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## **Addressing Radiography Workforce Competence Gaps in Zambia: Insights into the Radiography Diploma Training Programme Using a Curriculum Mapping Approach**

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### **Abstract**

In Zambia, the radiography diploma programme has been offered since 1970 and has undergone only five reviews against an estimated ten [10] over 40 years. Such a situation can call into question the quality of radiography training. Curriculum evaluation is a key factor in ensuring quality standards of an educational training programme. The timely review ensures that curricula are in keeping with contemporary practice requirements. We analysed the 2014 radiography curriculum using a curriculum mapping approach to evaluate the stated objectives and their alignment to the educational domains and contemporary radiography practice requirements. Method: A case study design was used to explore the 2014 TEVETA radiography curriculum. Content analysis was used to identify curriculum learning objectives. A framework based on Harden's curriculum mapping approach was developed. The first phase involved analysis of the curriculum content against the educational domains [i.e. cognitive, psychomotor, and affective domains, respectively]. The second phase involved comparing the stated learning outcomes with contemporary radiography practices.

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Results: A total of 90 learning outcomes were identified. The analysis revealed that 80% [N=72] of all the stated objectives were cognitive, while only 13% and 7% were psychomotor and affective, respectively. Furthermore, over 70% were pitched at the lower-order skills level of Dave's taxonomy. In terms of radiographer competence, 55% [N=40] were attributed to technical skills. However, more than 90% of the technical competences were knowledge components and 10% actual psychomotor skills.

Conclusion: A curriculum mapping approach was useful in analysing the current Zambian radiography diploma curriculum. The overemphasis on lower-order cognitive and psychomotor competence in the curriculum calls into question the technical readiness of new graduates to effectively perform at the expected level of proficiency in the workplace. Findings of this study provide valuable information that can be used for reviewing the curriculum to make the training more responsive to contemporary radiography practice demands.

**Keywords:** Curriculum; Mapping; Radiograph; Zambia.

## **1. Introduction**

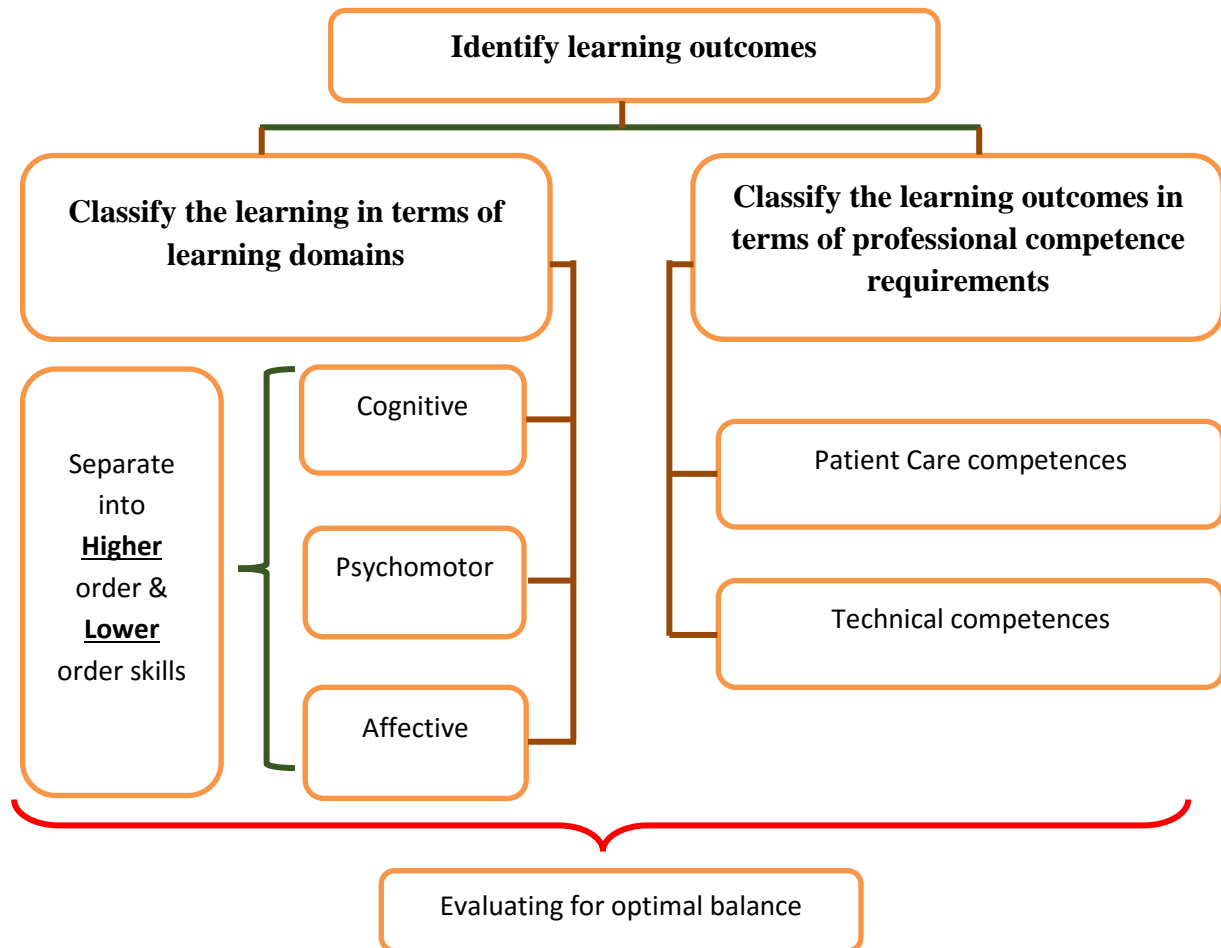
Contemporary health professions' practice has placed a lot of emphasis on the need for training programmes to be accountable to all stakeholders. Critical to the quality assurance process is the need for curricula that responds to contemporary requirements for practice [1]. In the health sector, such a necessity for a rigorous quality system has been emphasised by regulatory bodies providing oversight on the training of health personnel [2]. The evaluation of any curriculum is aimed at ensuring that a training programme remains relevant to societal needs, advancements in healthcare provision, and scope of professional practice [3]. Furthermore, the professional practice requirements must be reflected in the intended learning outcomes of the respective training programmes. One method that has been used to evaluate curricula is the mapping approach [4]. This approach allows for a critical review of a curriculum by creating a framework capable of utilising multiple lenses to create a realistic picture of the state of a curriculum [3]. In Zambia, the training of Radiographers at diploma level has been offered at the Evelyn Hone College of Applied Arts and Commerce since the 1970s [5]. This three-year training programme has been in recent years has been superintended over by the Technical Education and Vocational Training Authority [TEVETA]. Since the inception of the Radiography diploma programme in the 1970s, the curriculum has only undergone five [5] reviews. For any curriculum to remain relevant to the contemporary requirement for practice, it is recommended that a review is conducted every four to five years for a three-year programme. The erratic review can result in curriculum remaining incongruent to contemporary practice requirements and societal needs [6]. The objective of this study was to analyse the 2014 Zambian radiography diploma curriculum and its alignment to the educational domains of learning and the contemporary competencies expected of radiographers at diploma level.

## **2. Methods**

### **2.1 Design**

A case study approach was used to fully explore the 2014 TEVETA radiography curriculum and provide an insight into the alignment of the objectives with contemporary radiographer competences. A curriculum

mapping approach as described by Harden [4] was used as the overall analytical framework. However, this particular review focused on using the “what is taught” element as a method to provide insight into the relevance of the stated learning outcomes to contemporary radiography requirements. The analytical framework [figure 1] combined Bloom’s classification of education domains as articulated by McNeil [7], Miller’s prism for assessment of competences [8] and Andersson’s Radiographers Competence Scale (RCS) [9].



**Figure 1:** Analytical framework for curriculum evaluation

## 2.2 Data collection and analysis

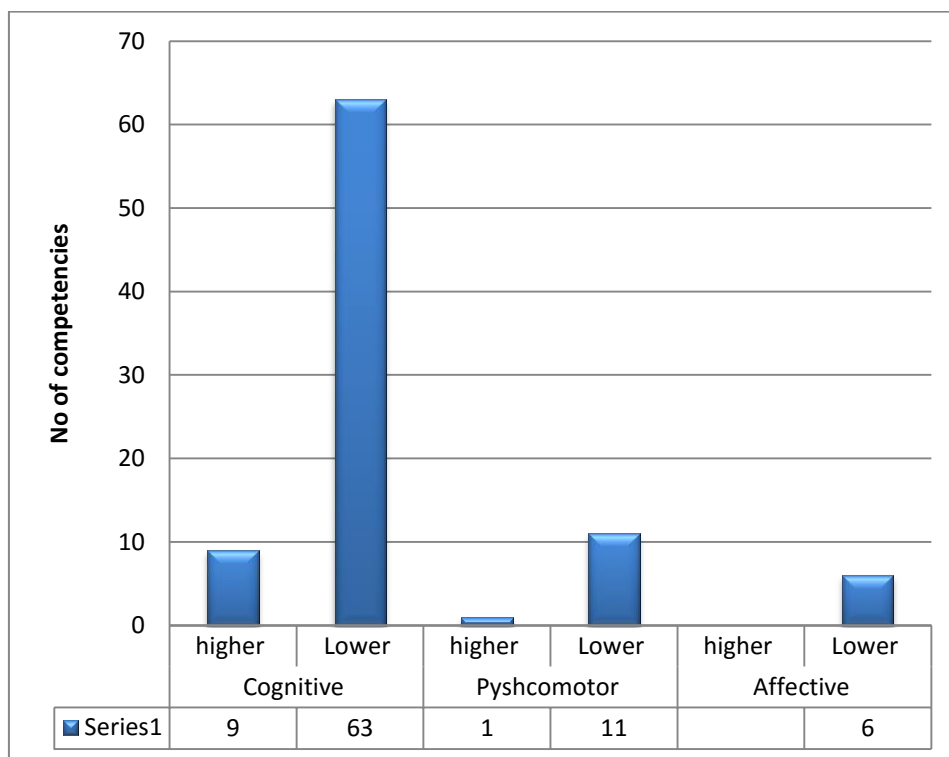
The information processing sequence began with a thorough reading of the 2014 TEVETA Radiography curriculum. Objectives for each course were identified and summarised into a Microsoft Excel spreadsheet. A two-path categorisation was then embarked on first to classify the learning outcomes into educational domains and then into either higher-order or lower-order skills based on Bloom’s hierarchical taxonomy [10]. In the second phase, the same outcomes were then divided into patient care or technical radiography competencies [9]. The technical skills were then compared to literature to draw comparisons with contemporary practice requirements. Content analysis was used for the categorisation of the data. Summary statistics using proportions were then computed for data description purposes.

### 2.3 Ethical considerations

This study was a part of a larger study which explored the use of work-based assessment in informing curriculum evaluation. The larger study had ethical approval from the University of Zambia Biomedical Research Ethics Committee [Approval reference No 2017012].

### 3. Results

A total of 90 competencies were identified from the curriculum. When categorised, 80% (n=72) were cognitive in nature. The psychomotor skills were 13%, while the affective domain skills accounted for 7%. Further analysis revealed that 63 (70%) of the cognitive domain competencies were classified as lower-order cognitive ability using Bloom’s taxonomy of the knowledge domain.



**Figure 2:** Distribution of the competences in 2004 TEVETA radiography curriculum

Using the categorisation of radiographer competencies developed in the main study, the majority of the competencies (n=40) were aligned with technical competence. This category was followed by administration and clinical care roles (21 and 15 respectively).

The focus of this study was on the evaluation of the technical competences of practising radiographers. To interrogate this aspect mapping of the technical roles was undertaken. The results show that 55 out of 61(90%) of the objectives in this category was dedicated to the technical knowledge required for proficient utilisation of technical equipment. Only 5 (8%) of the objectives addressed the issue of image quality.

**Table 1:** Number of competences in line with generated competency list

Competence	Number	%
<b>Technical</b>	40	44
<b>Administration /Management</b>	21	23
<b>Clinical</b>	15	17
<b>Patient care</b>	6	7
<b>Interpersonal</b>	3	3
<b>Professional</b>	2	2
<b>Research</b>	2	2
<b>Theoretical</b>	1	1
<b>Training/Education</b>	0	0
	90	100

**Table 2:** Technical roles represented in the TEVTA curriculum

Technical Role	Number	%
<b>Image Quality Assurance</b>	5	8
<b>Equipment Care &amp; Quality Assurance</b>	1	2
<b>Technical Knowledge</b>	55	90
<b>Technical Support</b>	-	-
<b>Patient Safety</b>	-	-
<b>Clinical Audit</b>	-	-
	61	100

#### 4. Discussion

This study analysed the 2014 Zambian radiography diploma curriculum and its alignment to the educational domains of learning and the contemporary competencies expected of radiographers at diploma level. Radiography, as a professional practice, is one that relies on the technical skills of an individual to provide images that will be utilised in the diagnosis and management of a medical condition [11]. Coupled with the spirit of vocational and education training, which also emphasises on developing sufficient technical skills to allow and individual effectively contribute to delivery of a service, the Zambian radiography programme is intended to have a healthy blend of expected learning outcomes that ensure technically competent individual capable contributing to the medical imaging process in a meaningful way [5]. The analysis of the 2014 Radiography diploma curriculum showed a combination that was skewed towards cognitive competences. The question that arises is whether such a combination is sufficient for the training of a radiographer. The Society of

Radiographers of the United Kingdom has established a learning and development framework for clinical imaging which outlines competence areas for training of radiographers. While this framework is designed for degree level radiographers, the inference can be drawn in terms of the required combination for competence requirement for radiographers. This framework provides a balanced mix between the cognitive, psychomotor and affective competencies [12]. Such a framework for training radiographers currently is unavailable for the Zambian setting. Attempts have been made by the Health Professions Council of Zambia to establish core competencies for health professions which can be used to as a reference framework. However, this framework is yet to be implemented. The operationalisation of such an agreed framework would serve as a guide for curriculum developers. Furthermore, the level within each domain is a transition between lower order to higher order [12]. It would be expected that at the diploma level, such a balance would also be required. One can argue that the distinction into two distinct levels (Higher-order and lower-order) for the three domains (Cognitive, Psychomotor and affective) [8] places diploma training at a disadvantage because a middle ground is probably the best where a balance or transition level is provided. Our study also showed that over 70% of all the learning outcomes were in the lower order skills range. This combination of predominately cognitive learning outcomes and a ranking of lower-order ability may be a cause for concern in a training that is designed to produce technically competent radiographers. The competence of a graduate from such a training programme can be called into question because radiography as a profession is considered to be a predominately skills-based practice [13]. The skillset of diploma radiography candidates in Zambia is essential to interrogate because these individuals are the workhorse of the medical imaging service delivery in Zambia. In a situation such as the Zambian scenario, where very few radiologists are available, the competence of these frontline health workers is vital [5]. Furthermore, in the event where these individuals are considered for continuous professional development, questions concerning what level of prior learning should be regarded as important [14]. In a study by Vanckavičienė and his colleagues [15], the competence categories were streamlined into two categories, technical and patient care related competences. The technical capabilities refer mostly to cognitive and psychomotor skills necessary for the production of high-quality images for medical diagnosis and management [9]. In our study, it was established that the curriculum had also emphasised the category of competences. However, the drive was on centred on most cognitive aspects. This picture calls into question the readiness of graduates in terms of their ability to perform in the workplace. The quality and type of curriculum have an impact on a graduate's capacity to perform in a work environment [16, 17]. This is so because the learning outcomes provide the basis for what is taught assessed and learnt [18].

## **5. Limitations**

The study focused on the evaluation of the Zambia national diploma curriculum to provide insight into possible competence gaps. Evaluating other aspects such as actual workplace competence, views of supervisors, and students can provide much more information. Furthermore, the study findings can only be extrapolated to training programmes with a similar curriculum. However, the aim was to establish a conceptual framework that can be utilised to yield information concerning the link between curriculum inadequacies and competence gaps.

## **6. Conclusion**

The framework developed for curriculum evaluation based on Harden's curriculum mapping approach, McNeil's [7], approaches to Bloom's classification of education domains, Miller's prism for assessment of competences [8] and Anderson's Radiographers Competence Scale [RCS][9] proved valuable in obtaining information about curriculum competences. The 2014 Zambian diploma curriculum is skewed towards establishing lower cognitive competences. If the curriculum has been implemented with design, one would call into doubt the competence level of the graduates from such a system. The curriculum is critical in establishing the framework for training and thus, subsequent reviews must attach importance when setting up learning outcomes. It would also be essential to conduct a complete curriculum mapping by addressing other factors such as teaching methods, timing, and assessment [19]. Such an approach would provide better insight into the state of the radiography curriculum.

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