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The Influence of Learner Support on Performance in Mathematics' Modules of Open Distance and e-Learning (ODEL) for in – Service Secondary School Teachers at University of Rwanda, College of Education

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Abstract: *The present study argues that there is a great relationship between the learning support and the performance of mathematics of ODeL level one students. The findings of this study were drawn from a large study aimed at examining the influence of learners support on performance in mathematics' modules of open distance and e-learning (ODeL) for in – service secondary school teachers with a case study of University of Rwanda-College of Education level one mathematics ODeL students 2021-2022. This study investigated the lecturers' perception towards the learning support; the extent to which ODeL instructional materials contribute to the performance and examination of the relationship between learning support and the performance of mathematics of ODeL students. The study was carried out based on the gap found in literature review where others have been script on ODeL but not on specific topic of mathematics. Through questionnaire, quantitative data were collected from 40 respondents using mixed approach and analyzed using Statistical Package of Social Sciences (SPSS) for descriptive and inferential statistics. The findings revealed that there is a significant relationship between learning support and the performance of mathematics modules. This study, therefore, recommends the provision of ICT tools to ODeL students, put more efforts in using technology as ODeL students, cooperate each other as ODeL students and choose the options related to their background.*

Keywords: *Learner support, Performance, Open distance, e-Learning, Mathematics*

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1. Introduction

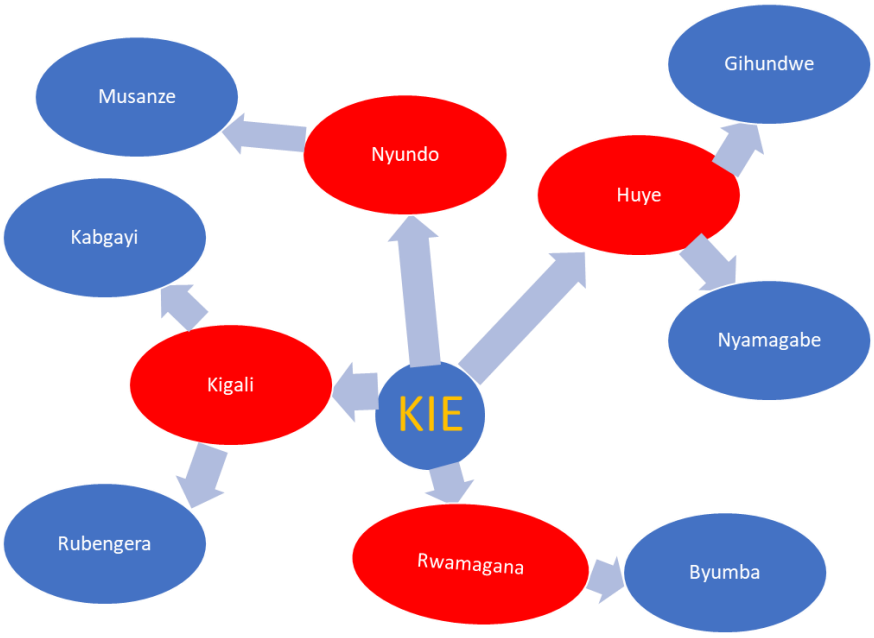
Open Distance e-learning help in service teachers to pursuit their studies far from ther distance. In Europe and other Western countries, a global concern was to emerge about distance education and European Open University began in 1992. The use of media and technology in higher education in Europe reflected upon the need for providing unified education in the form of a European Open University to a culturally diverse population (Date & Price, 1990). In addition, distance education is not a new concept. In 1800 at the University of Chicago, the first correspondence program in the United States of America established in which the teacher and learners were at different locations. As radio and television developed during the First World War in 1950, they stated to be used in teaching and learning for example the University of Wisconsin-Madison in USA (Clark, 2019). Moreover, the establishment of the British Open University in the United Kingdom 1969 marked the beginning of the use of technology to supplement print-based instruction through well-designed courses (Clark, 2019).

Open distance and e-learning programs have started being used for learning also in many countries of Africa. For instance, the Open University of Tanzania which started this program in 1994 works as an example of one of the first higher learning institutions which introduced this learning program in East Africa.

In Rwanda, the Center for Open and Distance Learning has been established at University of Rwanda, the College of Education with the expectation of advancing and leading Open and Separate Learning in UR colleges. This Center is composed of four Offices namely, the Centre of African Virtual University (AVU), Educational studies (former DTP), Pan African Tele-Education Project and Centre of Instructional Technology (CIT).

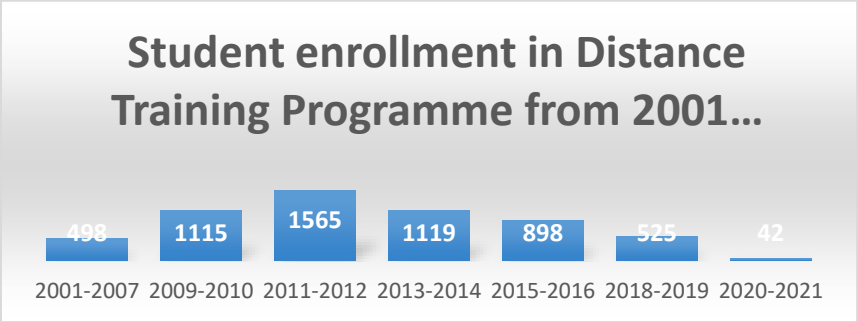
The Distance Training Programme (DTP or IYAKURE) was introduced in the College since 2001 within the previous Kigali Institute of Education (KIE) known as College of Education today. This programme aims at upgrading in-service secondary school teachers in pedagogical skills and at alleviating the shortage of teachers both in terms of quality and quantity. From 2000 – 2006, the project was funded by DFID Afterwards, it became one of the regular programmes offered by KIE. The programme was based on printed teaching materials; modules were written by UR- CE Lecturers. Teachers were supported by a network of part-time Subject Tutors who were allocated in centres, regional staff taught and managed the use of reference textbooks, laboratories, computers and other resources. Twice a year, students attended residential training sessions during school holidays (Face-to-Face) and once a month, students attended alternating weekend tutorials and its management was done by the Distance Training Office (DTO).

After the establishment of University of Rwanda through the law no 71/2013 of 10/09/2013, DTP was shifted in the Centre for Open and Distance Learning (CODeL) created under the College of Education. Later, CODeL was transformed into the School of Open and Distance Learning (SODL) in August 2014, with an Acting Dean appointed on 1st September 2014. The school had four departments which are Department of Education Studies, Department of Pana-African Tele-Education, Department of Instructional Technology, and the Department of African Virtual University. It also had 10 centres across the country which are Kigali, Kabgayi, Rubengera, Nyamagabe, Huye, Gihundwe, Rwamagana, Gicumbi, Musanze and Nyundo. They are distributed as follows: 4 Regional Centres (in Red Color) and 6 Provincial Centres (in Blue Color).



The school aimed at extending UR-College of Education's mission by making the Institute's scholarship accessible to the wider community. The main objective of the school was to provide high quality, flexible, part time education tailored for adults in order to complement the Institute's core mission. In 2017, the school had also been replaced by the Centre for Open, Distance, and e-Learning (CODeL). As per the mission of CODeL, it should not manage academic programs, but coordinate ODeL activities in all colleges.

Student enrollment in Distance Training Programme from 2001 – 2021



ODeL student population – March 2022

Table 1 Registered students in 2020-2021

Year	Department	Number of students
Year 1	HLE	253
	MSPE	87
Year 2	HLE	69
	MSPE	25
Total		434

The current situation of ODeL Programme is based on the Centers which are relocated in 5 University of Rwanda (UR) Campuses namely Busogo campus, Nyarugenge campus, Huye campus, Rusizi campus and Rukara campus. In addition, it is a semester based.

Moreover, during everyday activities of the researchers of teaching mathematics, they had time to explain Mathematics algebra module to my fellow teachers who attend Distance Training Programme (DTP) and I noticed that they had a serious problem in that module of reading mathematical symbols and interpreting them, which were leading to a misunderstanding of the concepts. It was found out that the DTP program depends generally on printed materials given at the beginning of the studying modules and supplemented by week-end instructional exercises and face-to-face sessions.

Nonetheless, nowadays, the ICT and e-learning are developed and the college is encouraged to use Open Distance and e-learning as COVID 19 challenged a lot of face to face studies. For any support given, the students were required to maximise all opportunities as they were the main agents of their learning (Maboe, 2019). The researchers noticed that in-service teachers do not have enough ICT tools for accessing the e-learning materials any time and the ability of using the materials and doing research. Therefore, they decided to examine how the learning support given to the ODeL students influences their performance in mathematics especially and the ways this support can be boosted so that the in-service teachers gain more from the programme.

2. Literature Review

This review of literature looks at the existing theories and establishes the relationship between them and the topic under study. It has a related literature and other studies in relation to this study.

2.1. Open Distance and e-Learning

ODeL is the way of learning where there is a physical distance between a student and the university (Amoo & Disu, 2012). They added that Open Distance and e-learning (ODeL) is one of the fast-developing areas of education nowadays and it has considerable effect on all education delivery systems. According to Eze et al., (2020) modern ODeL framework is developing quickly through the use of Internet-based., This concept of ODeL instruction came from thought where the learners and the instructors cannot be in a lesson room and they ought to be isolated by a few geological separate (Pena-Bandalaria, 2011).

According to Ndahayo, (2013) to create a complete instruction system which is adaptable for every learner is not easy but ODeL is the best to help learners in their learning. It is known that distance instruction isn't a new concept (Pena-Bandalaria, 2011) within the late 1800s, at the College of Chicago, the primary propelled major correspondence program within the US in which the educator and learner were at diverse areas and is changed as technology developed. From that, The open distance and e- learning become useful in the different areas (Maboe, 2019)In sub-Saharan Africa (SSA), ODeL is developed because of none of the nations in Sub-Saharan Africa have satisfied the promise of giving instruction to the complete population through the conventional instruction system (Rai et al., 2007) and it is started by combining both face to face and distance learning and in different regions organize the teams in charge of ODeL development for serving many people in education and

separate instruction can be pointed at giving individuals who have missed an instructive opportunity at one level or another a way to recapture what they have misplaced without essentially going back to the classroom (Rai et al., 2007).

In other words, distance instruction can give individuals a chance to receive instruction at a distance (Maboe, 2019). Moreover, some countries have the issues of technology which can hinder the implementation of ODeL during teaching and learning (Maboe, 2019). He added that infrastructures and materials are at the root for best implementation of ODeL instruction. This requires the conducive environment and enough technological materials for effective teaching and learning through ODeL.

According to Lukwekwe (2015) the lack of technological resources and lack of infrastructures can affect students' performance in Open Distance. Moreover, the study conducted by Lukwekwe (2015) analyzed the variables that influence students‟ execution in open and separate learning at the Open University of Tanzania (OUT) - a case of Kinondoni territorial middle. In addition, the study utilized surveys with questionnaire and met direct to urge the data from 80 students and 30 scholarly staff of Open College of Tanzania. The key findings were that most students had a part of duties and went through less time in examining, coupled with insufficient direction within the separate mode of instruction.

The gap in most of studies from different authors showed that they did not focus on the open distance and e-learning support for in service teachers. It is mostly found in undeveloped countries who combine studies and daily duty of teaching and learning especially those who are studying mathematics modules.

2.2 ODeL and Mathematics Teaching and learning

According to to Eze et al., (2020) Open Distance and e-learning (ODeL) used as one of the instruction model of teaching mathematics. Currently, e-learning help us to explore current trends in mathematics for effective learning and teaching the course (Genot, 2018). McLean and McLean (2003) added that the theory of E-learning success model of DeLone states that e-learning should be good under the integration of six dimensions of success factors. The success factors include good quality of E-learning system, quality of information transmitted to the learner in E-earning, quality of services given to the learner, good use of E-learning facilities and information, E-learning user satisfaction and net benefit that the learner gets from E-learning. The E-learning success model of DeLone and. This theory states that for (DeLone & McLean, 2003). The first dimension is quality of E-learning which is based on pedagogy of teachers; e-Learning is not just a technological add-on that teachers need to learn how to use; it is a new educational approach involving new pedagogical and professional procedures and processes that require support and professional development beyond conventional teaching forms(Masoumi & Lindström, 2012). The second dimension is quality of information transmitted to the learner in E-earning and ODeL based on quality requirement which are Tutor support, Collaboration, Technology, Expectation and Benefits of the learner, Information transparency of the course, Course structure, and Didactics(Ehlers, 2004); the e-learning materials imparted with the best approach and perspective enhance the quality of learning(Elango et al., 2008). The third dimension of success of e- learning and ODeL is quality services given to the learner by learning communities, the ODeL setting take different forms and their qualities are different from the learning communities in private instruction, and this improve the motivation of the learners in the system(Pena-Bandalaria, 2011). The fourth dimension is good use of E-learning facilities and information and this depend to the training on the use, ICT tools ownership; strong of internet and personal engagements of teachers and students.

All of these factors are supposed to improve the quality of teaching and learning Mathematics if all partners of ODeL who are engaged in that system of learning (Eze et al., 2020). The fifth dimension is E-learning user satisfaction and the satisfaction depend to the computer self-efficacy of the students which can be characterized as a person's self-evaluation with respect to the achievement of the assignment employed on a computer (Isik, 2008). The last but not the least dimension is net benefit that the learner gets from E-learning and ODeL, The ICT has gotten to be one of the crucial ways to create accessible materials for investigating and learning for both instructors and students for sharing and obtaining contents anytime and anywhere (Arkoful & Abaidoo, 2014), which is a high profit ODeL students.

From these dimensions of success factors, the best support of ODeL students can be applied for improving the learning and teaching mathematics.

3. Methodology

This chapter explains the methods that were used to carry out this study. It focuses on research design, location of the study, target population and sample size, research instruments, validity and reliability, data collection techniques, data analysis and finally the ethical considerations of the study.

3.1 Research design

The study used a case study research design. According to Rashid et al. (2019) a case study is defined as a

methodology of research mainly used in the social sciences and life sciences. They added that it involves an up-close, in depth and a detailed maximum examination of the subject. The use of the case study research design is to bring to an understanding of a complex issue or object and can extend experience or add strength to what is already known through previous research (Rashid et al.,2019). It also helps to emphasize on detailed contextual analysis basing on quantitative and qualitative methods. It is therefore that this research used a quantitative methods and statistical tools in data analysis. However, questionnaires distributed to respondents.

3.2 Population of the study

The population of this study was made of 40 mathematics Open Distance and e- Learning in service teachers' level one mathematics students at University of Rwanda College of Education who are in 5 centers, namely Nyarugenge, Rukara, Busogo, Huye and Rusizi. This research referred data of the academic years 2021-2022 of ODeL in service teachers and lecturers of mathematics modules level one in the same academic years.

3.3 Sampling Techniques and Sample size

A sample is a group which is selected from a large group of a population for a purpose of the study with a view to making generalization about the population as a whole (Taherdoost et al., 2016). When gathering information from questionnaires and interviews, the purposive sampling was employed for selecting 40 mathematics students of Open distance learning and e-learning under the above-mentioned research population were surveyed.

3.4 Data collection instruments

During the data collection it is important to note that instrument should be easy to understand and to complete and they are giving information responding the research questions (Kabir, 2016). The data were collected by using questionnaire and semi-structured interview. The questionnaire had two parts, A and B. Part A was for demographic data related to gender, age and level of study and second part B contained the questions related to this study. Questionnaire and interview guide were designed based on the information needed, the target participants, the wording of the questions, the order that made sense, and the length of it. Participants were asked to answer all the questions asked. In addition, the language and the vocabulary used for interview and questionnaire was appropriate to the level of respondents. The semi-structured interview was given to the lecturers of mathematics algebra modules in ODeL programme. Therefore, descriptive and inferential statistics were used to analyze the quantitative data by using SPSS.

3.5 Data analysis strategies

Data collection was done by personally contacting the respondent and distributing copies of the questionnaire to the respondents. Some of the respondents were joined through phone for an interview in order to complement the results from the data collected by the means of questionnaire. The qualitative data were analyzed through grouping of common themes and the quantitative data were analyzed by descriptive and inferential statistics using SPSS.

3.6 Ethical considerations

The participants were requested to sign voluntary informed consent forms. This declaration of consent prompted the participants to actively fill out the open questionnaire. The completed questionnaires were kept in a secure place for confidentiality. In addition, codes were used.

4. Results and Discussion

The purpose of this study was to determine the influence of learner support on the performance in mathematics' modules of open distance and e-learning (ODeL) for in – service secondary school teachers at University of Rwanda - College of Education**.** The results of this study also based on lectures perspectives towards the learning support given to ODeL students in Mathematics modules, the extent to which ODeL instructional materials contribute to the performance of Mathematics modules of ODeL students, and relationship between learning support and the performance of mathematics of ODeL students. In this section, the findings are organised in tables.

4.1. General information of respondents

Gender of respondents

The table below presents the gender of respondents by frequency and percentage.

Table 1 Respondents by gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	24	60.0	60.0	60.0
Female	16	40.0	40.0	100.0
Total	40	100.0	100.0	

Source: Researcher (2022)

The above table shows that among 40 respondents, 60% (N=24) are males and 40% (N=16) are females it shows that the number of students who attended the ODeL programme mathematics combinations, males are frequently presented than females.

Level of study of the respondents

The table below presents the level of the students who were in level one mathematics combinations in academic year 2021-2022

Table 3 Level of study of the respondents

Level	Frequency	Percent	Valid Percent	Cumulative Percent
Level 1	40	100.0	100.0	100.0

Source: Researcher (2022)

All respondents 100% are level one mathematics students. This shows that all respondents participated in survey as was planned in population and sampling.

The table below presents the ways the ODeL mathematics combinations students get the materials by using e- learning plat form.

4.2 Participation in mathematics e-learning modules

Table 4 Frequency of using mathematics E-learning documents.

	Frequency	Percent	Valid Percent	Cumulative Percent
No	1	2.5	2.5	2.5
Yes	39	97.5	97.5	100.0
Total	40	100.0	100.0	

Source: Researcher (2022)

The above table indicates that 97.5% (N=39) of respondents had used E- Learning mathematics documents in their studies while only 2.5% (N=1) did not used mathematics e-Learning documents. This implies that almost ODeL students were not able to get learning material using e-learning plat form.

The table below presents the place by which the ODeL level mathematics combinations students accessing the learning materials.

Table 5 Place of accessing mathematics E-Learning documents

Places	Responses		Percent of Cases
	N	Percent	
Attending from School		40.3%	64.1%
Attending from Home		40.3%	64.1%
Attending from Neighbor's home		6.5%	10.3%
Attending from elsewhere		12.9%	20.5%
Total		**100.0%**	**159.0%**

Source: Researcher (2022)

From the table 5, 64.1% (N=25) of the respondents access the E-Learning at their home, 64.1% (N=25) at school, 10.3% (N=4) at their neighbors and 20.5% (N=8) accessed the documents elsewhere (Bus, by walking, Library and websites, at work). This shows that accessing the E-Learning mathematics documents is mainly accessed from school and at home.

The table below presents ICT tools used by ODeL level one mathematics students for accessing the e-learning materials.

The table below represents the tools used by ODeL students in learning process.

Table 6 Technical tools used in accessing mathematics modules on E- Learning

Tools	Responses		Percent of Cases
	N	Percent	
	22	38.6%	0%
Computer	2	3.5%	5.0%
Smart TV screen	33	57.9%	82.5%
Smart phone			
Total	**57**	**100.0%**	**142.5%**

Source: Researcher (2022)

The table 5 indicate that 55% (N=22) used computer, 82.5% (N=33) used smart phone and 5% (N=2) used smart TV screen to access the mathematics modules. This shows that a number of students used smart phone in their studies.

The table below represents number of ODeL level one mathematics combinations who have their own computer.

Table 7 The ownership of computer

		Frequency	Percent	Valid Percent	Cumulative Percent
	No	28	70.0	71.8	71.8
	Yes	11	27.5	28.2	100.0
	Total	39	97.5	100.0	
Missing	System	1	2.5		
Total		**40**	**100.0**		

Source: Researcher (2022)

Table 7 show that 70% (N=28) do not have computer and only 27.5% (N=11) have their own computer. This shows that many students do not have their own computers and is the reason why they were using smart phone in their studies.

4.3 Lecturers' perspectives towards the learning support given to ODeL students in mathematics

To find Lecturers' perspectives towards the learning support given to ODeL students in Mathematics, interview was given to the lecturers of Mathematics and Geometry module. From the information they gave, the ODeL students get the materials from UR-E Learning plat form and they have one weekend of face to face session, equivalent to 4 hours Saturday and 4 hours Sunday.

The selection of the lecturers who have to facilitate face to face sessions is closer to the final exam and is not linked to the specialisation of lecturers. Therefore, students are not satisfied with the help they receive. The limited skills of ICT for on line continuous assessment test (CAT), unappropriated ICT tools and individual commitment are the main problems of ODeL students in their studies. The attendance of the students was not perfect as many of them come late and this case is more serious for women who have family responsibility, daily school activities and they have to take care of their children.

4.4 Instructional materials and performance of mathematics

The quality of teachers' use of teaching and learning materials affect students' performance and happiness of learning mathematics (Bimenyimana & Uworwabayeho, 2022). The extent to which ODeL instructional materials contribute to the performance of Mathematics of ODeL

level one students based on their satisfaction of the learning materials was investigated in this study.
In terms of organisation of findings, this section is containing quantitative analysis of students' satisfaction about the support they have and the performance in mathematics. The data presented in tables 8 and 9 below are from the responses of all 40 level one mathematics students' academic year 2021-2022 who answered the questionnaires.

Table 8 Satisfaction of the students with mathematics material

Level of satisfaction of on line mathematics modules	Responses		Percent of Cases
	N	Percent	
	10	3.6%	25.0%
Strongly agree	11	.9%	27.5%
Agree	95	33.9%	237.5%
Disagree	125	44.6%	312.5%
Strongly disagree	39	13.9%	97.5%
Neutral			
Total	**280**	**100.0%**	**700.0%**

Source: Researcher (2022)

According to the results from table 8, 44.6% of all respondents strongly disagreed, 33.9 % of all respondents disagreed, 3.9% of all respondents agreed; 3.6% of all respondents strongly agreed and 13.9% are neutral for the statements. This shows that large percentage of respondents were not satisfied with the learning support for understanding mathematics concepts.
The table below represents satisfaction of e- learning mathematics modules of ODeL level one mathematics combinations students

4.5 Relationship between the learning support and the performance of mathematics of ODeL level one students

The relationship between the learning support and the performance of mathematics of ODeL level one students was examined in this study and findings are presented in the table. In terms of organisation of findings, this section is composed of the quantitative analysis of the relationship between support and performance of the mathematics modules. The data presented in tables 10 and 11 below are from the responses of all 40 level one mathematics students' academic year 2021-2022 who responded to the questionnaires.
The table 9 below represents the answers of respondents on the questions related to the relationship between learning support and the performance.

Table 2 Relationship between the learning support and the performance of mathematics

The student's agreement of success according to the support.	Responses		Percent of Cases
	N	Percent	
Strongly agree	13	2.5%	32.5%
Agree	37	7.1%	92.5%
Disagree	113	21.7%	282.5%
Strongly disagree	292	56.2%	730.0%
Neutral	65	12.5%	162.5%
Total	**520**	**100.0%**	**1300.0%**

Source: Researcher (2022)

According to the results from table 9, 56.2% of all respondents strongly disagreed, 21.7% of all respondents disagreed, and 7.1% of all respondents agreed; 2.5% of all respondents strongly agreed with the level of performance in mathematics according to the materials and face to face sessions and 12.5% are neutral for the statements.

5. Conclusion and Recommendations

5.1 Conclusion

From the findings of this study, there is a significant relationship between learning support and the

performance of mathematics modules. It also found that instructional materials play a great importance on the performance of Mathematics among students. Therefore, this study found that there is a great relationship between the learning support and the performance of mathematics of ODeL level one students.

In addition, there is relationship between the learning support and the performance of mathematics. this means that students nedd more support from their lecturers during their learning. Moreover, the provision of ICT tools to ODeL students is very crucial for students' performance. Therefore, there is an Influence of students' support on Performance in Mathematics' Modules of Open Distance and e-Learning for in – Service Secondary School Teachers.

5.2 Recommendations

Basing on the issues findings of this study, the researchers make the following recommendations:

1. Lecturers should particularly give support to the students who are in this programme

2. Improving ICT skills and ICT tools for the students of ODeL

3. Lecturers are recommended to investigate the effects of online learning on the performance of mathematics and geometry on ODeL students and the effects of socio- economic factors on the performance of mathematics of ODeL students.

4. Students are recommended to put more efforts in using technology in their learning and cooperate each other as ODeL students.

5. The ODeL in-service teachers should choose the options related to their background studies and to maximise all learning support given.

6. Head teachers and education planners are recommended to help ODeL students to know which kind of facilities ODeL in service teachers need in order to perform well and being the good future teachers.

7. University of Rwanda College of Education ODeL Planners are recommended to adapt the learning support to each student according to their economy and check very well admission criteria.

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