Learners’ Science Process Skills for Chemistry 5124 Practical Activities in Selected Secondary Schools of Kitwe District, Zambia

Sunday Ng’andu1, Goodwell Kaulu2

Mathematics and Science Education Department, University of Zambia, Lusaka, Zambia

Abstract: This study investigated how learners use science process skills (SPSs) to solve chemistry 5124 practical activities in selected secondary schools of Kitwe district, Zambia. The study was subsequently guided by the research question: how do learners use science process skills to solve chemistry 5124 practical activities, and an hypothesis there is no significant difference between gender of learners and science process skills used to solve chemistry 5124 practical activities (null hypothesis). The skills which were considered include observing, measuring, classifying, predicting, interpreting, communicating, and inferring. The study used a mixed methods approach and a descriptive survey design to investigate the issues involved. The study sample consisted of 48 grade 12 learners randomly selected from four secondary schools. Data collection instruments included practical instructions called SPSAI and observation schedules. Qualitative data were analyzed through establishment of common themes while quantitative data were analyzed by descriptive (frequencies) and inferential (t-tests) statistics generated by statistical package for social sciences (SPSS). Findings indicated that learners used observing, measuring and classifying at least at satisfactory levels, but failed to use interpreting, inferring, predicting and communicating in Chemistry practical activities at the least required level. It was further established that, there was no significant difference with regard to use of SPS according to gender of learners (t=-0.283, df=335 & p value=0.777>0.05). The study concluded that learners did not use most of the science process skills in chemistry 5124 practical activities at the required level, and gender had no significant impact on how learners used the SPSs. In view of the findings, the study recommend that teachers should emphasize more on acquisition and enhancement of developed science process skills among learners, the cognitive development level of learners should be considered when designing practical activities, and a longitudinal study to be done on Chemistry teachers in order to get in-depth understanding of the nature of chemistry practical activities teachers design and deliver to learners.

Keywords: Learner, Science process skills, Practical activity

1. Introduction

The importance of science education cannot be over emphasized as it ranges from transmission of knowledge, values, culture, skills and norms among others, to actualizing developmental agendas of given societies and nations at large (Padilla, 2004; Akani, 2015). According to Akani (2015), no nation can progress in terms of development without correct scientific base. Inarguably science is one of the subjects which are able to unleash the potential of learners to turn into desired responsible and productive citizens. Thus, an enviable education system should embrace science as part of core subjects and endeavor to develop and nurture students’ potential through a holistic implementation of the set curriculum. This is why nations across the globe endeavor to provide quality science education as the means to facilitate their national development.

According to the United Nations Children’s Fund [UNICEF], (2000), quality education is one that focuses on the social, emotional, mental, physical and cognitive development of each learner regardless of gender, race, ethnicity, social economic status, or geographic location. Quality science education should therefore prepare learners holistically for life other than making them pass school tests and examinations. This can be achieved by equipping learners with scientific knowledge, process skills, values and positive learning attitudes.

Developed countries seem to have done well in this regard, nonetheless, developing countries are still striving with regard to provision of quality science education (Willms, 2000). Zambia has not been an exception in striving to provide quality science education. In an effort to do this, in 2013 this country changed the science 5124 curriculum from content to outcome based curriculum. According to the Ministry of Education, Science, Vocational Training and Early Education [MESVTEE], (2013), the curriculum change was not only necessitated by the need to provide an education system that would integrate most modern social, economic, technological and political developments but also equip learners with fundamental scientific knowledge, process skills and values that are essential to contribute to the attainment of vision 2030. Three years later the Examination council of Zambia (ECZ) introduced practicals in science 5124 and this led to the nomenclature of assessment changing from theory papers only to the one incorporating both theory and practical papers. ECZ is a body mandated to oversee the affairs of national examinations such as preparing and marking national examinations at primary, junior and senior secondary school levels in the country.

Since the introduction of science 5124 practical examination, literature has shown that candidates have been displaying weaknesses in questions involving the use of science process skills in chemistry practical activities (ECZ, 2016; 2017). This problem could be attributed to learners’ inability to use science process skills in practical tasks (Tobin & Capie, 1982; Valanides, 1996; Omioko, 2013; Nweke, 2015). This raises a great concern as literature has shown that acquisition and use of science process skills (SPS) is crucial both in science learning and the
development of a society (Akani, 2015). However, no empirical study has been conducted to investigate how learners use science process skills in chemistry 5124 practical activities particularly in a natural setting other than relying on candidates’ examination scripts to make inferences in the Zambian context. Hence, this study which investigated how learners used science process skills to solve chemistry 5124 practical activities in selected secondary schools of Kitwe district.

1.1 Statement of the problem

Previously, ECZ used to administer theoretical examinations in science 5124, but following a curriculum review in 2013, a practical paper was incorporated. ECZ (2016; 2017) annual performance reports have revealed that candidates generally have been facing challenges related to use of science process skills in chemistry 5124 practicals, which lead to poor performance (Tobin & Capie, 1982; Valanides, 1996; Omiko, 2013& Nweke, 2015). However, little is known about how learners use science process skills to solve Chemistry 5124 practical tasks in the natural setting in the Zambian context. This creates a knowledge gap.

1.2 Purpose of the study

The purpose of study was to investigate how learners use science process skills to solve chemistry 5124 practical activities in selected secondary schools in Kitwe district of Zambia.

1.3 Research objectives

The study was guided by the following objectives:

a) To assess how learners use science process skills to solve chemistry 5124 practical activities.

b) To establish whether gender has an effect on the use of science process skills by learners in chemistry 5124 practical activities.

1.4 Research question

The research question was: How do learners use science process skills to solve chemistry 5124 practical activities?

1.5 Research hypothesis

The null hypothesis (H₀) was: There is no significant difference between gender of learners and science process skills used to solve chemistry 5124 practical activities, while the alternative hypothesis (H₁) indicated otherwise.

2. Methodology

Examination annual performance reports from 2016 to 2017 for science 5124 were analyzed to identify the science process skills to be studied. The skills indentified included observing, measuring, classifying, predicting, interpreting, communicating, and inferring. The study took a mixed methods approach and used a descriptive survey design to investigate the issues involved. The study sample consisted of 48 grade twelve learners randomly selected from four secondary schools. Data collection instruments included practical instructions called science process skills assessment instructions, SPSAI and observation schedules (OS). Both instruments were established by the researcher and validated by experts from mathematics and science education department of the University of Zambia. The researcher observed the learners while they carried out practical activities (SPSAI), and used OS to record observations. The level of use of science process skills was based on a 5-point Likert scale of no attempt, unsatisfactory, satisfactory, good and very good. Qualitative data were analyzed thematically while quantitative data were analyzed by descriptive (frequencies) and inferential (t-tests) statistics generated by statistical package for social sciences (SPSS).

3. Presentation of Findings

Findings are presented according to research question and hypothesis.

3.1 How learners use science process skills to solve chemistry practical activities.

The research question was: “How do learners use science process skills to solve chemistry practical activities?”; in order to answer this question data was collected by observing learners carrying out SPSAI while the researcher used OS to record observations. Figure 1 shows the findings on performance level indicated by the aforementioned scale.
The results in figure 9 indicates that learners used observing, measuring and classifying at least at satisfactory level while the level at which they used predicting, interpreting, inferring and communicating was unsatisfactory.

### 3.2 How learners use science process skills with respect to gender

In order to account for gender disparities against level of use of process skills, a paired sample t-test was conducted and hypothesis tested at 95% confidence interval. The following table 1 indicates results which were generated in SPSS.

<table>
<thead>
<tr>
<th>Pair</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference</th>
<th>T</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender-SPSs</td>
<td>-.01488</td>
<td>.96340</td>
<td>.05256</td>
<td>-.11827</td>
<td>.08850</td>
<td>-2.835</td>
<td>.005</td>
</tr>
</tbody>
</table>

Table 1 depicts that there was no significant difference between gender of learners and the SPSs used to solve Chemistry practical activities (t=0.283, df=335 & p value=0.777>0.05). This means gender had no effect on the use of SPSs by learners to solve chemistry practical activities.

### 4. Discussion of findings

#### 4.1 How learners use science process skills to solve chemistry practical activities

Findings of the current study indicated that learners used observing, measuring and classifying skills except predicting, interpreting, inferring and communicating at the required level. At first glance percentages for observing, measuring and classifying may seem to depict very good performance but that is not the case when analyzed in detail. A closer look at all the skills, the level of use of science process skills is worrying. This is because such skills are basic and that is where most if not all SPSs depend. Therefore, it was expected of learners to use the said skills at higher levels if they were to succeed in using sophisticated skills such as integrated skills in an effective and efficient manner. According to the scale used in this study, the findings indicated that learners used observing classifying and measuring at satisfactory level, while unsatisfactory levels was observed in predicting, interpreting, inferring and communicating. These findings are on one hand consistent and on the other inconsistent with findings of Akani (2015) who investigated the level of Possession of observing, measuring, communicating, inference and experimenting in college of education final year students in South-Eastern States of Nigeria. His study revealed that there was high level possession of observation, experimentation and measurement skills and low level possession of communication and inference. Despite the difference in terminologies on the scale used in these two studies, findings can be related as they investigated the same phenomenon and same purpose in mind.

For instance, findings of the current study on the level of use on inference and communicating are to a larger extent consistent with findings of Akani (id). The current study established that communicating and inferring skills were at unsatisfactory (low) level while Akani (id) established that it was at low level. Nonetheless, the current study revealed that measuring and observing were at satisfactory (low) level while Akani’s (id) study revealed that these skills were at high level of possession. Hence, the findings of the two studies in this regard were not consistent. According to Piagetian theory, the observed discrepancies can be explained by participants’ developmental level. Participants in Akani’s study were college students while this study considered grade secondary school students. Age differences and particularly education level of participants could have led to the differences noticed. Therefore, it cannot be argued further for literature has shown that possession or use of
科学过程技能在认知水平年龄对于个体（Ozgelen, 2012; Brotherton & Preece, 1996）。Piaget（1964）认为存在正相关性，因为儿童的思维能力对于信息处理和他们的年龄。这有一个直接的证据，认知发展和科学过程技能之间。

然而，满意度水平在科学过程技能（如测量、观察、分类）中由大多数学习者可以被认为是相当低的，因为好的，非常好的水平是希望的科学过程技能，因此他们需要得到改进。不满意水平在预测、解释、推断和沟通的技能应该被关注。需要发展和改善科学过程技能的参与者。教师在这里发挥了主要的角色，而且开始发展和改善科学过程技能，其中学习者可以由化学教师的训练在科学过程技能，所以如果他们能得到改善。低水平和不满意水平的化学技能5124可以被追踪到无效的实践的理论学习（化学知识）。因此，化学教师应该在手中引导学习者在实践活动。只有通过手-实践活动，学习者可以获取科学过程技能（Akani, 2015）并改进它们。而且，它变得对教师的目标是化学5124来支付特别的注意力到过程技能的水平和不满意水平，如推断，解释和沟通的多个其他技能以发展和改进它们。使用水平的使用根据性别在下一段讨论。

4.2 学习者在科学过程技能的使用


因此，可以发现性别对过程技能在一些研究中是不显著的。尽管在最近的研究，性别没有影响过程技能。有些原因可以认为这些差异，其中一个是自我调节。Aydogdu（2017）认为在一些研究中的女性学习者，他们有一种特殊的在过程技能中的能力也可能有在自我调节影响他们的能力在科学过程技能。这项研究可以很好地推广到成熟的男性学习者。这是因为在一个人，更成熟的自我调节，他们将变成，这是为什么有差异的在使用科学过程技能的根据性别是观察在一些研究中涉及的成熟的学生。

5. 结论与建议

这项研究确认了学习者使用测量、解释推断，预测和沟通的在基本技能的最小要求水平时解决化学5124的实践活动。这一研究进一步确认在性别有无差异在使用科学过程技能中。在视图的发现，这项研究推荐了科学过程技能的的获得和改善需要被优先，而化学5124的过程技能。一项在化学5124课程中教师应该被深入理解的实践活动，他们计划并交付给学习者。这将有助于理解不同的问题在不同的维度，这是使我们理解科学过程技能的在本主题中。

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参考文献


