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Pre-service Teachers' Secondary School Experiences in Learning Geometry and their Confidence to Teach it

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Abstract

This paper presents the findings of a convergent parallel mixed methods research that was carried out to explore the views of student-teachers on how geometry was taught and the confidence of those student-teachers in teaching geometry to secondary school learners when they will become professionally qualified. Respondents were randomly selected from two Colleges of Education in Burundi. Although the study was predominantly quantitative, some qualitative data were also collected to gain deeper insights into the prevailing situation. Ninety-seven pre-service teachers of Mathematics from the said institutions completed the questionnaire whose items were closed-ended except for one that was open-ended. Results show that the teacher-centered approach had dominated geometry classes in their respective secondary schools. Nevertheless, student-teachers exhibited higher confidence in teaching geometry. These findings provide evidence on the need for teacher education programs to consider embedding instructional and assessment approaches designed for specific branches of mathematics.

Keywords: confidence, experience, geometry, pre-service mathematics teachers

INTRODUCTION

Experience is one of the attributes that can influence positively or negatively a person's behavior towards something in the future. Having been in school for many years and sometimes having been taught by teachers of different educational backgrounds, pre-service teachers can analyze different situations regarding the teaching and learning of various mathematical concepts. These learning experiences can influence their teaching practices and confidence when they become professionally qualified. Geometry is one of the topics that is taught in every class where Mathematics is taught not only in Burundi but also in other settings worldwide. Both the analytic and algebraic aspects of geometry should be taught to students. However, the latter seems to be more interesting than the former for most Burundian teachers. For instance, the National Bureau of Evaluations in Burundi [NBEB](2015) reports that some teachers are spending the whole year teaching algebra and skipping geometry chapters. Sunzuma and Maharaj (2019) in Zimbabwe also found that even in-service teachers did not learn some topics and they had to skip those chapters because they did not have sufficient knowledge to teach them. They found that 47.5% of in-service teachers were not well prepared to teach geometry due to the insufficient competency in the topic.

That deficiency of teachers has affected the teaching and learning of geometry. Due to the teachers' fear of that branch, students fail even some chapters of algebra related to geometry. The way geometry has been taught at secondary school is one of the reasons for that fear, especially that elementary geometry is not usually taught at the tertiary level of education because every student is considered to have some basic understanding of the topic. Worse still, new teachers are requested to teach geometry at a time they are not ready and not well prepared in terms of content and knowledge (Adolphus, 2011; Jones, 2002). The pedagogies of how geometry is to be taught are equally not seen in the mathematics curriculum of the university. The only course they take during their study program (teaching) is called 'didactic of mathematics' which is general and does not deal with how specific topics are to be taught

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Contribution to the literature

- Given the way teachers teach, this paper will help to expose what is happening in Burundian schools and inform those responsible for making decisions to act accordingly.
- It will also allow higher education institutions to adequately prepare their students in content and pedagogy and will integrate some specific courses or tutorials on using software like Geogebra, Graphmatica, and others.
- While most previous studies have focused on the experiences of in-service teachers, this study explored the views of university students regarding their past experiences at the secondary level and their confidence to teach geometry before they go on the field.

Amidst the challenges highlighted above, there has been no study conducted in Burundi to get the views of the future teachers on how confident they feel to teach geometry, and how they intend to improve the teaching and learning of geometry.

Pre-service' Experience as Students

Governments and researchers aimed to enhance the way mathematics is taught and sometimes focus their researches on in-service teachers. High performing countries in mathematics such as Japan, Singapore, Russia, Hungary, and Finland focus their researches in primary school considered as the only way to produce young people mathematically confident (Burghes & Lawlor, 2012). Students are taught by mathematically competent teachers and that prepares students for the career of teaching (Burghes, 2012). Researchers have also devoted time to study the views of pre-service teachers on how they are prepared and how they are confident to teach mathematics in general and Geometry particularly. Some of them went far and developed scales with which you can measure teachers' interest, enjoyment, and confidence with mathematics (Brady & Bowd, 2005; Chen, McCray, Adams, & Leow, 2013; Li & Kulm, 2008). Also, researchers have focussed on the experience of pre-service about different projects like project-based learning to enhance the way mathematics is taught at all the levels of schools (Tsybulsky, Gatenio-Kalush, Ganem, & Grobgeld, 2020). Bekdemir (2010) in his research on pre-service teachers mathematics anxiety found that the worst mathematics classroom experience creates anxiety towards mathematics and in most cases, teachers' behaviors or teaching approaches are the causes of that anxiety. For instance, some of the pre-service teachers he interviewed revealed experienced hit, insults, negative judgments (bonehead), disdain, high speed of teaching and other reasons which created anxiety. This leads to the hatrage of mathematics because students are sometimes classified into two major groups: those who are 'good' and those who 'are not good' in mathematics.

One of the ways of creating confidence in students is to create a classroom environment where wrong answers are seen as an opportunity rather than a problem. Olson and Jablon (2019) distinguished Mathematics Anxiety (MA) and Mathematics Teaching Anxiety (MTA). MA is related to the anxiety caused by mathematics while MTA is related to the teaching of mathematics. Aithal and Kumar (2019) discussed whether the objectives of courses in postgraduate should be knowledge with skills or knowledge with confidence and found that for being successful in the world of competition, confidence is important. Gresham and Burleigh (2018) found that the way participants in their study were re-taught the same subjects easily so that they can understand changes the way they were thinking about mathematics.

Ball (1990) conducted a study on primary and secondary pre-service mathematics teachers and found that some of them fear to teach mathematics even though they feel full of content but not enough prepared for teaching it. The results from that study were of three kinds: worry about how 'to *word'* mathematics, confidence to teach mathematics (algebra and geometry), and worry about *concepts.* Avcu and Avcu (2015) found that attitudes toward mathematics topics are different from each other and that like one branch of mathematics and hate another is common among students and mathematics teachers. Charalambous, Philippou, and Kyriakides (2008) in their research on pre-service teachers found a low level of confidence among those pre-service teachers, and some went far claiming not able to teach mathematics. '*I am not qualified*' say one of their interviewees. This leads to anxiety toward mathematics.

Li and Kulm (2008) revealed a 'double discontinuity' for pre-service teachers. The first one appeared when students from secondary schools enter university (college) where they learn advanced mathematics disconnected from the mathematics they learn in terms of abstraction. The second appears when pre-service teachers finish college studies and begin to teach secondary mathematics which is disconnected to the mathematics learned at college but connected to what they saw as secondary school students, sometimes not seen everywhere in their college' studies.

Mathematics anxiety is not limited at the primary level. Brady and Bowd (2005) found that some students experienced good moments in the primary but boring situation without any connection with the real world at secondary school with mainly the chalk and blackboard

method. The same study shows that the previous learning experiences and the lack of confidence in the subject are the causes of mathematics' fear among students. The authors showed that anxiety is carried with pupils even at the college level. Given the fact that those pupils of today will be teachers of tomorrow, that anxiety will be transferred to students again and so and so one.

Teachers' trainees mathematically anxious are likely teachers with low confidence in teaching mathematics and that cycle of anxiety deserved to be broken by focussing research on its development and effects as teachers and students. This can be done by training teachers on how to focus on individual development instead of comparing students among themselves and creating situations where students get opportunities of playing with examples related to the concepts (Bekdemir, 2010). Without surprise, Bursal and Paznokas (2006) revealed a high level of confidence in pre-service teachers with a low level of anxiety while those with a high level of anxiety have a low level of confidence. It is probably obvious that teachers with a high level of anxiety are likely those teachers who teach for teaching without care about methods or procedures to follow. They don't care of what to teach, how and what students are learning. That anxiety can also create a lock to mathematics learning which leads to the hate of that science.

Pedagogical Content Knowledge

The contribution of future teachers is important in improving the way mathematics is taught. At any level, every teacher needs to be confident with the topic s/he teaches. This cannot be possible if the teacher is not acquainted with the topic so that he can teach it in a variety of ways. The lack of adequate preparation in mathematics in both contents and pedagogy leads to classroom difficulties if it becomes the time for teaching mathematics. This is often found among early years mathematics teachers as pointed out by Moss, Hawes, and Naqvi (2015) where the lack of content is accompanied by the lack of confidence. Ball (1990) noted that the traditional teacher education did not prepare adequately the future teachers in content but prepared them pedagogically ignoring that you cannot teach what you do not have.

Askew (2020) found that research is not focussing on the quality of teaching and learning mathematics and sciences as it was expected. That gap in the research about the quality of teaching and learning pushed Fenstermacher and Richardson (2005) to define the quality of teaching as well as the characteristics of a good quality of teaching. According to them, teaching is a process where teachers are engaged in a relationship with students to acquit content to students. That definition is not complete and leaves unresolved senses of teaching.

The acquisition of enough knowledge and skills in mathematics will lead to confidence which influences positively teachers' practices and students performance (Li & Kulm, 2008). Research indicates that teachers with confidence in mathematics are comfortable when they learn new skills while those not confident tend to avoid the teaching of it (Chen et al., 2013). Besides, Henderson and Rodrigues (2008) suggested to do not change the level of mathematics but it is necessary to analyze the kind of mathematics to be taught and learned for giving a full foundation of mathematics which leads to confidence and competence of teaching mathematics. Also, Bishop (1986) suggested to strongly emphasize the spatial and visual roots of geometry for better preparation of mathematics teachers at the tertiary level.

According to Meserve and Meserve (1987), pre-service teachers need to deepen their understanding of geometry not only for future use but also for their aids of mathematics. In the context of South Africa, Bowie, Venkat, and Askew (2019) found that pre-service teachers of the fourth year of universities who are prepared to teach at primary schools had a poor performance than those in the first year. This implies that the expected mathematics to be taught by those students who were at the end of their studies is not guaranteed especially because the question on which they are responded are those of primary schools. The refrain of you cannot teach what you do not know can be applied for the context of South Africa as well as elsewhere. The preparation of pre-service mathematics should enable them to view mathematics by emphasizing on approach to objectives, contents, and methods.

Research has shown a positive correlation between teacher qualification and students' achievement. The National Research Council (2001) has shown that teachers with high content knowledge go far by questioning students for a better understanding than those with low content knowledge who only give superficial explanations. King and Newmann (2000) revealed that the improvement of teachers' knowledge and skills is important for better students' achievement and that can be done using Teacher Professional Development. The authors noticed a full contact and control of teachers on students. Pre-service teachers need good preparation rather than a general education.

Smith (2018) compared the Knowledge of Teaching Geometry between pre-service and in-service mathematics teachers and found that in-service teachers are better than in-service. That gap is attributed to the experience of teaching that in-service have. That study showed a gap in some contents which pre-service missed at their colleges and gained during the experience in teaching. Someone with a bachelor is considered as a qualified teacher in the context of Burundi, though that qualification is not specific to a branch of mathematics. Although a student who successfully passed the certification test is considered qualified, it does not mean

that he is qualified in the teaching of each branch of mathematics.

Li and Kulm (2008) summarized five components knowledge by adding one component not found in the categorization of Shulman (1986) as follows:

1. Common content knowledge (CCK) is the common knowledge in the specific subject that is required for everyone who finished secondary school before starting university. Pre-service teachers need to know it at the same level as in-service teachers.
2. Specialized content knowledge (SCK) is the type of knowledge specialized and of the high level of abstraction that students need to know because they are still in the position of learning.
3. Knowledge of content and students (KCS) is the knowledge related to the difficulties of learning and common misconceptions of learners. Pre-services teachers sometimes are not aware of that because of the lack of experience in teaching. However, some pre-service teachers remind how they were the time they were pupils and remind their errors, not for others.
4. Knowledge of content and teaching (KCT) is the type of knowledge that is used in the practice of teaching. It includes knowing the appropriate approach that fits with specific content for teaching a specific topic for a better understanding (Henderson & Rodrigues, 2008; Li & Kulm, 2008)
5. 'Knowledge of mathematics curriculum (KMC) is part of Pedagogical Content Knowledge in Shulman's (1986) categorization, but not part of MKT. It is an important part of what pre-service teachers need to learn through their program of study'

Research has focussed on the improvement of teachers' knowledge and skills. Given the fact that the effort doesn't give the expected outcome, research has emphasized the preparation of pre-service teachers and build confidence by preparing those pre-service teachers in contents and pedagogically. What remains is to know the extension of that preparation and what is needed to enhance classroom practice in the future (Li & Kulm, 2008).

Geometry is full of examples of life with many visible applications. Examples that teachers can found within the classroom are not shown to students for a better understanding of geometry concepts or topics. The way someone has been taught is often the way he wants to teach. Research has shown that some teachers forgot the methodology they learned from universities and try to teach the way they have been taught (Vidermanova & Vallo, 2015). To be a teacher, it requires not only pedagogical content knowledge but also a vocation, confidence, and creativity by not giving only the example you saw in class but linking and analyzing examples susceptible to reinforce the understanding and prepare students for life.

Confidence

According to Cambridge Advanced Learners' Dictionary Third Edition, confidence is '*the quality of being certain of your abilities or of having trust in people, plans, or the future*'. Ball, (1990) revealed that pre-service secondary mathematics teachers start their education program with enough background in education, and thus that creates confidence to teach it. However, more mathematical preparation in colleges may not lead to more confidence if that preparation is not completed by the need for teaching school mathematics. Confidence in what pre-service required to learn is needed but also confident in what to know for teaching (Li & Kulm, 2008). According to them, pre-service teachers need to learn and master mathematics knowledge for teaching for being able to teach mathematics with confidence in their daily classroom practices. However, even though participants in his study revealed the usefulness of geometry in life and their career, the research of Tsao (2017) revealed that many pre-service primary teachers do not manifest a positive attitude toward geometry learning.

Gresham (2017) showed that the lack of confidence and anxiety are the major barriers of participants in his study to advanced courses. That low level of confidence is also at the origin of choosing to teach at a low level (grade). Pre-service teachers show also that their low level of confidence pushed them to do not take advanced courses by avoiding hindering their students. Iyer and Wang (2013) studied the relationship between anxiety, self-efficacy, and content knowledge and found that the low level of anxiety, high level of content knowledge, and self-efficacy are the factors that lead to confidence.

Stipek, Givvin, Salmon, and MacGyvers (2001) have shown that the confidence of mathematics teachers is correlated with the self-confidence of learners in mathematics in elementary schools. Asked to rank teachers' attributes, 95% of students who participated in the research conducted by Henderson & Rodrigues (2008) put confidence at the third position of importance after good basic numeracy skills and enthusiasm. Though, that confidence is low even for students with higher requirements than the minimum for entering teacher undergraduate primary teaching program. Norton (2017) found that confidence in mathematics content and confidence in teaching mathematics were high in the Australian context among primary pre-service teachers. Gresham (2017) has found that some teachers interviewed have lost their confidence in early education but have increased their confidence in teaching mathematics after training. He found that anxiety and mathematical confidence affect classroom practices. Ron and Kaur (2017) found that homework can

build the confidence of students. Teachers with confidence in what they teach do not have a complex of explaining in simple words that enable students to well understand.

PURPOSE OF THE STUDY

This study explored how pre-service teachers had been taught geometry at secondary school and their confidence in teaching the topic when they become professionally qualified. This study was guided by the following research questions:

1. What are the pre-service teachers' experiences in learning geometry when they were secondary school students?
2. How confident are they in teaching geometry when they become qualified teachers of mathematics?
3. What are the potentially optimum ways through which the teaching of geometry could be enhanced?

It is hypothesized that the way those pre-service teachers were taught at secondary school may affect their confidence to teach geometry. It is also anticipated that other researchers could use the results from this research to make further suggestions on how geometry teaching and learning could be enhanced.

METHODOLOGY

Research Design and Respondents

A convergent parallel mixed-methods design was used for this study. Quantitative and qualitative data were collected via a questionnaire and were analyzed separately.

This study was conducted among pre-service mathematics teachers in the first and third year of study towards a Bachelor of Mathematics with Education at École Normale Supérieure (ENS) du Burundi and Institut de Pédagogie Appliquée (IPA) which is the College of Education affiliated to the University of Burundi. Ninety-seven students were chosen randomly among students in mathematics from the two aforementioned institutions who train secondary school teachers. Students are admitted at the two Institutions without any criteria about the background in education. They are admitted after a National exam which gives them the opportunity of studying in National Universities after secondary schools.

The respondents were in two groups: the first group is the group of new students in the first year, without any experience in educational courses at the university level and any content knowledge from their colleges while the second group was of those who have been trained in Pedagogical Content Knowledge and ready to start their internship in different schools. Two reasons pushed the researcher to choose those two groups: the first reason is that for students of the first year, they remember well in details how geometry have been taught to them; the second reason is that, the second group have been trained to teach and have been trained in Content Knowledge even though the content in which they are trained is not related to the one they will teach.

Within each of the two groups (1st and 3rd years), some had primary school teaching background, while others were only trained in sciences without any experience or course in teaching.

Given the fact that students were trained in different schools, the results from this study could be generalized and give an overview of the way geometry is taught in Burundi and how it will be taught according to the views of pre-service teachers. Also, during the time those pre-service mathematics teachers filled the questionnaire; there was no relationship either academic or personal with the respondents and the researcher. This can indicate that the answers are not influenced by any factor and would be as sincere as possible.

Instruments, Data Collection Procedures, and Validation

The data was generated from a questionnaire distributed to mathematics students from two Colleges of Education. The questionnaire was designed to explore the respondents' views and feelings about the teaching and learning geometry they benefited from secondary schools and their confidence to teach some specified topics of geometry at their round.

The questionnaire had 31 items where 21 items were related to the teaching practices and thoughts while the remaining items where related to the confidence of teaching geometry on ten geometry topics. An exploratory factor analysis using principal component extraction was carried out using SPSS software version 20. It showed that 3 items did not meet the criteria of factor great than .40 and were removed from the questionnaire. All the items that their factor was greater than .40 were all retained and are the only ones presented in this study.

The questionnaire compromised closed-ended questions and open-ended questions. The quantitative data about their experience as students and their confidence to teach some selected topics were collected using closed-ended questions. The open-ended questions complemented the closed-ended where pre-service teachers were asked to suggest ways for enhancing the teaching and learning of geometry. They were required to give their views on how they learned geometry in their respective secondary schools and their confidence in teaching the topic. The instruments were designed by the researcher and given to the experts for checking. The instrument was checked for reliability after a pilot study.

Table 1. Students-teachers agreements on perceived classrooms practices and thoughts

Agree and Strongly Agree	%
Teachers were Lecturing	83.51
Teachers were lecturing and give exercises	74.23
Teachers were giving Reason to study a concept	46.39
I was ease in geometry	79.38
Geometry was not well taught	34.02
I liked geometry	43.3
Geometry was interesting	79.38
I can choose geometry as other branches	38.14
Elders applied geometry	67.01
Geometry was complicated	43.3
I could have liked if it was taught by material	82.47

All the questionnaire items were internally consistent since the Cronbach's Alpha (α =. 77) is way above the recommended threshold of .70 (Taber, 2018). However, it is highly recommended to report Cronbach alpha for sub-categories than that of a questionnaire as a whole. Following this recommendation, further analysis showed an initial Cronbach alpha value of .63 for 21 items related to teaching practices. After the removal of 3 items that did not meet the criteria, the remaining items gave a Cronbach alpha of .68. Despite being slightly less than the recommended threshold, this value was considered acceptable especially after the qualitative analysis of the retained items. The other 10 items related to student-teachers' confidence were all retained with the Cronbach alpha of .80.

Respondents were asked to state their experiences as former secondary students about the teaching methods, and what they experienced in the classroom throughout their schooling in elementary, middle, and high school. Their confidence to teach geometry as mathematics teachers in the future was also explored. Ten topics were selected to be used for asking them to assess their confidence to teach it. The open-ended questions were about the propositions of enhancing the teaching and learning of geometry according to their views.

Data Analysis

A side-by-side comparison was used to analyze data. According to Creswell (2014), a side-by-side comparison is a way of presenting data from quantitative and qualitative data by starting presenting quantitative (or qualitative) and then presenting qualitative(or quantitative) data that confirm or disconfirm the first results. Quantitative data were analyzed using descriptive statistics generated by SPSS version 20. Qualitative responses for an open-ended item were analyzed into categories of meaning based on the themes that emerged from the data.

An independent samples t-test was used to establish the significance of the mean differences in geometry teaching confidence levels between year 1 and year three student teachers. There has been a growing concern in educational research that statistical significance alone may not be practical because it does not quantify the extent to which the group means differ. To account for this inadequacy, and following recommendations by Lakens (2013, p.3), Cohen's d effect size was calculated using the following formula:

$$\frac{M_1 - M_2}{\sqrt{\frac{(n_1 - 1){SD_1}^2 + (n_2 - 1){SD_2}^2}{n_1 + n_2 - 2}}}$$

In this formula, the numerator represents the mean difference between two independent groups whereas the denominator is the pooled standard deviation.

RESULTS

Pre-service Teachers' Experience

The results about the experiences of prospective mathematics teachers are presented in two different tables (Table 1 and Table 2) according to where a high percentage of participants agreed or disagreed on the practices or the thoughts. Table 1 shows the percentage strongly Agree and Agree for some classroom practices and thoughts in geometry as indicated by prospective teachers while Table 2 shows the percentage of strongly Disagree and Disagree.

Teachers were mainly lecturing and give exercises without interesting students. Fewer of those pre-service teachers (34.14%) can choose to teach geometry compared to the other branches of mathematics while 79.38% of them were ease in Geometry. Most of them (82.47%) could have liked geometry if it was taught using materials.

Some pre-service teachers revealed having experienced 'bad' events in the teaching of Geometry. This is like the ways demonstrations were taught and marked. '*It was just like a set of rules to follow without accepting their reasoning*' replied one of the respondents in this study.

Table 2. Students-teachers disagreement on perceived classroom practices and thoughts

Disagree and Strongly Disagree	%
Teachers used material	55.67
Students worked in the groups	69.07
Teachers awarded groups	58.76
Students chose the sitting arrangement	56.7
I liked Geometry	37.11
Geometry should be removed from the curriculum	96.91
Teachers skipped geometry chapters	63.92

Table 3. Level of confidence to teach some selected topics
0= no confidence, 1=very low, 2=low, 3= average, 4=high, 5=very high

Topic	***n***	**Level of confidence**					
		0	***1***	***2***	***3***	***4***	***5***
Triangle	92	0	2	1	14	36	39
Remarquables lines of triangles	94	0	1	5	18	45	25
Thales Theorem	89	0	1	7	51	14	16
Quadrilaters	86	0	0	8	22	37	19
Conics	91	0	7	10	27	25	22
Projections	90	0	1	6	15	28	40
Isometries	90	2	9	20	30	18	11
Homotheties and similarities	91	16	20	23	23	6	3
Parallelism	93	3	4	7	18	28	33
Reduction or increase figures	91	26	18	11	16	10	10

Confidence

Results show that most of the respondents are confident to teach geometry and manifested to like geometry at the same level as other branches of mathematics. Some proposed to learn additional courses of geometry and participate in a workshop for geometry teaching. Others were not happy with geometry content even though they will be obliged to teach it. The enrolled students might have been influenced by the experience they have from their university courses and the level of reasoning they now have.

In this area, there were no variations accordingly to the institution of origin or level attending but variations due to the way they are trained at secondary schools.

It was expected that students from the first year will be less confident to teach geometry because they have not yet studied many Geometry courses and methodology but they manifested confidence to teach it expecting some supporting courses in the second and third year of college.

Table 3 summarizes the results in terms of percentage for those pre-service teachers about the level of understanding some of the 10 selected topics from the curriculum of mathematics at secondary school level which related to the confidence they have to teach it.

Table 3 shows a low level of confidence to teach homotheties and similarities where 16 out of 97 do not have the confidence to teach it. The reduction of the figure also has low confidence among those preservice teachers. This might be because those chapters were located at the end of the year and some teachers did not finish the curriculum.

Comparison of confidence between 1st year and third year

Table 4 illustrates the means and standard deviations regarding student teachers' confidence in teaching various geometrical concepts. Respondents were requested to rate their level of confidence from 0(no confidence) to 5(highly confident). To test whether the differences in means between first-year and third-year student-teachers were significant, an independent samples *t*-test was used. Although the normality assumption was not met in some cases, the computed skewness coefficients for each group (yea1 and year 2) on all of the 10 itemized geometry concepts were within the acceptable range of chance fluctuations. Levene's test for equality of variances was also satisfied for items 3, 4, 7, 8, and 9. Equality of variances was not assumed for the rest of the items and appropriate statistics have been reported.

Results in Table 4 indicate that the confidence level of third-year student teachers was significantly higher than that of first-year student teachers with an exception of items 5, 7, 8, and 10 as indicated by their p-values. All the pairs that showed a statistically significant mean difference also exhibited above medium (d = 0.5) to above large (d = 0.8) effect size. Among the items that did not show a statistically significant mean difference, only item 5 had a relatively medium effect size. These results tend to suggest that the confidence levels in geometry teaching were higher among third years than those of first-year student teachers.

Table 4. Comparing Student-Teachers' Confidence in Teaching Geometry (Year 1 Vs Year 3)

Geometry Concept	Year of Study	N	M	SD	t	df	P-value.	d
Item1	1	20	3.60	1.23	-2.60	22.4	.016	.892
	3	72	4.35	0.69				
Item 2	1	22	3.32	0.99	-3.51	28.7	.001	.993
	3	72	4.13	0.75				
Item 3	1	21	3.05	0.97	-2.15	87	.034	.537
	3	68	3.53	0.87				
Item 4	1	20	3.40	0.88	-2.20	84	.031	.561
	3	66	3.89	0.88				
Item 5	1	22	3.05	1.59	-1.65	26.7	.112	.503
	3	69	3.64	1.01				
Item 6	1	21	3.57	1.25	-2.42	25.7	.023	.743
	3	69	4.28	0.84				
Item 7	1	21	2.76	1.41	-0.82	88	.415	.204
	3	69	3.01	1.18				
Item 8	1	21	1.90	1.22	-0.03	89	.977	.007
	3	70	1.91	1.36				
Item 9	1	22	3.00	1.41	-3.25	91	.002	.792
	3	71	3.99	1.19				
Item10	1	21	1.95	1.28	-0.01	47.2	.989	.002
	3	70	1.96	1.85				

Note. The statistical significance of the mean differences is set at .05. The order of items in this table follows the one in Table 3.

Suggested solutions for enhancing geometry teaching

Asked to suggest three ways through which geometry teaching and learning could be enhanced, respondents have varied views. The propositions given were mainly focussed on the implication of government and university teachers. They are grouped into two main groups: internal to teachers and external. The internal is about teachers to change the way they are teaching strategies by focussing on what students need to learn instead of content-oriented: using concrete material, practical work, increasing the applications in the teaching and motivations. One of the respondents said:

> High school teachers are called upon to provide a great deal of effort so that the subject provided is taught. I find that the similarities and the homotheties are not taught by the majority of the teachers.

The external is about the implication of higher institutions and government. One of the respondents said:

> University teachers need to be involved in effective geometry teaching. It is not normal for a student to complete his studies in Mathematics without being able to draw a figure using a computer.

Another said:

> The government should do everything to ensure that mathematics is taught by only those who are qualified. It is absurd that mathematics is taught by an Engineer in agriculture and expect performance for the students.

That participant touched the quality of teaching they received and compared it to the qualification of the teacher.

Preservice teachers from the first-year proposed solutions related to teachers blaming the way of teaching. They expect enough training in geometry teaching at their respective colleges. However, there is no course related to geometry teaching in their curriculum.

DISCUSSION AND CONCLUSION

The purpose of this study was to explore the experiences of pre-service mathematics teachers from two institutions training teachers in Burundi. Results show that participants have learned geometry in very different ways. Although Geometry is perceived as complicated and difficult to teach, none of the pre-service mathematics teachers who filled the questionnaire has suggested that Geometry should be removed from the curriculum of mathematics. This result is not similar to the results of Bekdemir (2010) where some pre-service teachers proposed some subtopics to be removed from the curriculum. Almost all the respondents agreed or strongly agreed to maintain the curriculum as it is. However, some of the respondents attributed the bad experience they encountered to the content of geometry itself especially the teaching of proof where 43.3% found geometry as complicated. Though they are prepared for teaching it, they do not see a miracle solution to well teach the section related to proof so that they can bring all the

students to a better understanding given the fact that they are not taught how to approach that part even for participants from the third year.

Prospective mathematics teachers from the aforementioned institutions have had various experiences in geometry when they were in high school. Based on results displayed in Table 1, a larger proportion of the teachers agreed or strongly agreed that the lecture method dominated the teaching of geometry in their classrooms. Results further revealed that group work was rarely used. This is contrary to the recommendations of previous studies (Chin, 2014; Fritz & Butterworth, 2019; Mukuka, Mutarutinya, & Balimuttajjo, 2019) that have stressed the need to embrace cooperative learning models to improve the teaching and learning of mathematics. This shows that students were passive and active learning was not used. The method-oriented was more prevalent than the material-oriented. This research also revealed that future mathematics teachers do not generally like it. Only 38.14% of respondents can choose to teach geometry among other branches of mathematics. In addition, respondents see lecturing as a good way of teaching because 83.51% agreed that teachers are lecturing but only 46.39 % agreed that geometry is not well taught. This is against excellence in teaching which requires presenting the link of every basic concept of mathematics with its application by bringing insight to students from different backgrounds and levels of understanding which is not the case for most of the lecturing teaching method (Wood & Harding, 2007).

Furthermore, results show that those prospective teachers were taught without concrete materials (55.67% agreed or strongly agreed) and show that 82.47% of the participants could have like geometry if it was taught using materials. Lecturing dominated the teaching and exercises were given after lecturing. In addition, pre-service mathematics teachers were not implicated in the process of learning. Less than half of participants were told the reason why they were taught a certain topic while nowadays, starting by giving the importance of learning a specific mathematics topic could enhance and increase attention and attitudes toward mathematics. This can help to avoid the question of why students learn geometry and its applications to real-life situations.

Confidence

It has been found also that pre-service mathematics teachers are confident to teach geometry despite some ineffective practices or no- innovative methods of teaching they experienced back in secondary school. A simple comparison of participants from the first year and the third year shows that third-year student teachers had a high level of confidence than those in the first year. This could be attributed to the fact that third-year student teachers had been exposed to more content and pedagogy of mathematics education as opposed to their counterparts in first-year who had just joined tertiary education.

That high confidence was also reported in the results of Norton (2017) though he noticed that teachers overestimated it. High confidence was also reported by Gresham (2008) in preservice primary teachers with a low level of anxiety. Low confidence was observed on the teaching of some topics like homotheties, similarities both for 1st and third year. Geometry is viewed as difficult and that hardness is sometimes due to the way it has been taught. Confidence was found in all levels and is supported by the results of Nisbet (1991) where students at a high level of university manifested a high level of confidence than students at a low level of the university.

Results also have shown that prospective teachers want to enhance the way geometry is taught. The participants proposed a series of methods and practices which could improve how geometry is taught in Burundian secondary schools. These include, among other things, the recruitment of competent and qualified teachers in geometry; the introduction of mini-computer drawing programs at the university level; the introduction of specific didactic courses for teaching mathematics branches. The participants also proposed the reinforcement of the capacities of the content and pedagogical knowledge because they noticed a fault in the content of some teachers which accepted only the procedures found in the guide of the teacher and thus limited the reasoning of their students.

Prospective mathematics teachers miss content knowledge of some specific topics in the chosen and given topics of geometry. This demonstrates the lack of awareness among college lecturers on the level of mastery of geometry content among student teachers. In addition, prospective teachers in the first year did not propose the same solutions for enhancing geometry teaching. Those in the first year expect to be trained on how to teach geometry. They expect also to reinforce some content knowledge they missed at the secondary level in the second or third year. On the other hand, third-year student teachers indicated that they will try to improve the teaching of geometry. Their opinions demonstrate that they missed something they expected to learn at their colleges including the introduction of software in teaching geometry and other courses.

Both quantitative and qualitative data converge on the fact that the respondents experienced lecturing methods and proposed various strategies of enhancing teaching and learning geometry so that it becomes more attractive and effective.

RECOMMENDATION

The results of this study show that prospective teachers experienced different classroom practices including those qualified as non-innovative methods.

Low confidence is reported in some geometry topics. Therefore, the government and stakeholders should ensure that geometry content is well taught. High Institutions in charge of training teachers are recommended to start introducing some basic courses on identified contents where preservice teachers have misunderstandings before starting advanced content in Geometry. This will eventually increase the confidence in teaching geometry among student-teachers. One of the ways of increasing that confidence is to create a laboratory of mathematics where students can 'see' Mathematics and its applications in the real-life. Other researchers can search further and found the relationship between the confidence of teaching geometry and other branches of mathematics including in-service teachers. A follow-up study can be conducted on the same sample for evaluating their level of confidence as professionally qualified teachers.

LIMITATION OF THE STUDY

This study adds value to the existing knowledge of the potentially effective geometry teaching practices in secondary schools of Burundi and other contexts with similar education systems. However, results should be interpreted with caution due to a limitation in the research design used. It has been argued in the literature that survey studies use self-reported data without any evidence of the reality of respondents' reports. The respondents explain their own experience and opinion subjectively according to their understandings. Their status as university students might have influenced them to show greater confidence and show their capacity to be well prepared to teach geometry given the fact that they are supposed to be qualified teachers. They may even consider that stating that they are not ready for teaching Geometry may be a shame on them. The bad practices experienced by pre-service mathematics teachers when they were secondary students might have been forgotten. This is why it is highly recommended that a follow-up study be conducted on the same sample to determine the change in their confidence to teach geometry when they become professionally qualified teachers. At that point, it would be possible to ascertain not only their confidence but their competence as well.

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