

## Doctoral Student Research Skills: Case of the University of Rwanda – College of Education

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### Abstract

*Although many universities offer Doctoral programs by research in the field of education, students' preparation to conduct doctoral research has remained uncertain. This paper reports the knowledge and skills of doctorate students of one college of the University of Rwanda acquired during their initial training on academic and scientific writing in terms of research methodology. We administered a questionnaire to 11 doctorate students before and after the training to reveal the training practices and analysed the content of two research proposals. Results show that participants had a moderate knowledge of educational research methodologies before the program and were improved after the training. We, therefore, concluded that further enhancement of training on research skills amongst doctorate students in education is essential to ensure the production of very knowledgeable and skilful students before engaging in any research for publication. We expect that this paper will contribute to the improvement of Doctoral programmes.*

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**Keywords:** Academic writing, doctoral research, doctorate students, research knowledge.

### Introduction

Research plays a significant role in the economic development of any country (Inouye & McAlpine, 2019; Nsanganwimana, 2018; Plowright, 2016). Research does not only lead to discoveries, innovations, and the creation of new technologies and products. However, it allows practitioners to contribute to the existing knowledge that can help to improve and solve a variety of political, socio-economic, technological, and environmental issues. One of the aims of Higher learning institutions is to train students in the creation and dissemination of knowledge, equipping them with the necessary research skills and prepare them for knowledge society (Melin & Janson, 2006; Mowbray & Halse, 2010). However, several factors that are to do with prior knowledge have been hindering students' success in pursuing research in an appropriate direction. This paper explored this hypothesis by analysing the research skills among doctorate students.

East African region needs more research personnel to face the challenge of an insufficient number of students at the doctorate level and gender imbalance in both staff and students in higher learning institutions. Thus, encourage regional Universities to train more doctoral students embarking on the programme. Sponsored by World Bank, many regional universities, including the University of Rwanda (UR), have won and initiated Centres of Excellence that offer a doctorate programme by research in different fields, including education. The centre that was investigated for the purposes of this article is the African Centre of Excellence for Innovative Teaching and Learning Mathematics and Science (ACEITLMS) based at the University of Rwanda, College of Education (URCE). The ACEITLMS goals include empowering human capacity to deliver quality research based on teaching and learning mathematics and science in Rwanda and across the region.

Students gaining entry into the doctorate programme at ACEITLMS have an educational background plus science or mathematics at either Masters or Undergraduate level, and have passed the interview. So, they possess needed skills for writing as a means of creating knowledge rather than producing knowledge (Inouye & McAlpine, 2019). Skills include but are not limited to knowledge and understanding of the field and mastery of the research method associated to that field, ability to contribute to the knowledge, ability to make judgments by criticizing and analysing the new and complex idea, ability to focus on the learning expertise and communicate their idea to the society. However, students' competences and preparedness to showcase their potential to do research are still questionable. This is possibly because students in the region have been obliged to embrace an education system that uses non-native language as the medium of instruction. Common drawbacks in research writing may indicate areas for improvement of competencies, abilities, and skills in conducting doctoral research. In the light of diverse complications such as this one, publication rate and timely completion of the programme among doctorate students are invisible (Ndayambaje, 2018; Nsanganwimana, 2018).

In response to improving competences, abilities, and skills needed to engage in doctoral research, many universities offer and organize different pieces of training, workshops, and seminars on a range of topics. For instance, ACEITLMS holds and provides a non-credited training on scientific and academic writing within URCE. The training conducted by visiting famous professors in education aim at equipping students with the ability to communicate their ideas in their areas of expertise with peers, the broader scholarly community, and the society in general through writing. These training sessions are meant to support students in the write up of their research proposal as well as in their writing for publication as the doctoral programme is currently by research with a production of final thesis (There is no structured training on research skills though the rules and regulations for research clarify structure of the thesis). It follows the ACEITLMS code of conduct requires them to publish at least three papers in Scopus or Thomson Reuters indexed international journals before they are awarded a degree. Given this background, it is essential to analyse the pre-knowledge and the training outcomes regarding research skills on scientific and academic writing among doctorate students. In the existing literature, there are discussions on completion rate of postgraduate students with little say about program design itself as well as students' prerequisite skills. The study anticipated that ACEITLMS and other institutions in a similar context would be informed on the kind of research knowledge and skills needed and when they need it, so it is taken care of timely before embarking on any research at the doctorate level. The article draws on available literature and the authors' experiences as students that are undertaking the programme and supervisors.

## **Literature Review**

Previous studies on the doctoral experiences suggest that doctoral students face a variety of difficulties during their

studies (Pyhältö, Toom, Stubb and Lonka, 2012). While supervisors can change particular supervision protocols to improve doctoral throughput rates (ibid.), the present study focuses on enhancing students' research skills that encompass problem-solving, critical thinking, and information skills. According to Garg and Passey (2018), research skills refer to the ability to search for a problem and respond to it using appropriate means. Inouye and McAlpine (2019) have also referred research skills to individuals with diverse knowledge of understanding the field of study, the research methods and capability to apply them. It involves much reading, exhaustive search, critical analysis in the light of responding to the specific questions or hypotheses of the topic under study. The development of research skills are important mostly to doctoral researchers who are commissioned to produce new knowledge, interpretations and explanations through writing (Inouye & McAlpine, 2019). On the other hand, making an effective writing of high scholarly level requires skills and strategies. Academic writing emphasize logical reasoning (Samuels, 2013). Effective academic writing should demonstrate clear argument by supporting them with evidence, logical connection between sentences and coherence between paragraphs with a developed idea. Thus, a collection of skills is needed to make a good writing.

Doctoral research differs from research at other levels due to the new useful knowledge that is expected to have resulted from it and be used to address workplace issues and real-world problems. Doctoral research has been considered as the most valued and high scholarly research because it engages individuals in the position to acquire the necessary skills needed to carry out independent and original research and allows showing their potential to do research (Nsanganwimana, 2018). The motivations for individuals to undertake doctoral research derive from career, job, or personal fulfilment (Nsanganwimana, 2018; Plowright, 2016). When a large number of candidates succeed in conducting quality doctoral (Ph.D) research, it increases the university visibility and attributes for ranking and accreditation. Besides, when individuals complete a doctoral study, they are awarded a Ph.D., that guarantees them as workforce and implementers of different policies and they can, therefore, contribute to the economic development of a nation (Ndayambaje, 2018).

Potential candidates at a Ph.D level are required to fulfil the university requirements before admission. For instance, many European universities need doctoral candidates to pass the interview or written test before admission (Sadlak, 2004). Once enrolled in a doctoral program, students continue to work on the idea of getting into a doctoral degree and especially reducing the size of the project through reading literature reviews (Nsanganwimana, 2018; Plowright, 2016). Students review literature critically in the searches of the topic and gaps and synthesize the idea and write in a comprehensive way because they will have to defend their proposal before writing a thesis or a dissertation with their assigned supervisors in the field. Although being a doctorate student is enough to have a Bachelor's and Baster's or equivalent degree (Alabdulaziz, 2020), it does not mean that one has the necessary skills for academic writing. That is why different universities choose the types of doctoral degrees they can offer to support

their students (Plowright, 2016). The question remains on how those skills can be acquired, how and where its development takes place.

Besides, students at the doctoral level should acquire research skills, competencies, and abilities in academic and scientific writing in order to produce research with new knowledge. According to Plowright (2016), the new knowledge derives from the conceptualization of the project, methodology, methods, and empirical work to the thesis. Also, Ndayambaje (2018) added that new knowledge is influenced by professional development. Learning and education development enhance the profession to be taken by someone in the future since the units are mainly accountable for the professional development of staff relating to teaching and learning as well as providing teaching quality within the institution (Samuels, 2013). In this regard, there is a need to analyse the research knowledge and skills of doctorate students accumulated after training in terms of academic and scientific writing.

Several authors (e.g. Garg and Passey, 2018; Inouye and McAlpine, 2019; Mowbray & Halse, 2010; Ndayambaje, 2018; Plowright, 2016) have stressed that supervision and mentorship, relevant trainings, feedback on scholarly writing, workshops, seminars and conferences facilitate students' research skills development during doctoral program. They focused on the knowledge and understanding the research methods and methodologies (Plowright, 2016) as a key skill to be possessed by students. Also, research skills of students have been assessed through their project at the undergraduate level (e.g. Garg & Passey, 2018; Meerah et al., 2012) in order to know the weakness of the program. To our knowledge, there has been little emphasis on the research skills that students ought to possess before embarking on doctoral program and no study have analysed this situation. For that reason, this paper reports the result of the study that analysed the pre-knowledge and training outcomes in terms of academic and scientific writing of doctorate students in research skills. It also highlights weaknesses and strengths of doctorate students on research skills needed in writing for publication or thesis.

### **Research problem and aim of the study**

Like in many doctorate programs, a range of skills are needed for successful completion. One of the primary reasons is the required task at the doctorate level to serve the society for their well-being (Inouye & McAlpine, 2019). Candidates appear as a reserve force towards societal needs, problem solvers, and academicians in a related field. The doctoral candidate is supposed to be a good thinker, critical instructor, and a knowledge supplier. However, there are unclear guidelines and structures, in particular, the shifts from pure science and mathematics to educational research-based methodologies. Naturally, there is no formal assessment since pieces of training are not associated with credits for a certificate through one training session offered to ACEITLMS students on academic and scientific writing courses offered by an international expert ended with one assessment. The course aimed at improving postgraduate skills in criticising and analysing academic reports themselves as well as developing skills for writing academic papers. The curriculum included two parts: (1) Structuring research proposal, learning to write using evidence and paragraph writing, argumentation and literature review, conceptual frameworks and methodology,

writing for publication, research management, and supervisory relationships, (2) Individual consultation. The period of the study was eight days, from 16 to 23 March 2018. This paper discusses a series of skills gained by doctorate students during training on academic and scientific writing as well as individual consultation outcomes. To achieve this aim, we first analyse the doctorate students' prior knowledge before training and then analysed the post knowledge after the training. This study benefits universities catering to doctorate programs to design needed training systematically. It also helps students that want to undertake such a program and engage in a research career to prepare beforehand well.

### ***Research design and data analysis***

This study reports the research knowledge and skills of doctorate students accumulated during training on academic and scientific writing. To attain this aim, we employed a quantitative and content analysis research approach (Fraenkel, Wallen, & Hyun, 2012). We analysed ratings from doctorate students from questionnaire using Microsoft Excel and presented them in texts and tables of frequencies. Consequently, we analysed comments given by the trainer in writing doctoral research proposals. We analysed research proposals' comments to triangulate the questionnaire data (Orodho, Nzabarirwa, Odundo, Waweru, & Ndayambaje, 2016). To retrieve data from commented proposals by the trainer, we compared the provided comments in each section of the research proposals before and after the training. Content analysis is the best way to analyse data in social science. Krippendorff (1989) defines content analysis as "a research technique for making replicable and valid inferences from data to their context (p. 403)." The appropriate sources of content analysis data are texts varying from verbal, written texts, to visual representations. In our case, we have undertaken the written tests as we analysed the research proposals.

### ***Participant and data collection***

There were 25 doctorate students in mathematics and science education from which 14 sponsored by the ACEITLMS and 11 non sponsored. The main difference between these two categories consist in while the former category is full time engaged in their doctoral programme without any other workload and include both national and regional candidates, the latter is composed of candidates (mainly national) who have full employment in other either URCE or other instructions. The attendance to the training is compulsory for the first category and optional for the second. Therefore, only 11 students who attended the research training for at least four times within eight days participated in the study. They were in a range of specializations: Mathematics (3), Physics (3), Chemistry (2), and Biology Education (3). Data were gathered from a questionnaire and two research proposals. These two out of 11 proposals were picked because they fulfilled conditions by which the participants were willing to share their proposals with us and give consent to analyse them. Another condition is the proposals that received comments before and after research training during an individual consultation (student vs. trainer). For instance, some proposals were given comments before and not after the training and vice versa. The questionnaire contained six questions and was

a five-point Likert-scale, coded from highly sufficient=1 to very low=5. That is their experience and knowledge in research skills before and after training and their ability to engage in academic writing after they receive training. Percentage points to identify the level of understanding in terms of research methodology amongst doctorate students and common drawbacks found in their research proposals were used. In addition to this, the study sought to evaluate the training styles used. For the ethical purposes, all names and any other identification were not disclosed..

### Data Presentation and Findings

The study had three research objectives. The first concerns with the level of understanding of research methodology while the last two involved with drawbacks found in research proposals. Table 1 presents the percentage level of knowledge of doctorate students of research methodology.

Table 1: Experience of doctorate students in research methodology

<b>Have you been introduced to the following during your previous studies?</b>	<b>Yes</b>	<b>No</b>	<b>Maybe</b>
Formulation of a research topic	81.82	18.18	0.00
Formulating research questions	72.73	18.18	9.09
Formulating hypotheses	72.73	18.18	9.09
Choosing a research theory	54.55	45.45	0.00
Data collection process in your field of study	72.73	27.27	0.00
Writing a literature review	72.73	18.18	9.09
Searching into databases for existing literature in your field	81.82	9.09	9.09
Developing conceptual frameworks	45.45	54.55	0.00
Avoiding plagiarism	90.91	9.09	0.00
Research Ethics	72.73	27.27	0.00
<b>Average</b>	<b>71.82</b>	<b>24.54</b>	<b>3.64</b>

From Table 1, most of the doctorate students (71.82%) have experienced educational research methodologies before enrolment to the programme. They are most knowledgeable on how to avoid plagiarism, as 90.91% of doctorate students said that they had been introduced to it. About 81.82% of them showed that they have been introduced in the formulation of a research topic and searching into databases for existing literature. However, 54.55% and 45.45% of doctorate students showed little experience in developing conceptual frameworks and choosing a research theory, respectively.

Table 2: Knowledge of PhD students in research methodology before and after training

<b>At what level did you have the knowledge about the following before the training?</b>	<b>Highly sufficient</b>		<b>Sufficient</b>		<b>Neutral</b>		<b>Low</b>		<b>Very low</b>	
	<i>Bef</i>	<i>Aft</i>	<i>Bef</i>	<i>Aft</i>	<i>Bef</i>	<i>Aft</i>	<i>Bef</i>	<i>Aft</i>	<i>Bef</i>	<i>Aft</i>
Argumentation	0.0	<b>18.2</b>	63.7	<b>63.7</b>	18.2	<b>18.2</b>	9.1	<b>0.0</b>	9.1	<b>0.0</b>
Paragraph writing	18.2	<b>36.4</b>	27.3	<b>54.6</b>	27.3	<b>9.1</b>	18.2	<b>0.0</b>	9.1	<b>0.0</b>
Academic language	9.1	<b>36.4</b>	27.3	<b>63.6</b>	36.4	<b>0.0</b>	9.1	<b>0.0</b>	18.2	<b>0.0</b>
Idea within paragraph	9.1	<b>36.4</b>	36.4	<b>63.6</b>	18.2	<b>0.0</b>	27.3	<b>0.0</b>	9.1	<b>0.0</b>
Writing for publication	9.1	<b>27.3</b>	36.4	<b>36.7</b>	18.2	<b>18.2</b>	18.2	<b>18.2</b>	18.2	<b>0.0</b>
Organizing themes within a literature review	9.1	<b>18.2</b>	36.4	<b>63.6</b>	9.1	<b>18.2</b>	27.3	<b>0.0</b>	18.2	<b>0.0</b>
Finding journal	9.1	<b>36.3</b>	36.4	<b>54.6</b>	18.2	<b>9.1</b>	18.2	<b>0.0</b>	9.1	<b>0.0</b>
<b>Average</b>	9.1	<b>29.9</b>	37.7	<b>57.2</b>	20.8	<b>10.4</b>	18.2	<b>2.6</b>	13.0	<b>0.0</b>

When we asked doctorate students their level in educational research methodology before training, 9.1%, 37.7%, 20.8%, 18.2%, and 13.0% of students responded highly sufficient, sufficient, neutral, low, and very low respectively (table 2). The knowledge received by doctorate students in educational research methodologies after training has shown improvement. For instance, 29.9%, 57.2%, 10.4%, 2.6%, and 0.0% of doctorate students responded highly sufficient, sufficient, neutral, low, and very low, respectively, showing that they have benefited from the training.

After checking the outcome of the training, we thought of measuring the ability of doctorate students in academic writing. Table 2 shows how these students improved their proficiency in academic report writing, critical reviewing, English writing, and analysing research methodologies.

Table 2: Ability of doctorate students in academic writing after training

<b>How did you improve your ability for the following in the table below?</b>	<b>Highly sufficient</b>	<b>High</b>	<b>Moderate</b>	<b>Low</b>	<b>Very low</b>
Academic report	9.09	27.27	54.55	9.09	0.00
Critical reviewing	18.18	9.09	72.73	0.00	0.00
English writing	9.09	45.45	45.45	0.00	0.00
Analysing research methodologies	18.18	36.36	27.27	18.18	0.00

The doctorate students were able to improve their ability to educational research writing. For instance, most of the doctorate students (100%) showed that they had improved their critical review and English writing, 90.91% and 81.82% of them rated more than low sufficient in terms of the ability of academic writing and research methodology analysis respectively (see Table 2).

Apart from the outcome of the training, the study has also sought to evaluate the training strategies used (Figure 1).

Figure 1: Training strategies used during the training

Doctorate students rated usefulness of training strategies at 81.8% (presentation), 72.73% (discussion), 54.55 % (both group work and feedback), and 45.45% (assignment). In other words, doctorate students were more exultant with course presentation than being given an assignment.

The last two research objectives relate to drawbacks found in doctorate proposals and training outcomes in supporting participants to overcome these drawbacks. Table 3 presents comments given to students by the trainer face to face (individual consultation) before and after training. It means, when a student met with the trainer before the training (referred to as first meeting), during training, the student has to address the comments and modify according to skills gained from the training. Finally, he/she met again with the trainer after the training (referred to as second meeting) to track the improvement. We have analysed the proposals according to their sections. We have elaborated on the comments given in the first meeting and consistently track the changes after the second meeting, along with each comment. We read and classified them as main comments, and counted them and presented their number (quantity). "No" stand for several comments before and after the training (number of given comments). For example, the empty cell means no comment found, and in the column of "no" is zero.

Table 3: Research proposal was given comments before training: case one

Part of the research proposal	Before training		After training	
	no	Main comments	no	Comments
<b>Title</b>	1	Do not use acronyms in titles	0	
<b>Number of words</b>	1	This proposal is too long at the moment. Aim for 3000 words maximum	0	
<b>Introduction</b>	10	-The introduction is too short -The phrasing is not well -Unnecessary phrase -You have omitted the scope of Tanzanian secondary schools	0	
<b>Background</b>	20	-Repetition of the same thing in one paragraph -Phrasal verb -I think you are jumping into this without defining key terms -Seems to be a vague, general statement -For a summary which lasts more than one sentence, just use he/she and leave out the citation -Putting a series of citations in brackets does not constitute a persuasive argument -You have already introduced an acronym of ICT -Not the right choice of connecting word (furthermore) at the end of a paragraph: better to use in conclusion/summary, etc. -This paragraph is WAY too long! -Why use full citation? Kafyulilo et al. -Using a section title like this in the background sounds like	0	



		a section in a literature review		
<b>Problem statement</b>	<b>0</b>		<b>0</b>	
<b>The significance of the study</b>	<b>0</b>		<b>0</b>	
<b>Aims and objectives of the study</b>	<b>6</b>	-Two objectives are few. We recommend between 3 and 7	<b>1</b>	-Check to unpack; it can take you to a PDP cascading
<b>Research questions</b>	<b>1</b>	-These questions are not consistent with the objectives. I think they are essential questions, nonetheless. Perhaps you should be exploring these in your proposal? You could also ask questions about the other elements of your conceptual framework	<b>0</b>	
<b>Research hypotheses</b>	<b>1</b>	-I don't think this kind of statistical null hypothesis is beneficial here	<b>0</b>	
<b>Conceptual framework</b>	<b>5</b>	- These constructs appear challenging to measure and will depend upon the context	<b>0</b>	
<b>Literature review</b>	<b>-</b>	<b>-</b>	<b>7</b>	-Come up with the general statement at the beginning -Too many things need to be more specific in the argument. Link Livingston with Smeets
<b>Methodology</b>	<b>5</b>	-This section reads like a grand tour of different possible methods. I am not sure why they all need to be used. Without understanding your aim better, it is difficult to assess a common-sense approach to how to achieve it -If you are planning an intervention, you need to include this in your objectives. Have you considered action research? -What is the purpose of the control group?		
<b>Total</b>	<b>50</b>		<b>8</b>	

In case one, there was a drop of comments from 50 comments given in the first meeting to eight comments given in the second meeting. The structure of the research proposal was as follows: introduction, background, and problem statement, the significance of the study, aims and objectives of the study, research questions, research hypotheses, conceptual framework, literature review, and methodology. The background contained sections; the literature review was empty filled. In contrast, the sections in methodology were the population of the study, sampling, data analysis, research variables, tools, validity and reliability, research ethics, and work plan. However, these sections were not given comments. The whole proposal before training had 5 334 words, while after training, it

counted down to 2 660 words, both without references. The title was constructed in 19 and 17 terms before and after training, respectively.

Table 4: Research proposal given comments before training: case two

Part of the research proposal	Before training		After training	
	no	Main comments	no	Comments
Title and the number of words	1	-Good title	1	Add the "influence of the development."
Introduction	0		0	
Background	27	<ul style="list-style-type: none"> <li>-This is a pleasant coherent paragraph; however, you need to improve your grammar. Please install Grammarly.</li> <li>-Put the author's name outside the bracket, e.g., According to (Vijay Kumar, 2013)</li> <li>-Another good paragraph, but perhaps it needs a conclusion</li> <li>-You need to define this acronym before you use it, e.g., PCK</li> <li>Define this the first time you use it.</li> <li>-It is not the number of researchers; it is the quality of their research and arguments, and how highly they are regarded by the research community that matters. This is a form of critical thinking</li> <li>-Direct quote: add a page number</li> <li>-Perhaps you need to discuss this before the previous paragraph.</li> <li>-Exaggeration, e.g., PCK is found to be very crucial in setting up the stability of all types of teacher's knowledge</li> <li>-Is this topic relevant to your study? As your proposal is nearly 4000 words long, perhaps this paragraph can be omitted?</li> <li>-I would end the background here</li> <li>-You now seem to be moving into the niche, which should be discussed under the problem statement</li> </ul>	0	
Problem statement	4	-You seem to be repeated the argument you made above	0	
Purpose of the Study and Specific Objectives	3	-This is an explicit aim	1	Reframe objectives referring on the new title
Research questions	3	-I do not see the need for this additional question.	1	Reframe research questions referring to the new title
Significance of the study	1	-I suggest writing this as a single paragraph, not as bullet points.	0	
Conceptual framework	4	-Say something about this diagram. Is it your own or someone else's? It seems to contain some elements that you have not discussed above	1	Good conceptual framework

<b>The scope of the Study</b>	<b>0</b>		<b>0</b>	
<b>Literature review</b>	-	-	<b>1</b>	Three themes are well elaborated in the literature review
<b>Methodology</b>	<b>9</b>	- This is the first time you have mentioned this outcome in the text. It needs to be discussed earlier. Are you also going to measure learning outcomes using traditional assessment techniques? E.g., problem-solving and students attitudes (in research design) - Thesis writing? In work plan instead of report writing	<b>0</b>	
<b>Total</b>	<b>52</b>		<b>5</b>	

In case two, there was a drop of comments from 52 comments given in the first meeting to five comments given in the second meeting. The structure of the research proposal was as follows: chapter one as an introduction sectioned by the background of the study, problem statement, purpose of the study and specific objectives, research questions, significance of the study, the scope of the study, theoretical framework; and research methodology sectioned by research area, research approach and design, population, sample size, sampling technique, data collection method, data analysis procedures, validity and reliability, and ethical issue; and work plan. The whole proposal before training had 3 416 words, while after training, it counted to 3 813 words, both without references. The title was constructed in 19 and 21 words before and after training, respectively.

In the background section of the first case (Table 3), the trainer has advised that students should carefully choose the connecting words like “furthermore” to avoid confusion. It is also good to not use full citation (Figure 4). The example was extracted from the proposal of one student (case one) where the trainer was giving comments.

in the creation of knowledge-based society with a target of integrating ICTs throughout the education system by June, 2021 (URT, 2016). Furthermore the policy strategizes to ensure effective use of ICT in teaching and learning in both the formal and informal education system.

These efforts resulted to increased access to technology and integration in different sectors. For example there has been increasing use of mobile devices such as phones. For example telecommunication subscribers rose from 2.96 million in 2005 to 39.8 million in December 2015 (URT, 2016). Computers availability in educational institutions has also increased. For example in 2009 teacher education college **ware** equipped with computers in order to prepare teacher to integrate technology in teaching (Kafyulilo, Fisser, Pieters, & Voogt, 2015). Despite this increase in ICT facilities and devices, their uptake in education is still low (URT, 2014, 2016). Different challenges have impeded ICT integration in education. Such challenges include

**Comment [PCS27]:** Not a good choice of connecting word at the end of a paragraph: better to use in conclusion/summary, etc.

**Comment [PCS28]:** This paragraph is WAY too long!

**Comment [PCS29]:** Good use of evidence.

**Comment [PCS30]:** Kafyulilo et al.

**Comment [PCS31]:** I don't fully understand this evidence. What exactly are you saying?

Figure 4. Trainer's comments on connecting word and referencing

Before the consultative meetings, case one does not have a literature review section. However, based on the second consultancy, students should come up with the general statement at the beginning before they undergo the specific context (Figure 5). This instance does not apply to the only literature review, but whenever one is introducing a particular section.

### Literature review

This section provides the review of related literature to the study. the review is organized thematical. It begins with explaining the educational potential of ICT and then the extent of use of ICT. Also, factors affecting effective use of ICT are explained as well as the more focused teacher factors and their relationship with effective use of ICT in mathematics education.

Comment [u2]: Come up with the general statement before this. This should be about ICT and say it context.

Figure 5. Trainer's comments on starting section writing

Similarly, on the second student (case two), the referencing style was tackled the first time the trainer met with the student. He advised on putting the author's name outside the bracket. He also recommended defining any acronym before using it. An example was PCK, which was to be set before use it as pedagogical content knowledge to help the reader to read the work (Figure 6).

According to (Vijay Kumar, 2013), the quality of mathematics teachers is [very crucial] in making the process of teaching and learning effective and hence improving student performance in mathematics. Also Orchieng, et al.( 2017), indicated that the achievement of mathematics is a function of both students and teachers, and can be described in terms of teacher's competences and learning outcomes. The highlight of (Vijay Kumar, 2013) in the effective process of teaching and learning, it is strong engagement process, for which teachers are to be equipped with teaching competency. However, {student's} encouragement toward LEARNING mathematics depends on the extent in which mathematics teacher deal with the subject in classroom (Ratna, et al. 2016)]

Comment [PCS5]: Put the author's name outside the bracket.

Comment [PCS6]: Overstated

Comment [PCS7]: students'

Comment [PCS8]: Another good paragraph, but perhaps it needs a conclusion.

For many years now [PCK] has become familiar construct in THE education system particularly in

Comment [PCS9]: You need to define this acronym before you use it

Figure 6. Trainer's comments on referencing guideline

Sometime, students may be confused during the training (research objective section under Table 4). Where the objectives, for example, were apparent before the training and ambiguous after training. For instance, the trainer recommended more than three objectives in the doctorate research (Samuels, 2018), but the student failed to adjust them with the new suggested title. As mentioned by the trainer in the first case, students also need to specify or define the terms and not bring a new concept in the middle without previously explained (see Table 5 and Figure 7).

### 3.2.2 Research Design

The design of the study will be correlation study design. Correlation research design seek to discover the relationship between two or more variables without any attempt to influence or manipulate them (Orodho, Khatete, & Mugiraneza, 2016). The variables in this study are mathematics teacher's PCK (pedagogical knowledge, content knowledge and learner's knowledge) and student learning outcomes (Problem solving skill) and Students Attitude). Thereby the researcher is interested in correlating between these two variables.

**Comment [PCS44]:** Assumes that your variables are valid scale measures of your constructs. Unless you can measure these constructs in a multidimensional way you are in danger of simply establishing an obvious positive correlation between PCK and learning outcomes.

**Comment [PCS45]:** This is the first time you have mentioned this outcome in the text. It needs to be discussed earlier. Are you also going to measure learning outcome using traditional assessment techniques?

**Comment [PCS46]:** Similarly for this outcome

### 3.3 Population

Figure 7. Trainer's comments on explaining variables of keywords

## Discussion of findings

The purpose of this study was to analyse the research knowledge and skills of a sample of doctorate students at the UR College of Education before and after consuming research training on academic and scientific writing. The study suggests that participant doctorate students showed experience on how to avoid plagiarism, and they have been introduced to the formulation of the research topic and searching into databases for existing literature. However, the little experience was found among students in developing conceptual frameworks and choosing a research theory, respectively. These results are also supported by the data from document review before and after training. They show similar findings from the study of Meerah et al. (2012) that suggests students should, without doubt, gain new skills when they are exposed to the training. Therefore, they would be good at research methods. Plagiarism should be avoided as much as any academic researcher can (Sibomana, Ndayambaje, & Uwambayinema, 2018). This practice helps the researcher to build on the other existing works but in his/her original way. Conceptual frameworks and choosing a research theory should be emphasized in the next training as these are essential knowledge in structuring the research paper. It shows that the lack of skills to build a conceptual framework will end up omitting the research variables and therefore struggling to understand the connections of input and output of research. Consecutively, a quantitative theory should be accompanied by a learning theory such as constructivism theory so that the researcher checks if his/her study findings compromise with the suggested theory. Controversially, the deep analysis of a certain behaviour would end up generating a new theory.

A successful doctorate student could mainly depend on countless factors which may be from the surrounding environment. According to Nsanganwimana (2018), among the main determinants of a successful student include career aspirations, interest in the topic, and intrinsic personal motivations such as a sense of identity, self-enrichment, and general intellectual interest to prove themselves at a higher level. Regarding research knowledge and skills gained before and after the training, doctorate students have developed their expertise in educational research. Some skills on argumentation, paragraph writing, academic language, the idea within a paragraph, writing for publication, organizing themes within a literature review, and finding journals were improved.

The last has resulted in the significant improvement of students' ability and confidence in writing an academic report, critical reviewing, English writing, and analysing research methodologies. The fact that some students still rate academic writing and analysing research methodologies low sufficient, they think of publication upon drafting a research paper. Some also refer to reviewing or criticizing other's papers such that they evaluate the consistency and write up, such as the research method used to carry out a particular paper. It would be called upon ACEITLMS to encourage seminars on review papers so that students experience the review process and enhance critical reading and evaluation.

Participant students were generally happy with the different strategies used during the research training course, but particularly presentation mode occupied about 81.8%. Various methods of professional development on this aspect of research training were tried out successfully, as indicated by multiple pieces of literature. Hence, the university needs to offer such training and workshops to improve the current research training since the students showed moderated knowledge of research preparation. Although teaching strategies are a core of the learning activity that aims at bringing student's active involvement and fulfils their needs, it does not always allow us to progress. It moves forward because it mostly culminates with traditional teaching methods and is unlikely to produce significant changes in the learning processes. In the present study, students appreciated the trainer's presentation instead of being given an assignment. Critically, any teaching method that enables and enhances the betterment of the learning of the course content is essential. It would activate students' curiosity about the learning topic, develop critical thinking skills, keep students on task, and engender sustained and useful classroom interaction (Kolesnikova, 2016). According to Prince (2004), a meaningful learning activity that enables students to think about what they are doing is the active learning method. The last is often contrasted to the traditional way where students passively receive information from the instructor. Therefore, students are encouraged also to shift to active participation such as appreciating performing a given assignment.

At the doctorate level, when students fail to conceive research knowledge and skills needed in producing new experience, they delay completing their doctorate program (Baltes & Brown, 2018). Garg & Passey (2018) supports the practice of providing intensive research training, seminars, and workshops to doctorate students by research in education to improve their preparation to research work even though students show moderated developments. Common drawbacks in the research proposals indicate weak prior knowledge and skills in conducting research. In analysing two cases of doctorate research proposals, there was a substantial decrease in the number of comments in both analysed research proposals. The case one had 50 comments given in the first meeting, while only eight comments were given in the second meeting. Consecutively, case two had 52 comments given in the first meeting, while only five comments were given in the second meeting. It shows a significant improvement in training and individual advice. The trainer also emphasized on making a short proposal counting 3000 words with a short title. The ability to shorten the number of words in the research proposal without losing argument reflects gained

knowledge. The short research proposal convinces as it summarizes many arguments into a single construct the evaluators to understand the intention of the researcher within their limited time. The short title of a research work removes the confusion that a reader might face.

Our findings are in connection with the findings of the study conducted by Meerah et al., (2012). They found that moderate knowledge on research preparation can prove one's ability to conduct research even though the research does not meet the desired level. For improvement, the university should offer training and workshops in that aspect. Also, the level of supervisor-supervisee interaction, technical guidance, and feedback from supervisors can support students to develop their level in writing academic document. For instance, the response testified that the level of supervisor and the way he/she guides the student is the power of improving skills in research. This instance is evidenced in the present study where provided consultative meeting has cleared drawbacks and mistakes found in the students' research proposals.

## **Conclusion**

The present study intended to reveal the level of research methodology skills that doctorate students have before admitted to a doctorate program, drawbacks in their proposals as well as how they overcome these drawbacks after receiving the experts' comments and research method training. It was found that students were not new in mathematics and science education research methods. For instance, they have already experienced in avoiding plagiarism (90.91% of them). In comparison, 81.82% of them have been introduced in the formulating research topic and searching into databases for existing literature during their undergraduate and master programs. However, some of them showed little experience in developing conceptual frameworks (54.55%) and choosing a research theory (45.45%). The knowledge before and satisfaction after training about argumentation, paragraph writing, academic language, the idea within a paragraph, writing for publication, organizing themes within a literature review, and finding journals were also increased comparatively. They have all of them even showed that they improved their critical evaluation and English writing. At the same time, 90.91% and 81.82% of them rated sufficiently in terms of the ability of academic writing and research methodology analysis, respectively. Doctorate students rated the usefulness of training strategies with course presentation than being given an assignment. While analysing the proposals, most comments and advice given to students were to make an understandable title which is free from acronyms, write a coherent paragraph with proper argumentation, well citing and referencing others' works, explain clearly variables, theming literature review and make a proposal within 3000 words including the reference list. In general, the results indicated that participants have moderate skills for academic and scientific writing. Moreover, research shows that different aspects of training on professional development have yielded interesting results. Therefore, the URCE-ACEITLMS should continuously offer and enhance such training and workshops to Doctoral students.

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