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Lesson plan analysis protocol in assessing mathematics and science lessons

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ABSTRACT

Lesson planning is important in an educational setting. This study assessed how Rwandan tutors and teachers prepare lesson plans (LPs) before implementing them in a classroom. We employed a current and standard lesson plan analysis protocol (LPAP) developed by researchers from Rwanda to code data. We collected a representative sample of 119 mathematics and science subject lesson plans from teacher training college tutors and secondary school teachers for analysis to serve its usability. The study results revealed that only 11% of collected LPs were teachable as they were rated in both a good (70-79% scores) and very good (80-89% scores) range of LPAP interpretation. It was also found that the special education needs, lesson approaches, and lesson evaluation components got low mean scores (below 50%). These components were not given appropriate attention in developed LPs. Therefore, this study suggests that tutors and teachers build a quality lesson plan based on the standard LPAP.

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1. INTRODUCTION

In Rwanda, mathematics and science contribute considerably to creating a knowledge-based society and promoting science and technology students' needs for global and regional job-market competitions [1]. The shift from a knowledge-based to a competency-based curriculum (CBC) for mathematics and science is one of the recent reforms that were done seven years ago by the Government of Rwanda to empower more students to be creative and innovative and help them to contribute to solving problems faced in our modern society [2], [3]. This reform also aims to empower and improve students' preparation for the actual job by providing career pathways in science, technology, engineering, and mathematics-related fields.

In supporting the effort put into improving the quality of education, the Government of Rwanda emphasizes the importance of aligning teaching and learning materials with the syllabus to ease the learning process. Some factors influencing what students learn, how well they learn, and the acquired competencies have been reported. Among those factors, one may include the relevance of the specific content, the quality of teachers' pedagogical approaches, the assessment strategies, and the instructional materials [3]. In this era of educational reform in Rwanda, much has been done about professional development and training for

teachers by the Rwanda Basic Education Board (REB) in collaboration with several partners, including Japan International Development and Cooperation Agency (JICA), VVOB, and the UNICEF [4].

Despite different initiatives toward organizing and implementing professional development interventions in mathematics and science, many teachers still claim not to have enough time to plan. This was witnessed in the study conducted on 731 primary and secondary school teachers around Rwanda during CBC assessment training, whereby 82% of teachers claimed that completing the contents is not easy when much emphasis is put on lesson planning [4]. Therefore, there is imperative to train mathematics and science teachers to overcome this challenge by planning lessons wisely and effectively. This paper provides recommendations to improve lesson plan preparation and overcome challenges. This paper may raise awareness for mathematic and science educators on the importance of effective lesson planning.

Teachers' pedagogical content knowledge should not miss important knowledge of quality lesson preparation. In addition to subject content knowledge, lesson preparation knowledge adds value to subject content presentations comprehensively to learners and readers [5]. Mathematics and science lesson preparation act as an image of how math and science concepts flow during instructions. In simplifying this teacher pedagogical knowledge implementation, the lesson plan, as one of the teacher documents, supports them to specify their role and students' stand in a classroom environment [6]. Lesson planning for mathematics and science as concepts requiring a logical way of presenting offers teachers time critically decide lesson types, either traditional or student cantered lessons, to opt for before teaching. This keeps teachers confidential in implementing their professional teaching skills, considering their role as facilitators instead of content transmitters [7].

Lesson planning is essential to promote the quality of lesson delivery. For the perspective of teaching mathematics and science, teachers need to address the description of the lesson and indicate activities in each step. For example, the existing literature [8]–[11] showed that some mathematics teachers do not prepare mathematics and science lessons similarly while the content to be taught is the same. This practice has a negative effect on students' learning [12] and this is the issue with mathematics and science teachers' lesson planning in the Rwandan context [13]–[15]. For instance, Ndihokubwayo *et al.* [16] analyzed physics lesson plans and found that teachers are reluctant to plan lessons as required by CBC, and their lesson plans did not attain higher levels of Bloom's taxonomy. Thus, cognitive, and affective domains and inquiry approaches were not identified in evaluated lesson plans.

Students need learning that helps them develop their understanding and gives them opportunities to practice and consolidate meaningful and effective procedures. It is not always easy to get the resources needed, but if teachers prepare their lessons well that stimulate the students' interest, these resources are not required. Alternatively, one of the aspects of lesson preparation is identifying resources that will help and inspire students to learn [4], [17]. However, given the recognized importance of lesson planning in sessions and suggestions from the lesson planning used in the practicum [18], [19] the present study is concerned with assessing how Rwandan mathematics and science teachers prepare their lesson plans before implementing them in mathematics and science classrooms.

2. RESEARCH METHOD

2.1. Participants

This study applied descriptive research as its framework to explore and understand the issue [20]–[23]. During documents (lesson plans) analysis as one of the qualitative analytical methods [23], we applied our developed and published lesson plan analysis protocol (LPAP) [10] to generate understanding and develop empirical knowledge. The participants were 26 in-service science and mathematics teachers who were purposively selected. All 26 teachers completed their studies at the University of Rwanda College of Education (URCE). The institution was established to produce qualified teachers to improve science pedagogy and other subjects.

Among 26 teachers, 24 have a bachelor's degree (A0), while two teachers have diploma (A1) degrees. All teachers are qualified to teach their respective subjects and were trained in CBC implementation, including CBC lesson plan preparation. There were three teachers teach from grade 7-9; 10 teachers teach from grade 10-12; and 13 teachers teach from grade 7-12. A total of 19 teachers teach in rural areas, while seven teachers teach in urban areas. Sixteen teachers teach in boarding schools, while 10 teach in daytime schools. Day schools are where students spend the night at home [24].

2.2. Data collection and analysis

For the science lesson planning, 123 lesson plans (LPs) from 26 teachers (Mathematics: 18 LPs from 7 teachers, Physics: 41 LPs from 6 teachers, Chemistry: 15 LPs from 4 teachers, Biology: 49 from 9 teachers) were collected. LPs were collected from different teachers regardless of the levels in which they teach and the location of their schools or semester lesson. Teachers were called by phone and requested to

provide their LPs (what they have already used). They were introduced for research purposes, then asked to provide us with their LPs as shown in Figure 1 and assured to use them for only research purposes.

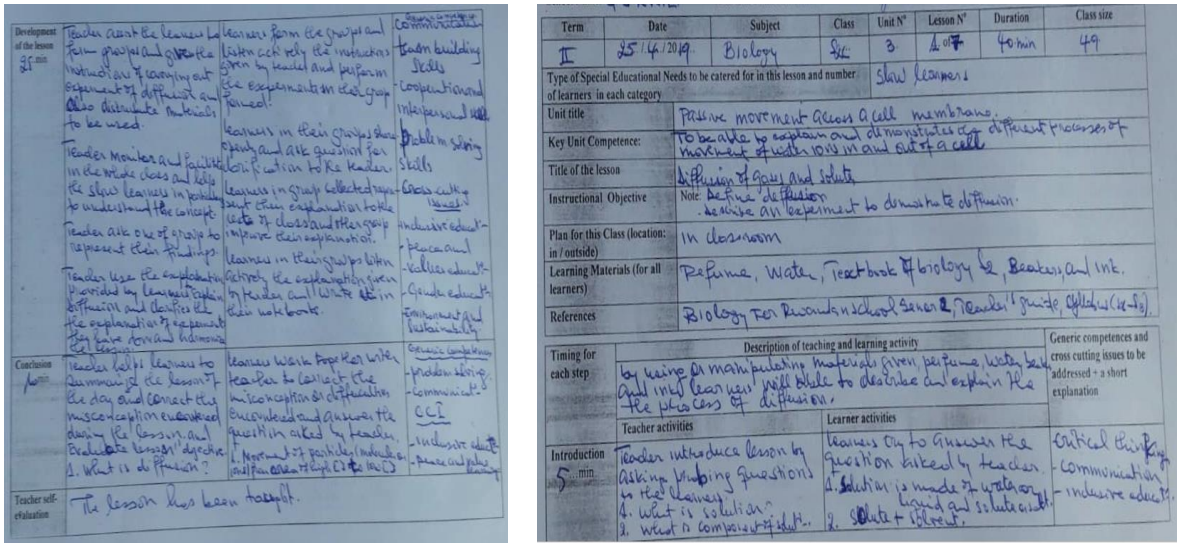

Figure 1. Sample of analyzed lesson plan

All 123 lesson plans were coded using LPAP designed in the Rwandan context, which is vital to the new curriculum CBC, and we sent 119 LPs to the analysis stage as four LPs were duplicates. Analysis was based on nine LPAP components and 27 LPAP items as seen in Table 1 and Figure 2, respectively. For more details on LPAP components and what they inform, refer to the previous study [10]. Data were analyzed using SPSS 23.0 version and Microsoft Excel 2016. The frequencies and percentages of answer categories were calculated among all 27 LPAP items, divided all 119 LPs into LPAP analytical ranges, and computed analysis of variance (ANOVA) statistics among four different subjects.

3. RESULTS AND DISCUSSION

3.1. Results

Among nine LPAP components, the lesson's title has the highest score of 1.79. Note that the highest score is 2. Key unit competence (KUC), title of the lesson, instructional objective (IO), generic competences (GCs), and cross-cutting issues (CCIs) have high mean scores. This high score shows how familiar teachers are with the new curriculum. However, special education needs (SEN), lesson approaches, and lesson evaluation got low mean scores. This shows the need for continuous professional training. Lesson stages to have 1.09 out of 2-mean scores were caused by the fact that many teachers do not use the required and updated LP format recommended by REB [25]. For instance, the development section in the current LP format supplementary materials contains "discovery activities," "presentation learners" findings production," and "exploitation findings production" components. The last component was special education needs had a 0.19 mean as shown in Table 1.

Table 1. Mean and standard deviations of all LPAP components

LPAP components	Mean	Standard deviation
Key unit competence	1.618644	0.738669
Title of the lesson	1.790329	0.323923
Instructional objective	1.573157	0.181903
Special education needs	0.196655	0.357592
Lesson description (DTLA)	1.10084	0.968967
Lesson stages	1.091973	0.190506
Lesson approaches	0.984241	0.134207
Generic competencies and cross-cutting issues	1.470588	0.062633
Lesson evaluation	0.781513	0.703016

In contrast, the conclusion section contains "conclusion/summary" and "assessment/homework" components. Our results show that 91% of all LPs were written using the old (non-recommended) format. Only 6% LPs have been written with the required (current) LP format, while 3% were written with a different REB required (current) LP format. This 3% of LPs were found in chemistry. The teacher used 5E's model to write their LPs. The introduction contained the excite and engage phase; development contained explore, explain, and elaborate phases, while the conclusion contained the evaluation phase. This teacher might use such a format due to the training provided by VVOB Rwanda [26].

The scores of four categories were calculated. Although each item has four scales, the scores are different across the items. The first and second are scored 0, the third is scored 1, and the fourth is scored 2. The items were categorized into three categories for easy analysis. These are "not" as the first two categories, "somehow" as the third category, and "yes, fully" as the fourth category as seen in Figure 2.

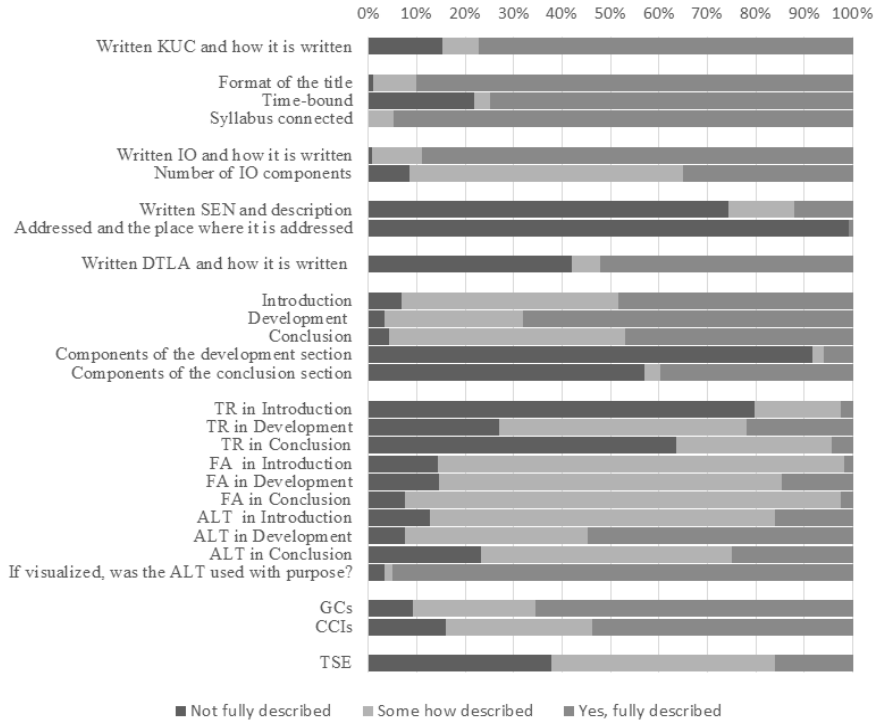

Figure 2. Percent of the answer categories among all 27 LPAP items

Most LPs are categorized as "syllabus connected" (95% of LPs) to the title, while only 1% of LPs address SEN and the location where it is being addressed. Although teachers are knowledgeable about the CBC, they fail to include the KUC in 15% of LPs. Only 2% of LPs have "Formative assessment (FA) in Introduction" as part of the "lesson approaches" LPAP component. In 22% of LPs, the lesson title does not adhere to the allotted time due to an imbalance between the amount of content planned compared to the time reserved on the LP. Only 12% and 14% (yes, fully, and somehow, respectively) of LPs have teachers writing SEN and describing it at the beginning of the LP format. Teachers do not address the IO, description of teaching and learning activity or lesson description (DTLA), or in lesson stages at 99% of LPs. Teachers are not using the development section's components as expected from the REB lesson plan. Only 6% and 3% of LPs contain the required components (yes, fully, and yes, somehow).

In the LPAP, the LPs percentages were categorized into five LPAP interpretation ranges (levels). Therefore, we have found that 16% of LPs range into "poor LPs," and 73% of LPs into "fair LPs." Thus, 89% of the LPs of our collected LPs are not teachable. Only 11% of all the LPs are eligible to be taught as 9%, and 2% of range into "good" and "very good" LPs, respectively Figure 3.

However, we did not find any "excellent LP" among the collected LPs. Among 119 LPs analyzed, 46 were Biology, 15 were Chemistry, 18 were Mathematics, and 40 were Physics as presented in Table 2. Chemistry LPs had the highest mean of 0.66 (66%), and the lowest of 0.52 (52%), and it is Biology. The analysis of variance displays a huge statistically significant difference among the four subjects in lesson planning [ANOVA, df=3, N=119, F=8.35, and Fcrit=2.68, p<.001].

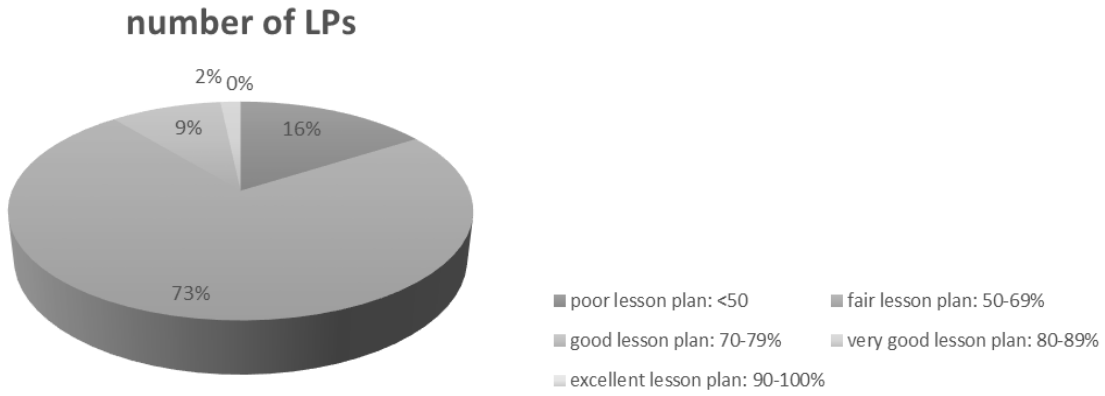

Figure 3. Range of LPs (%) and their interpretation

Table 2. Subjects' comparison across LPAP

Groups	Count	Sum	Average	Variance
Biology	46 (38.7%)	24.05556	0.522947	0.016814
Chemistry	15 (12.6%)	9.962963	0.664198	0.009351
Mathematics	18 (15.1%)	10.59259	0.588477	0.007002
Physics	40 (33.6%)	22.22222	0.555556	0.002585

3.2. Discussion

The study aimed at analyzing lesson plans from science and mathematics teachers. Although the original research of the tool [10] used in this study presented testing results, its findings concur with our present results. Teachers were supposed to use a similar lesson plan format (REB format) and observed that teachers prepare lesson plans differently. Teachers did not correctly prepare the LPs by following the REB format but using a mixture of old (knowledge-based) and new (competence-based) LPs. This way of lesson plan preparations may be due to different factors, including teachers' confusion about the two kinds of LPs (knowledge-based and competence-based LPs). A lesson plan is eligible to be taught if it is clear and opulent enough to direct any teacher to deliver a lesson. Unfortunately, the analysis shows that only 11% of all the LPs attained this. Therefore, most teachers regard competency-based lesson plan preparation as unimportant. These findings agree with other studies that the wrong construction of the pedagogical documents was standard among the pre-service teachers [12], [27] and passive learning is connected to poor lesson preparation and the following scheme work [13].

According to Fujii [28] about lesson planning in lesson study practice, teachers realized the role of tasks connected to the curriculum. The lesson study is a Japanese practice that enhances in-service teacher training [29]. The lesson study has four stages: analysis of the problem at the school level, planning the lesson by all teachers in a specific department of the school, and microteaching, where one teacher delivers the lesson in front of their fellow teachers using a planned lesson plan, implementing after rereviewing the lesson plan the lesson into the real classroom with students while other teachers are observing [8]. After these stages, a research study is conducted. It is a post-lesson discussion where all teachers discuss how the lesson was delivered and provides their insight to decide if a cycle should restart or not [9], [12], [30]. Not only can lesson study practice enhance teachers' collaboration during school-based in-service teacher training [11], but Njiku [12] calls upon teachers to help each other achieve lesson planning. Furthermore, collaboration is needed between the teacher training colleges and the internship schools [30]. Contrary to our findings, a study conducted in South Africa showed that pre-service teachers could incorporate the planning process into their lesson planning and choose teaching methods that scarcely stimulate cognitive skills [31].

Looking at each component, the most correctly done are 'title of the lesson" and "key unit competence." Though these two items are always written in the syllabus, some teachers forget to fill them in a reserved place. For instance, in 15% of LPs, KUC is not written; this may be due to a hurry to cope with time, negligence, or confusion of this preliminary item with instructional objectives because seemingly, in some lesson plans, KUC and IO were not dissimilar. About IO, we have seen that teachers try to state them correctly though some of them do not include all five components as they are (conditions, who, action, content, and standard of performance or criterion). Instructional objectives are essential in designing the competencies a learner should acquire at the end of each lesson. However, the timing and duration of a lesson are crucial to achieving these instructional objectives. For instance, 22% of LPs were found not binding to time.

Although inclusiveness in education is a trending issue globally, in 99% of LPs we analyzed, teachers never described how to address SEN in different stages of the prepared lesson. Teachers mentioned SEN in 12% of LPs, while in 14% of analyzed LPs, SEN was described only at the beginning of the LP. You may be wondering if teachers did not get enough SEN types and how to consider them in each part of the whole lesson, or if they felt it was not much needed. Inclusive education is an education that educates students with special needs together with others. Thus, it considers and accommodates the SEN of students in all lesson activities. According to Lindsay [32], integration is a learner adapting to a host setting such as a school, while inclusion is the host setting adapting to meet that learner's needs. Therefore, lessons should be planned before implementing them into the live class.

Remarkably, lesson stages and approaches, which might be considered the cornerstone of the lesson plan, have 1.09 and 0.97 mean scores. The main aspect behind our low scores is that teachers do not consider the recommended LP format. Besides that, they do not respect the ordering of lesson stage components. In this regard, worries among authors have developed; we wondered whether most teachers have not received sufficient CBC lesson plan preparation or if the time and duties are not correlated. On the other hand, some studies found it hard for some teachers to adapt to changes [4], [11], [33], [34]. However, the effectiveness of reform in a classroom is strongly influenced by how teachers understand and implement that reform. It implies that training for competence-based LP preparation is still needed, so our developed LPAP may boost understanding.

4. CONCLUSION

This paper presented the practices among Rwandan Mathematics and science teachers regarding lesson planning. Within this matter, the findings from this study will motivate teachers to improve their lesson planning. This paper enhances teachers' continuous professional development and self-evaluation about how they prepare mathematics and sciences lessons. The contribution of this study to the literature should not be limited to teachers only. It can be extended to all educational stakeholders to look for mitigative measures to address the gap in poor lesson planning observed among teachers. Referring to the LPs analyzed using the developed LPAP, teaching resources (TRs) were not visualized in the introduction and conclusion of LP among lesson approach components. It does not mean that teachers do not use TRs in class but implies that TR is mainly employed in Lesson development. However, reading our developed LPAP, teachers will know that TRs should be employed in all lesson stages as they attract and open students' minds to discover what behavior they can achieve. Thus, supporting students' hands-on and minds-on in the whole lesson. Our final recommendation is how teachers evaluate themselves after teaching on the LP. Teachers already used all analyzed LPs, but our results show that teachers leave them without commenting on how the lesson went. This assessment is vital as the teachers decide when and how to proceed to the next lesson. Teachers leaving this space show how the whole lesson assessment goes viral. For instance, teachers cannot assess the IO and measure acquired competencies in learners. Therefore, this study suggests teachers' continuous professional development opportunities to focus on LP preparation. In addition, future studies may determine whether what is written in the LP is taught as planned.

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REFERENCES

[1] F. Ukobizaba, K. Ndihokubwayo, and A. Uworwabayeho, "Exploration of societal considerations about Rwandan mathematics teachers' behaviours," *Rwandan Journal of Education*, vol. 5, no. 1, pp. 1–12, 2020.

[2] A. Uworwabayeho, "Teachers' innovative change within countrywide reform: a case study in Rwanda," *Journal of Mathematics Teacher Education*, vol. 12, no. 5, pp. 315–324, Oct. 2009, doi: 10.1007/s10857-009-9124-1.

[3] Rwanda Basic Education Board, "Competence-based curriculum. Curriculum framework pre-primary to upper secondary." 2015.

[4] N. Kizito, H. H. Telesphore, and J. C. Rukundo, "Rwandan new competence base: curriculum implementation and issues; sector-based trainers," *LWATI: A Journal of Contemporary Research*, vol. 16, no. 1, pp. 24–41, 2019.

[5] L. O. Cavey and S. B. Berenson, "Learning to teach high school mathematics: patterns of growth in understanding right triangle trigonometry during lesson plan study," *The Journal of Mathematical Behavior*, vol. 24, no. 2, pp. 171–190, Jan. 2005, doi: 10.1016/j.jmathb.2005.03.001.

[6] J. N. Causton-Theoharis, G. T. Theoharis, and B. J. Trezek, "Teaching pre-service teachers to design inclusive instruction: a lesson planning template," *International Journal of Inclusive Education*, vol. 12, no. 4, 2008, doi: 10.1080/13603110601156509.

[7] R. Zazkis, P. Liljedahl, and N. Sinclair, "Lesson plays: Planning teaching versus teaching planning," *FLM Publishing Association*, vol. 29, no. 1, pp. 40–47, 2016.

[8] Rwanda Education Board, "The project for supporting institutionalizing and improving quality of SBI activity (SIIQS)," Project Completion Report, Japan International Cooperation Agency (JICA), 2020. [Online]. Available:

https://openjicareport.jica.go.jp/pdf/12327383.pdf
[9] H. T. Habiyaremye, "Analysis of mathematical knowledge for teaching in Rwanda secondary schools focus on algebraic equation concepts," Master Thesis, Hiroshima University, 2016.
[10] K. Ndihokubwayo, C. Byukusenge, E. Byusa, H. T. Habiyaremye, A. Mbonyiryivuze, and J. Mukagihana, "Lesson plan analysis protocol (LPAP): a useful tool for researchers and educational evaluators," *Heliyon*, vol. 8, no. 1, Jan. 2022, doi: 10.1016/j.heliyon.2022.e08730.
[11] K. Ndihokubwayo and H. T. Habiyaremye, "Study practice lessons and peer learning methods to strengthen Rwandan science and mathematics teaching," *LWATI: A Journal of Contemporary Research*, vol. 16, no. 2, pp. 18–25, 2019.
[12] J. Njiku, "School based professional support to student teachers in preparation of teacher professional documents," *Voice of Research*, vol. 5, no. 3, pp. 1–52, 2016, [Online]. Available: http://www.voiceofresearch.org/doc/Dec-2016/Dec-2016_13.pdf
[13] E. Byusa, E. Kampire, and A. R. Mwesigye, "Analysis of teaching techniques and scheme of work in teaching chemistry in Rwandan secondary schools," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 16, no. 6, pp. 1–9, Mar. 2020, doi: 10.29333/ejmste/7833.
[14] J. de D. Nkurikiyimana, J. Uwamahoro, and K. Ndihokubwayo, "Teaching and learning mechanics explored through the use of the 5e's educational model," *Problems of Education in the 21st Century*, vol. 80, no. 1, pp. 179–194, Feb. 2022, doi: 10.33225/pec/22.80.179.
[15] J. Nyirahagenimana, J. Uwamahoro, and K. Ndihokubwayo, "Assessment of physics lesson planning and teaching based on the 5es instruction model in Rwanda secondary schools," *Contemporary Mathematics and Science Education*, vol. 3, no. 1, Jan. 2022, doi: 10.30935/conmaths/11573.
[16] K. Ndihokubwayo, I. Ndayambaje, and J. Uwamahoro, "Analysis of lesson plans from Rwandan physics teachers," *International Journal of Learning, Teaching and Educational Research*, vol. 19, no. 12, pp. 1–29, Dec. 2020, doi: 10.26803/ijlter.19.12.1.
[17] Rwanda Education Board, *The national teacher CPD framework*. Kigali: Rwanda Education Board, 2019.
[18] T. Falkenberg, "Knowing mathematics-for-teaching: the case of planning learning activities," *Problems of education in the 21st century*, vol. 35, no. 1, pp. 58–69, 2011, [Online]. Available: https://scientiasocialis.lt/pec/node/files/pdf/vol35/58-69.Falkenberg_Vol.35.pdf
[19] M. P. Marino and M. S. Crocco, "The pre-service practicum experience and inquiry-oriented pedagogy: evidence from student teachers' lesson planning," *The Journal of Social Studies Research*, vol. 44, no. 1, p. 151, 2020, doi: 10.1016/j.jssr.2019.02.001.
[20] J. W. Cresswell, *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*, 4th ed. Sage Publications, 2014.
[21] J. R. Fraenkel, N. E. Wallen, and H. H. Hyun, *How to design and evaluate research in education*. McGraw-Hill, 2012.
[22] K. Ndihokubwayo, E. B. Phd, and Y. Ito, "Redistributing public institutions to rural areas: a case of the university of Rwanda college of education, rukara," *African Journal of Governance and Development*, vol. 8, no. 1, pp. 24–35, 2019.
[23] A. Orodho, W. Nzabarirwa, P. Odundo, P. N. Waweru, and I. Ndayambaje, "Quantitative and qualitative research methods. A step by step guide to scholarly excellence," *Nairobi, Kenya: Kanezja publishers and Enterprises*, 2016.
[24] K. Ndihokubwayo, J. Uwamahoro, and I. Ndayambaje, "Usability of electronic instructional tools in the physics classroom," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 16, no. 11, Sep. 2020, doi: 10.29333/ejmste/8549.
[25] Rwanda Education Board, *Subsidiary Mathematics Senior 6 Teacher's Guide.* Kigali: Rwanda Education Board, 2019.
[26] Rwanda Education Board "Need assessment study report: leading, teaching and learning together in secondary education (2017-2021)," VVOB Rwanda, 2018.
[27] S. S. Moh'd, J. Uwamahoro, N. Joachim, and J. A. Orodho, "Assessing the level of secondary mathematics teachers' pedagogical content knowledge," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 17, no. 6, May 2021, doi: 10.29333/ejmste/10883.
[28] T. Fujii, "Designing and adapting tasks in lesson planning: a critical process of lesson study," *ZDM*, vol. 48, no. 4, pp. 411–423, Jul. 2016, doi: 10.1007/s11858-016-0770-3.
[29] Y. Ono and J. Ferreira, "A case study of continuing teacher professional development through lesson study in South Africa," *South African Journal of Education*, vol. 30, no. 1, pp. 59–74, Mar. 2010, doi: 10.15700/saje.v30n1a320.
[30] T. Tas, T. Houtveen, W. van de Grift, and M. Willemsen, "Learning to teach: effects of classroom observation, assignment of appropriate lesson preparation templates and stage focused feedback," *Studies in Educational Evaluation*, vol. 58, pp. 8–16, Sep. 2018, doi: 10.1016/j.stueduc.2018.05.005.
[31] M. I. Kola, "Technology teacher trainees' lesson planning approach in South Africa: Room for improvement," *African Journal of Research in Mathematics, Science and Technology Education*, vol. 21, no. 3, p. 293, 2017, doi: 10.1080/18117295.2017.1379215.
[32] G. Lindsay, "Educational psychology and the effectiveness of inclusive education/mainstreaming," *British Journal of Educational Psychology*, vol. 77, no. 1, pp. 1–24, Mar. 2007, doi: 10.1348/000709906X156881.
[33] K. Ndihokubwayo, V. Nyirigira, G. Murasira, and P. Munyensanga, "Is competence-based curriculum well monitored? learning from Rwandan sector education officers," *Rwandan Journal of Education*, vol. 5, no. 1, pp. 1–12, 2020.
[34] K. Ndihokubwayo and H. T. Habiyaremye, "Why did Rwanda shift from knowledge to competence-based curriculum? syllabuses and textbooks point of view," *African Research Review*, vol. 12, no. 3, Sep. 2018, doi: 10.4314/afrrev.v12i3.4.

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