creativity, curiosity, discovery, and the ability to analyze variables (Tanzania institute of education (TIE), 2007).

In Tanzania, National Practical Examinations are among the examinations administered by NECTA for Certificate of Secondary Education Examination (CSEE) and Advanced Certificate of Secondary Education (ACSEE). There are 4 topics designed for the ACSEE Chemistry real practical examination (NECTA, 2011) where as for the CSEE, there are 4 possible topics designed for chemistry practicals (NECTA, 2008). However, practically examined topics seem not to provide school leavers with solid foundation for employment and life-based needed skills as per curriculum for secondary education (TIE, 2007; 2010). A valid example is observed for secondary education leavers that join industrial, agricultural, environmental studies with no practical skills from relevant topics such as organic chemistry, buffers and pH or soil chemistry. There are few topics designed for national practicals examination (Revelian et al., 2017). Apparently, it is difficult to ascertain whether practically examined topics in the NECTA examination are valid or not in terms of topics represented in the examination and their relevance. This is because there yet no study on the content validity of the NECTA examination available. So far many studies in science education such as (Ball & McDiarmid, 1989; Hamilton, Mahera, Mateng'e, & Machumu, 2010; Hotaman, 2010; Jadama, 2014; Kennedy, 1990; Paulo & es Salaam, 2014) focuses on teacher's knowledge of subject matter while other studies address teachers' pedagogy skills, ethics and professionalism (Barretta & Anangisye, 2005; Betweli, 2013), teacher's psychology (Ahuja, 2015; Paulo & es Salaam, 2014).

The term content validity is referred as a degree to which the instrument covers the content that it is supposed to measure (Yaghmale, 2009). It is used synonymous with curricular validity to mean extent to which the content of the exam matches the objectives of a specific curriculum. Valid exam ought to measure a great part of the curriculum or specified content that students are taught in order to make a decision about whether learners received intended and relevant education. Practically, assessing exam content validity is about relevance of the representation of the whole syllabus content (Yaghmaei, 2003) to check if learners' skills concur with the learning outcomes because it is difficult, if not impossible, to administer an exam consisting all subject topics. One of the widely used method for assessing content validity is the Lawshe's method (Wilson, Pan, & Schumsky, 2012). It is based on the fact that each of the subject matter expert raters (SMEs) consider if the skill and/or knowledge assessed in the exam is 'essential' but 'not necessary' to the performance of the construct (Lawshe, 1975). In this regard, NECTA science practical examination has not been studied in the context of content validity. The present study assesses content validity of NECTA chemistry practical examination for junior and senior secondary education.

## **2. METHODOLOGY**

The study was conducted in Dodoma capital city, Tanzania from September 2017 and to January, 2018 involving teachers from thirteen secondary schools. Five schools were advanced level secondary schools teaching science subjects, and eight schools were ordinary level secondary schools teaching all subjects according to Tanzania four years of secondary education. The study involved science teachers because assessing examination content validity requires use of judgments made by subject experts. The study considered Chemistry because it bridges other science subjects and is studied by majority of students in secondary education. The Chemistry practicals examination was case study because few topics have been examined repetitively over

decades in the national practical examination (Revelian et al., 2017). The study chosen Dodoma capital city due to the fact that selected schools were easily reached, and the district has many secondary schools in the region compared with other districts.

### 2.1 Sampling Technique Involved

Simple random sampling technique was used to select secondary schools and chemistry subject teachers to involve in the study. Thirteen secondary schools were chosen among 57 secondary schools found in Dodoma capital city in 2017/2018. Chemistry topics designed for chemistry practical examination were identified with help of NECTA chemistry practical examination format, consecutive Chemistry syllabi for A-level and O-level and Chemistry practical past papers from 2003 to 2018 (33 %) considering the commencement of NECTA in 1973. Thirty Chemistry teachers were involved in the study. In order to obtain supplementary information, key informants were approached as well as 13 focus groups discussion, each of 3-5 chemistry teachers were conducted.

### 2.2 Data Collection Procedures

In data collection, the study used questionnaires supplemented with focus groups discussion, observation of Chemistry practical examination papers as well as NECTA Chemistry examination format documents. Through questionnaires, teachers were asked to rate the variables; NECTA Chemistry practical examination review, Laboratory practices for majority of topics, Curriculum-based NECTA chemistry practicals, and Practically unexamined topics based on the three-point scale of 3, 2 and 1 for Very Important, Important and Not Important respectively. Topics for NECTA chemistry practical examination and total number of topics in the chemistry syllabi for junior and senior secondary education were identified by use of Chemistry examination format documents (NECTA, 2008, 2011) and the most recent Chemistry syllabi for A-level and O-level (TIE, 2003; 2007; 2010).

## 3. DATA ANALYSIS AND RESULTS

The teachers' responses were analyzed using SPSS and Excel packages to obtain results used to compute Content Validity Ratio (CVR). The teachers' responses for "very important" and "Important" cases were combined and termed as "non-essential" where as responses for "not Important" were considered as essential to suit the requirements of 1975 Lawshe's method.

**Table1: Individual teacher's opinion on the Content validity of NECTA Chemistry Practicals Examination in terms of topic represented in the examination**

	Response for variable 1	Response for variable 2	Response for variable 3	Response for variable 4	Frequency	Percent (%)
Scores for validity	2	3	1	5	11	9.167
Scores for invalidity	28	27	29	25	109	90.833
Total teachers' responses for all variable					120	100.0
Content Validity Ratio (CVR)						0.184

Content validity ratio and content invalidity ratio was computed according to the Lawshe's method as follows;

$$CVR = (n_e - N/2) / (N/2)$$
 Where  $n_e$  is number of panelists indicating essential, and  $N$  is total number of panelists.

Content validity ratio (CVR) varies between 1 to -1; negative value indicate that at least half the Subject experts rated the variables as not fundamental and vice versa is true for positive value.

In this case, approximately 81.7% of the interviewed Chemistry teachers perceived the existing national chemistry practical examination as invalid against 18.3% of teachers that thought the examination as valid (table 1).

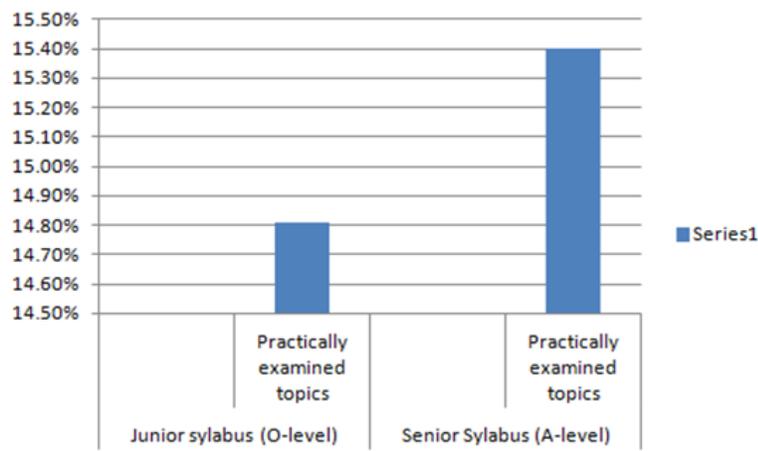
### 3.1 COHEN'S KAPPA COEFFICIENT

Cohen's kappa coefficient measures inter-rater agreement by taking into account the possibility of agreement occurring by chance among raters. It is determined by considering number of agreement scores against total scores. Inter-rater agreement is observed when the data raters give the same score to the same data item.

**Table 2: The Cohen's kappa coefficient for Chemistry teachers' opinion on the content validity of NECTA Chemistry practical examination**

Variable	Subject experts involved	Scores for non-essential	Scores for essential	I-CVIs	Interpretation
1	30	3	27	0.900	The reliability among item score by teachers is high
2	30	5	25	0.834	The reliability among item score by teachers is high
3	30	1	29	0.967	The reliability among item score by teachers is high
4	30	2	28	0.934	The reliability among item score by teachers is high

In addition to the CVR value, the study considered to include computation of Chemistry topics designed for NECTA chemistry practical examination against all topics specified in the chemistry syllabi for junior and senior secondary education (figure 1). This was meant to find the ratio of topics which are examined practically against all topics. There are 4 topics designed for the Certificate of Secondary Education Examination (CSEE) Chemistry practicals examination (paper code: 032/2). These include; Volumetric analysis, Ionic Theory and Electrolysis or Chemical Kinetics, Equilibrium and Energetics or Laboratory Techniques and Safety, and



Qualitative analysis (NECTA, 2008) among 27 topics specified in the syllabus (TIE, 2010). On other hand, there are also 4 topics designed for Advanced Certificate Secondary Education Examination (ACSEE) Chemistry practical (paper code: 132/3). They include; Physical Chemistry analysis, Reduction-oxidation, Chemical kinetics, Thermochemistry or Energetics (NECTA, 2011)

against 26 topics specified in the syllabus (TIE, 2010).

**Figure 1: The ratio of practically examined chemistry topics in the chemistry syllabus for junior (O-level) and Senior (A-level) secondary education in Tanzania.**

#### 4. DISCUSSION

The present study assessed content validity of the national Chemistry practical examination for secondary education in terms of examined topic. This came after the study which cited that about 4 topics are examined repetitively in the national chemistry practicals examination over decades (Revelian R Tibyehabwa, 2017). Referring the objectives of the Certificate of Secondary Education (CSEE) available at [www.necta.go.tz/csee](http://www.necta.go.tz/csee), which includes; assessing students' skills and knowledge, weighing the extent to which a student use skills gained for application in life, and the Advanced Certificate of Secondary Education (ACSEE) objectives which include among them; to assess the learner's knowledge and examine application skills in life. An obvious question may arise; If theoretical studies provide a rare insight into various experimental details (Revelian et al., 2017), how can the ACSEE and CSEE practical examination examine life-based application skills without engaging students with reputable, varied and relevant topics as well as stretching experimentation in the laboratory?.

In this regard, the CSEE and ACSEE objectives would be achieved by reviewing the existing NECTA practical examination format. This may involve inclusion of other practically unexamined topics and focuses on improving education for better quality of school leavers. In this case, subject examination in terms of content should have as many as possible sample of the teaching topics specified subject syllabus and essentially measuring learner's competence through wide subject topics.

During setting of examination, content validity is among important factor to be observed and begins in the earliest development of an instrument or examination (Zamanzadeh et al., 2015). Thus, in assessing students content validity is a requirement to compromise with a set of learning objectives defined in the syllabus and the curriculum of the examinees education level unless if there is different purpose for which the examination was administered for. Such other examination objectives may be for selection of students for further studies and technical studies. Based on the results where about 4 topics are regularly examined in the Chemistry national practical examination (figure 1), a lot of predictions can be made by teachers and students prior commencement examination. Such predictions include possible topic's questions in the national chemistry practicals examination. Consequently, this have led into low involvement of teacher in the students' practical sessions in schools (Revelian et al., 2017). However, Barke, W. C and co-author (2013) with their study "Science needs Africa as much as Africa needs science" a case in Tanzania cited that low involvement of teachers in the students' practicals in secondary schools is caused by lack of laboratory resources, limited space in laboratories and presence of few teachers in schools. In this case, laboratory practicals are performed towards final national examination, and could be considered mainly for earning grades by students.

In regard to the conduct of NECTA examination and referring to the NECTA 2018 website information available at <http://www.necta.go.tz/csee>, there is no comprehensive and systematic analyses and documentation on the validity of national examination conducted by national examination council of Tanzania. Base on this, a number of questions could be raised and may include; (1) Why NECTA have been administering examination over decades including practical

examination without conducting comprehensive and systematic analyses of its validity?. (2) How NECTA abide and implement policies and guidelines specified in the Tanzania curriculum for secondary education ensuring learning domains or skills are correctly examined without assessing the convenience of examination taken by secondary education leavers?

Moreover, based on the computed CVR value of about 0.183 and the ratio of topics practically examined topics (figure 1) obtained in this study, existing NECTA practical examination needs to be reviewed. This is because more than half the chemistry teachers' panel indicates that practically examined topics are good but are not essential than others. In this case, greater levels of content validity exist as larger numbers of panelists agree that a particular item is essential. Invalidity of the existing NECTA chemistry practical examination was also mentioned through focus group discussion by other experienced teachers as well as approached key informants that the practically examined topics are not enough to represent all topics in chemistry syllabus unless majority of topics are examined on regular basis.

## **5. CONCLUSION AND RECOMMENDATIONS**

The present study found that the existing NECTA Chemistry practical examination is invalid in terms of topics represented in the examination. Respondents recommend for review of science subjects' examination format by including other topics. This ultimately; enhances teachers and students' involvement in the laboratory practicals compared with the existing laboratory practices based on few topics and eliminate students' predictions of questions for next national practicals examination

## **6. DECLARATION OF CONFLICT OF INTEREST**

Foremost, we thank the Dodoma (M) district Director and Education officers for permitting this study in their secondary schools. We are thankful to the chemistry teachers, other experienced teachers and key informants for their involvement in this study. We declare that this study have no conflict of interest with any party, and is among several publications we have made as our main role to the public.

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