Use of e-learning in developing countries of Sub-Saharan Africa: An analysis of women's participation in Cameroon

By

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Abstract

The objective of this work is to analyze the determinants of women's participation in the use of e-learning in Cameroon. The methodology implemented uses data from the survey on the practice of new digital media carried out in Cameroon in 2021 by the Center for Research Studies in Economics and Management (Cereg) with the technical support of the National Institute of Statistics (Ins). The results of the estimates carried out on the basis of the dichotomous Logit model and deepened by the Heckman regression show that there is a positive and significant relationship between the use of e-learning by women and the Francophone and Anglophone education subsystems with probabilities increasing by 11.59% and 7.81% respectively. This would testify to the acceptance of e-learning technology by Women in these two educational subsystems. This is how the use of e-learning has a positive effect on obtaining a higher education diploma with an increase in the probability of 2.4%. However, there is no link between the use of e-learning and obtaining a primary diploma and a secondary diploma. This would justify the inadequacy of policies related to the use of e-learning to improve success or even school performance in these educational subsystems.

Keywords: e-learning, women, determinants, Logit, Heckman

JEL Classification: C25, O31, O33

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1. Introduction

The advent of the coronavirus pandemic (COVID-19) is considered by the World Health Organization (WHO) as an unprecedented situation on a global scale (WHO, 2020). The persistence of this disease in the world has led to more use of the Internet by economic agents, including those in the education system, as shown by the various reports of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations Children's Fund (UNICEF). New habits have appeared in the use of the Internet in developing countries in all sectors of activity, including education, which adopts them in order to keep education systems and categories awake (primary, secondary, higher). The Internet has become a real key to exchanges in the educational world between teachers and learners in both developed and developing countries (UNESCO, 2020 ; UNICEF, 2020). It has become very difficult to do without these days, especially in this period of the COVID-19 pandemic, where barrier measures have become the rule applied by States in order to thwart the spread of the disease. This health crisis has thus further engendered the development of new teaching methods and their organization. The majority of teaching yesterday, still face-to-face, today takes place more in "distance" or in hybrid or co-modal mode on digital platforms under the name of e-learning or online teaching or even teaching at distance.

However, achieving gender equality in education, which is one of the crucial indicators that affect sustainable development, is essential, especially in the way it develops human capital and provides people with equal opportunities on all markets including the labor market (Baker et al., 2016). Shindo (2010) shows that inequalities in education deepen economic inequalities, which ultimately hinder long-term economic well-being. Thus Bourdieu's theory of capital (1990) suggests that certain types of Internet use will help individuals to achieve significant economic, social and cultural capital and to advance their education, their professional career and their social status including obtaining a job. From this point of view, the use of the Internet can be done for two purposes. First, the Internet promotes the growth of human capital and uses resources to achieve educational and employment goals, as well as for the development of physical and mental health. Second, the Internet is for leisure and entertainment. Thus, the use of e-learning can be at the level of the first use of the Internet which allows women and men to increase their level of education and thus their human and social capital. Studies show an increase in educational inequalities around the world with the coronavirus pandemic (Korkmaz, Erer and Erer, 2022). Reports from UNESCO (2020) and UNICEF (2020) confirm these studies by showing that with the closure of many schools around the world, the COVID-19 pandemic has increased educational inequalities between households under conditions socioeconomic differences (poor and rich) on the one hand and between men and women on the other. Many individuals from the poorest families with a gender disparity existence have only limited access to information and communication technologies such as the Internet, telephones, computers and televisions. (Jones et al. 2021 ; Dreesen et al. 2020). UNICEF (2020) specifies that 31% of schoolchildren worldwide cannot access distance learning via the Internet due to the lack of the necessary technologies.

According to a World Bank report (2021), COVID-19 has caused the biggest disruption to education systems in decades with the longest school closure causing substantial loss and learning inequities. This school closure significantly increases learning losses and the dropout rate worldwide and especially in developing countries (Favara et al., 2021).

However, the education system is considered by many analysts and experts to be the sector most impacted by the coronavirus pandemic crisis (Marinoni et al., 2020; Schleicher, 2020). According to UNESCO (2020) as a direct consequence of the COVID-19 crisis linked to the education system was the closure of schools (kindergarten, primary, secondary and higher) in 185 countries around the world. This represented 1.5 billion pupils and students, or 89.4% of learners worldwide, who were deprived of face-to-face teaching (Marinoni et al., 2020). Today, this pandemic constitutes a test and a major turning point in the evolution of the education system, in the organization of educational establishments and in the design of new teaching methods (Allen et al., 2020 ; Daniel, 2020 ; Zhao , 2020). In Cameroon, given these barrier measures of social distancing, the new pedagogical paradigms in the education system will develop in "distance" mode, including e-learning (teaching online platforms), as well as teaching on the media, traditional or conventional such as conventional television and conventional radio. Our study thus attempts to assess the impact of this policy of distance education (e-learning) on the success of learners a few years after this decision was taken by the public authorities. In a logic of continuity, the public authorities have decided to continue with this policy of distance learning in the different categories of education (primary, secondary and higher) even with the control of the COVID-19 pandemic, in order to improve school performance.

The purpose of this study is to encourage schools (primary, secondary, higher) to systematically ensure both the active participation of women in online teaching and the active participation of men, in a logic of equal opportunity for all in school success and performance. To allow an improvement in the quality of distance learning by maintaining them in continuity even after the COVID-19 pandemic for efficient coverage of programs in the two official languages of French and English. To allow an increase in the success rates which are at half mast, especially for vulnerable people such as young girls and people with disabilities, in an egalitarian logic, inclusive education and success for all. And finally to assess the impact of distance education policies (e-learning) on the success of learners a few years after the decision by the public authorities to adopt them because of the COVID-19 pandemic in the Cameroonian education systems. Thus, this study being among the first to carry out reflections on the use of e-learning in Cameroon tries to evaluate the participation of economic agents in the use of e-learning in the educational systems (French-speaking system, English-speaking system and bilingual system) in order to make recommendations to public authorities. The objective of this work is to analyze the determinants of women's participation in the use of e-learning in Cameroon.

Specifically it is:

- To show that the use of e-learning by women has a positive influence on the educational subsystems of French-speaking, English-speaking and bilingual education.

- To show that the use of e-learning by women has a positive influence on obtaining primary, secondary and higher education diplomas.

The remainder of the article is organized into five additional sections. The second presents a brief review of the literature. The third is devoted to the justification of the methodology. The results are presented, exposed and analyzed in the fourth. The fifth concludes and the sixth gives recommendations.

2. Literature review

The theories that have highlighted the use of an innovation (e-learning) dwell on first showing the adoption behavior of an innovation by economic agents, secondly its acceptability and thirdly its use by the latter. Among these theories we have the mode the technology acceptance theory (TAM) (Davis, 1989), the diffusion of innovation theory (Rogers, 2003) and unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003). Diffusion of innovation theory puts attributes such as relative advantage, compatibility, complexity, trial ability, and observability behind the adoption of new technology (Rogers , 2003). Theories of acceptance and use of technology show that great ease of use and great usefulness of new technology facilitate its appropriation in terms of use (Venkatesh et al., 2003; Davis, 1989). The theories of reasoned action Ajzen and Fishbein (1975) and planned behavior by Ajzen (1985) also highlight predictions of consumer behavior with regard to the use of new technology. The latter are thus effective in predicting the decision probability of choosing to use e-learning.

The theory of the network economy adds to the theories of use by considering the Internet (e-learning) as a network good, which through the network effects in its use generate positive externalities on the demand side (consumer) and increasing returns on the supply side (producer) thus motivating the use of the new technology by economic agents (Vega-Redondo, 2007; Cohendet, Kirman and Zimmermann, 1998). These theories associated with the capital theory of Bourdieu (1990) are thus effective in explaining the use of the new technology of distance or online teaching such as e-learning with the corollary of an increase in performance and including academic success.

On the empirical level, beyond the socio-economic and demographic factors which determine the use of e-learning, a first category of authors were interested in showing the disparities that exist in the use of e-learning, existing on the presence of inequalities between households (rich and poor) on the one hand and between men and women on the other hand (Korkmaz, Erer and Erer, 2022, Favara et al., 2021, Jones et al. 2021, Dreesen et al ., 2020). A second category of authors studies the relationship between the presence of COVID-19 and the performance of the education system (Marinoni et al., 2020; Allen et al., 2020; Daniel, 2020; Zhao, 2020; Schleicher, 2020).

3. Methodology

3.1. Study data

The achievement of the objective of this study is made possible by primary data from the survey on the practice of new digital media (PRANOME) carried out in Cameroon in 2021 by the Center for Studies and Research in Economics and Management (Cereg) with the technical support of the National Institute of Statistics (Ins). The survey was only carried out in the Center and Littoral regions, mainly in the two largest cities of the country, Yaoundé the capital and Douala the main economic city which represent the cultural diversity of Cameroon. Because here we find more than 250 ethnic groups from the ten (10) regions of the country, each with its own cultural specificities such as the language and the customs that live there together forming a mosaic, with the key being a sharing of culture between the

different communities. And also in these localities, the internet connection is relatively (more or less) stable to carry out such a study unlike other regions.

The sample of the population studied includes all individuals who use e-learning. Thus, the main question on the use of e-learning was asked to individuals as follows: *Do you use e-learning/online teaching/videoconferencing for your academic/school training?* Before the individuals answered the questions, the use of e-learning was well explained to them with examples, as well as for the other variables of this study, after having provided them with guarantees on the confidentiality of the survey according to law number 91/023 of December 16, 1991 on censuses and statistical surveys in Cameroon. At the end of the collection, entry and entry control activities, the theoretical sample of 1,260 individuals made up of men and women aged 12 and over went to an empirical sample of 1,057 individuals, i.e. a retention rate 83.88% with 52.6% men and 47.4% women. The inconsistencies in the answers given during the interviews, the absence of eligible individuals within households, particularly concerning age, non-users of the internet, and compliance with government barrier measures to combat the spread of the coronavirus pandemic (COVID-19) mainly explain this discrepancy between the theoretical sample and the empirical sample.

3.2. Econometric Model: Dichotomous Logit Model

The methodology implemented uses data from the survey on the practice of new digital media (*PRANOME*) carried out in Cameroon in 2021 by the Center for Research Studies in Economics and Management (Cereg) with the technical support of the National Institute of Statistics (Ins). The results of the estimates are made on the basis of the binary Logit model to highlight the determinants of women's participation in the use of e-learning in Cameroon. We construct a binary variable Yi which is worth 1 if the female individual uses e-learning and 0 if no. We can then associate with this variable Yi, a value Yi^* which corresponds to the usefulness when she chooses e-learning. Yi^* depends on Women's activities on e-learning (courses, seminars, exams, etc.), socioeconomic and sociodemographic characteristics and noted (Xi) and an error term (Ui). Consider the equation:

$$Y^* = X_i\beta + U_i \quad (1)$$

This usefulness is random due to the presence of the error term Ui. We can then define a selection criterion for the individual Woman. If the utility he derives from the use of e-learning is greater than a certain value (C), he will choose to connect to e-learning, but if his utility is lower than this value, he will choose to do not make use of e-learning. We thus have:

$$\begin{cases} Y_i = 1 \text{ si } \quad Y_i^* > C \\ Y_i = 0 \text{ si } \quad Y_i^* \leq C \end{cases} \quad (2)$$

With Yi= 1 if the Woman uses e-learning and Yi = 0 if no. The realization of Yi (observable) comes from an underlying model, expressed by the latent (unobservable) variables Yi^*. The decision rule then becomes:

$$\begin{cases} P(Y_i=1)= P\ (X_i\beta+U_i>C) = 1-P\ (U_i\leq C-X_i\beta) \\ P(Y_i=0)=P\ (X_i\beta+U_i\leq C) = P\ \ \ (U_i\leq C-X_i\beta) \end{cases} \quad (3)$$

P(Yi=1) designates the probability that the individual Woman uses e-learning and P(Yi=0) the probability that he does not use it. In order to calculate these probabilities, it is necessary to specify a statistical distribution for the error terms (Ui). Two possibilities are generally used. It is assumed that the error term follows a normal distribution (Probit model) or that it follows the logistic distribution (Logit model). Thus in our work, we choose to use the binary Logit model because of its fluidity in terms of manipulation. The Logit model has the following properties:

- The error term U follows the logistic law Λ with mean 0 and standard deviation $\pi^2/3$ or $U \sim \Lambda\ \left(0;\ \pi^2/3\right)$.
- The distribution function is $\Lambda\ \left(X\beta\right)=\dfrac{\exp\left(X\beta\right)}{1+\exp\left(X\beta\right)}$ (4)

As the threshold value (C) can be normalized to 0 (Thomas, 2000), and given the logistic distribution, we can write the possibilities of use of e-learning by Women as follows:

$$\begin{cases} P\left(Y_i=1\right)=\dfrac{\exp\left(X_i\beta\right)}{1+\exp\left(X_i\beta\right)} \\ P\left(Y_i=0\right)=\dfrac{\exp\left(-X_i\beta\right)}{1+\exp\left(-X_i\beta\right)}=\dfrac{1}{1+\exp\left(X_i\beta\right)} \end{cases} \quad (5)$$

P(Yi=1) designates the probability that the Woman uses e-learning and P(Yi=0) represents the probability that the Woman does not use e-learning. The estimation of the Logit model is based on the maximization of the log-likelihood. Hence we have the likelihood function which is written as follows:

$$L\left(y,x,\beta\right)=\Pi_{i=1}^{N}\left[\frac{1}{1+\exp\left(X_i\beta\right)}\right]^{1-y_i}\left[\frac{\exp\left(X_i\beta\right)}{1+\exp\left(X_i\beta\right)}\right]^{y_i} \quad (6)$$

By linearizing the likelihood function, we obtain the log-likelihood function as follows:

$$lnL\left(y,x,\beta\right)=-\sum_{i=1}^{N}\left\{\ln\left[1+\exp\left(X_i\beta\right)\right]-Y_i.X_i.\beta\right\} \quad (7)$$

3.3. Study variables

The study variables are well defined in Table 1 below. Thus, we have a dependent or endogenous variable *Use of e-learning by Women*, and a set of independent or exogenous variables and controls such as the educational system (Francophone, Anglophone or Bilingual); the diploma obtained (Primary, Secondary or Higher); know how to read and/or write (French, English, French and English); be pupils/students, have a job; a monthly income; the standard of living (living very comfortably, living enough, living with difficulty); Religion (committed Christian, committed Muslim, other Religions/moderate commitment to Religion); marital status (single, couple); the number of dependent children, the number of people living in the household, the place of residence (Urban, Semi-Urban/Rural); have a mobile phone, a income; having access to the internet (high speed internet, medium speed internet) and the variable age of the woman with, for different modalities, the age intervals ranging from12 to 18 years old, 19 to 25 years old and 26 years old and over.

Table 1: Variable definitions

Variables	**Variable Definitions**
Dependent variable	
Use of e-learning by women	Binary, 1=If the female individual declares having used e-learning; 0=If no
Independent variables	
Use of e-learning by men	Binary, 1=If the male individual declares having used e-learning; 0=If no. NB: This variable only makes it possible to make a statistical comparison of the use of e-learning between women and men, but does not enter into the econometric model.
Francophone education system	Binary, 1=If the woman did or did the Francophone education system; 0=If no
Anglophone education system	Binary, 1=If the woman did or did the Anglophone education system; 0=If no
Bilingual education system	Binary, 1=If the woman did or did the Bilingual education system (Anglophone and Francophone); 0=If no
Primary Diploma	Binary, 1=If the woman has primary education as the highest diploma (CEP, FLSC, etc.); 0=If no
Secondary diploma	Binary, 1=If the woman has the highest diploma in secondary education (BEPC, GCEOL, CAP, Probatoire, GCEAL, BT, Baccalauréat, etc.); 0=If no
Higher Diploma	Binary, 1=If the woman has higher education as the highest qualification (BTS, HND, DUT, DEUG, Bachelor's degree, Master's degree, DEA, Master's, Doctorate, etc.); 0=If no
Read/write English	Binary, 1=If the woman can read or write a simple sentence in English; 0=If no
Read/write French	Binary, 1=If the woman can read or write a simple sentence in French; 0=If no
Read/write English and French	Binary, 1=If the woman can read or write a simple sentence in French and English; 0=If no
Mobile phone	Binary, 1= If the woman has a mobile phone; 0=Else
Broadband internet	Binary, 1=If the woman reports having access to a broadband internet connection; 0=If no

Medium internet speed (reference category)	Binary, 1=If the woman declares having access to a medium-speed Internet connection; 0=If no
Urban	Binary, 1=If the woman resides in an Urban area; 0= If no
Semi-Urban/Rural (reference category)	Binary, 1=If the woman resides in a Semi-Urban or Rural area; 0= If no
Woman's age	Continuous quantitative variable age
12-18 years old	Binary, 1=If woman's age is between 12 and 18; 0=If no
19-25 years old	Binary, 1=If woman's age is between 19 and 25; 0=If no
Age 26+ (reference category)	Binary, 1=If woman's age is 26+; 0=If no
Single	Binary, 1=If the woman is Single; 0=If no
Couple (reference category)	Binary, 1= If the woman is in a Couple; 0=If no
Committed Christian	Binary, 1=If the woman is engaged in the practice of the Christian Religion; 0=If no
Committed Muslim	Binary, 1=If the woman is engaged in the practice of the Muslim Religion; 0=If no
Other Religions/moderate commitment to Religion (reference category)	Binary, 1=If the woman practices other Religions or has a moderate commitment to the Religion; 0= If no
Student	Binary, 1=If the woman declares to be a pupil or a student; 0=If no
Job	Binary, 1=If the woman has at least one job; 0=If no
Children in charge	Continuous quantitative
People living in the household	Continuous quantitative
Monthly income	Continuous quantitative
Live Very Comfortably	Binary, 1=If the woman's monthly income allows her to live Very comfortably; 0=If no
Live Sufficiently / Averagely	Binary, 1=If the woman's monthly income allows her to live Sufficiently; 0=If no
Living Hard (reference category)	Binary, 1=If the woman's monthly income allows her to live Hardly; 0=If no

Source: Authors based on PRANOME data

4. Results and analysis

4.1. Descriptive statistics

Table 2 presents the descriptive statistics of female individuals who use e-learning in the entire population studied. In this global sample on average 32.6% of individuals surveyed use e-learning. From this statistics of e-learning users, it emerges that on average 33.3% of women have used e-learning against 68.7% of males. This statistic obviously justifies and confirms the studies which show the existence of inequalities between women and men in education and especially with regard to distance learning such as e-learning (Korkmaz, Erer and Erer, 2022; UNESCO, 2020; UNICEF, 2020).

Of the 47.4% of women surveyed in the population as a whole, 65.3% were students; 68.6% said they had attended or were attending the Francophone or French education subsystem, 20.7% the Anglophone or English education subsystem and 10.10% the Bilingual (French and English) education subsystem. These statistical differences linked to the education subsystems variable can be explained by the fact that the survey was conducted in an area where French is predominant in terms of language. However, comments are made on the significant growth of the Anglophone education subsystem in this predominantly French-speaking area and on the increasing choice of the bilingual education subsystem, which has only been implemented by the Cameroonian authorities for about ten years. Speaking of the highest qualification, 6.3% of women say that their highest qualification is a primary school

diploma, compared with 30.5% for a secondary school diploma and 19.1% for a higher education diploma. These statistics are still low in terms of gender equality in the education system. However, there is also the issue of school drop-out (Favara et al., 2021). Very few women manage to obtain a higher education qualification, but there are still a fair number of women in secondary education.

Similarly, 28.8% of the women surveyed said they could read or write a simple sentence in English, compared with 69.2% who said they could read or write a simple sentence in French and 35.9% who could read or write a simple sentence in both languages (French and English). These results testify to the increase in the practice of bilingualism in Cameroon, especially with the setting up by the public authorities of the National Commission for the Promotion of Bilingualism and Multiculturalism following certain tensions and social demands within the administrations concerning the practice of the two official languages (French and English) of equal value as advocated by the constitution of the Republic of Cameroon.

The study shows that only 25% of the women surveyed out of the 100% have at least one job; 13.1% of women live very comfortably against 60.2% who say they live moderately (sufficiently or averagely), i.e. have a personal monthly income less than or equal to the inter-guarantee minimum wage (SMIG) evaluated in 2021 in Cameroon at only 36,720 FCFA or $73.44 (US dollars) at time of survey. And 26.5% say they have difficulty living with their income, that is to say they have less than $1 (dollar) per day. This may also explain the high dropout rates for women due to poverty. These inequalities in terms of income can also increase inequalities in terms of education between women (UNESCO, 2020; UNICEF, 2020). Because those from rich families or with substantial means will have the opportunity to go to school unlike others from poor households. This would lead to and further explain the very active commitment of some women in the Churches, especially in those called new, for the search for well-being through Divine Blessings and Miracles (BDM). That is 32% of Christian women say they are actively involved in the Church against 10.9% of Muslim women surveyed.

Among the women surveyed, 61.6% are single against 33.5% in a couple. These statistics can be explained through the demographic surveys in Cameroon conducted by the Central Bureau of Censuses and Population Studies (BUCREP) where it is shown that there is a strong presence of female agents in the territory compared to men. And with the prevailing poverty, men would be more and more unable to maintain more than one household for an adoption of the regimes linked to polygamy which are authorized for men by Cameroonian legislation. 73.2% of women live in urban areas, 26.7% in semi-urban or rural areas. Individuals concentrate in large cities in search of well-being such as having a decent job. Statistics show that 94.8% of women have a mobile phone; 33, 7% say they have high-speed internet access, compared to 54.2% for medium-speed. However, it is shown in the literature that it is high speed internet that is favorable to the use of e-learning (Jones et al. 2021, Dreesen et al., 2020), which becomes problematic compared to the low rate of access to broadband internet (less than 50%). 35.2% of women are between 12 and 18 years old, 30.1% are between 19 and 25 years old and 34.7% are between 26 years old and over.

Table 2: Descriptive Statistics

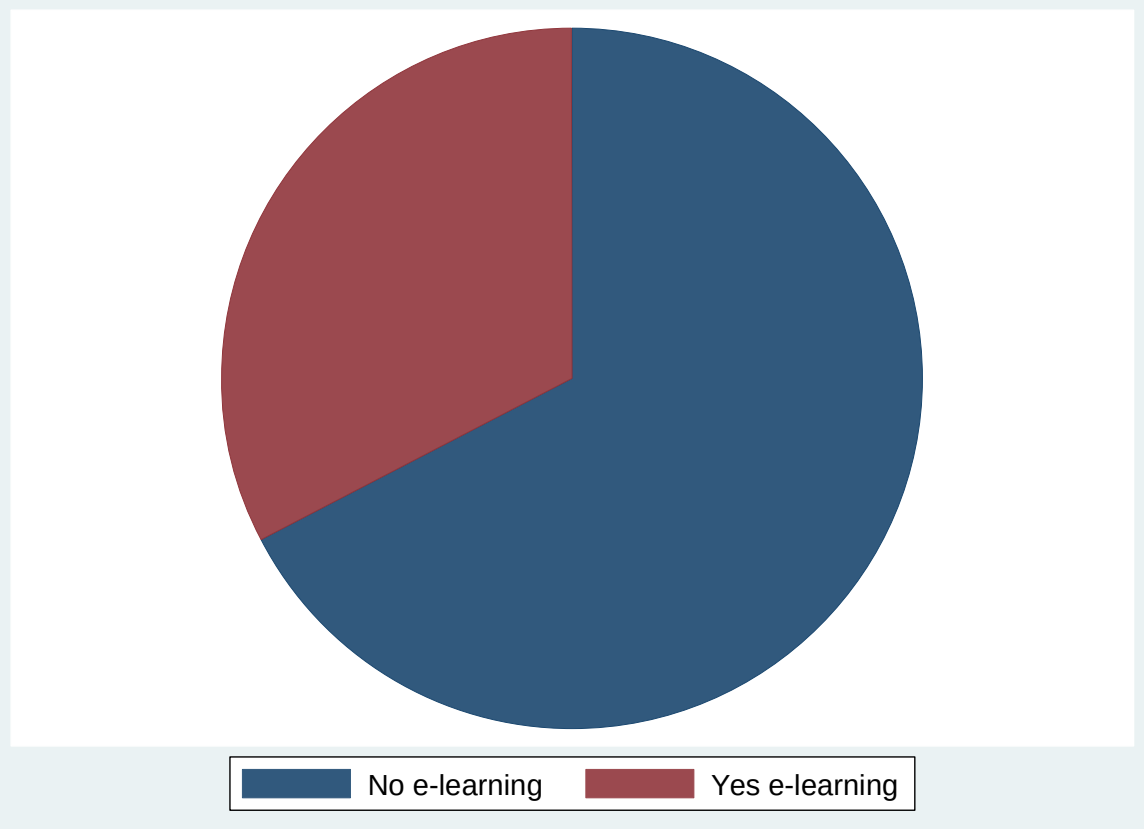
Variables	Observations	Means	Standard Deviation
General sample e-learning usage	1057	0.326	0.469
Use of e-learning by women	**1057**	**0.333**	**0.471**
Use of e-learning by men	1057	0.687	0.453
Francophone education system	1057	0.686	0.464
Anglophone education system	1057	0.207	0.405
Bilingual education system	1057	0.101	0.302
Primary Diploma	1057	0.063	0.244
Secondary diploma	1057	0.305	0.461
Higher Diploma	1057	0.191	0.393
Read/write English	1057	0.288	0.459
Read/write French	1057	0.692	0.191
Read/write English and French	1057	0.359	0.451
Student	1057	0.653	0.451
Mobile phone	1057	0.948	0.222
Broadband internet	1057	0.337	0.473
Medium internet speed (ref)	1057	0.542	0.498
Single	1057	0.616	0.486
Couple (ref)	1057	0.335	0.472
Children in charge	1057	1,801	2,385
People living in the household	1057	5,416	3,064
Job	1057	0.250	0.400
Monthly income	1057	10,409	0.611
Live Very Comfortably	1057	0.131	0.338
Live Sufficiently/Averagely	1057	0.602	0.489
Living Hard (ref)	1057	0.265	0.442
Urban	1057	0.732	0.443
Semi-Urban / Rural (ref)	1057	0.267	0.427
Committed Christian	1057	0.320	0.484
Committed Muslim	1057	0.109	0.297
Other Religions moderate commitment (ref)	1057	0.571	0.274
Woman's Age	1057	28,461	9,586
12-18 years old	1057	0.352	0.421
19-25 years old	1057	0.301	0.478
Age 26+ (ref)	1057	0.347	0.453

Source: Authors based on PRANOME data and Stata software. ref : reference category

We can thus appreciate the proportions of the use of e-learning in the graphs below. Graph 1 generally presents the proportion of e-learning use in the entire population surveyed. Thus, as previously mentioned, the percentage of e-learning use is 32.6% overall. Similarly, graph 2

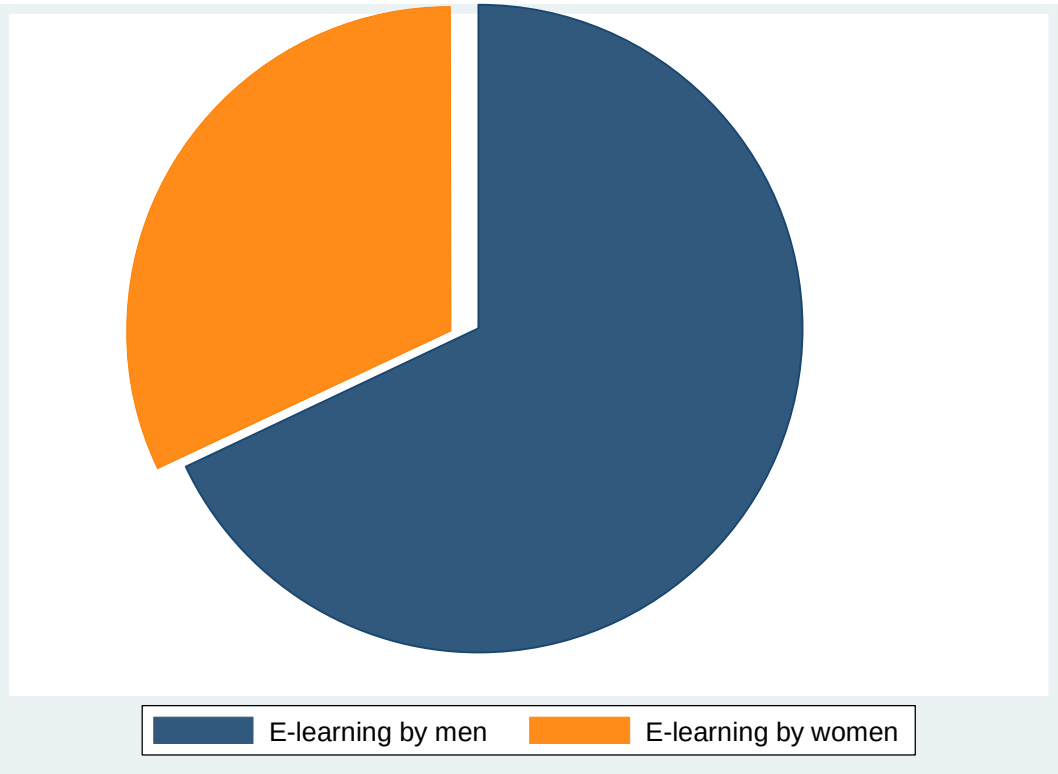
shows the proportion of e-learning use among women and men. So it emerges that the use of e-learning is 33.3% for women in the female population and 68.7% for men in the male population. An apparent inequality between women and men. Women are still below 50% in the use of e-learning, a real problem that remains to be solved for inclusive education for all.

Graph 1: Use of e-learning in the entire sample



Source: Authors based on PRANOME data and Stata software

Graph 2: Use of e-learning by the female population



Source: Authors based on PRANOME data and Stata software

4.2. Econometric results

Table 3 of the binary Logit model estimation results highlights the coefficients and marginal effects. The numerical value of the coefficients of the dichotomous Logit model not having a direct interpretation, the probability of women to use e-learning is assessed through the calculation of marginal effects. Table 3 below indicates that the model is globally significant, because the limited probability associated with this estimate is less than 1% (Prob > chi2 = 0.0000). The indicator of goodness of fit of the model (R^2) to Mc Fadden data (Pseudo-R^2 = 0.778) is quite significant. This shows that the model estimate is valid. It should be noted that the multiple determination coefficient of Mc Fadden (Pseudo-R^2) is between 0 and 1 and

measures the proportion of the variability of the dependent variable which is explained by the independent variables contained in the model and it indicates the quality of the model.

Thus, there is a positive and significant relationship at the 5% threshold between the use of e-learning by women and the education systems. When a woman is enrolled in the Francophone education subsystem, this increases her use of e-learning by a probability of 11.59% and 7.81% when she is enrolled in the Anglophone education subsystem. This would testify to the acceptance of e-learning technology by women in these two educational subsystems (English and French). However, we can observe the effect of the use of e-learning on performance or academic success.

There is a positive and significant relationship at the 1% level between the use of e-learning by women and obtaining a higher education diploma with an increase in the probability of 2.4%. This would justify a positive influence of the use of e-learning by women on performance or academic success. But this probability is probably quite low. However, contrary to what was expected, there is no link between the use of e-learning and obtaining a primary diploma and/or a secondary diploma (Marinoni et al., 2020; Allen et al., 2020; Daniel, 2020; Zhao, 2020; Schleicher, 2020). This would justify the inadequacy or ineffectiveness of policies related to the use of e-learning to improve success, performance or school results carried out by the public authorities. These policies being mixed remains to be reviewed and to be well implemented by public policies in order to be well addressed to schools for success for all in education. The point here is to see where the problem lies, whether at the infrastructural level or at the institutional level.

If we nevertheless observe at the infrastructure level, the results of the regression model show that there is a positive and significant relationship at the 1% level between the use of e-learning by women and access to high-speed internet with a probability that increases by 28%. However, the broadband connection is not always the thing best shared by all because of its high access cost (fiber optics), the poor quality of the connection or its absence in various localities (semi-urban and rural), thus, we observe that more than half of women say they have access to medium-speed internet (Jones et al. 2021, Dreesen et al., 2020). Here is a first infrastructural problem, that of connectivity to the high-speed Internet network, which is an infrastructure at the heart of the use of e-learning or online teaching. With the absence of high-speed internet in semi-urban or rural areas, it is very difficult for female students in these areas far from major cities to use e-learning. The rural area is an obstacle to the use of e-learning, which constitutes an inequality compared to students in urban areas. From where the State must act to "save" the education of the students in these remote peripheral mediums of the large agglomerations for the equality of opportunity for all and for all as regards education. Another capital variable at the center of the use of e-learning by women is the possession of a mobile phone (smartphone) with a probability which increases by around 20.9%. The mobile phone occupies more and more a place of choice in the use of e-learning beyond computers, video kits or even television screens.

At the institutional level, poverty reduction is an asset for the use of e-learning by women. Poverty is a barrier to access to education (Shindo, 2010). Thus, the presence of income inequalities is a problem for equal access to Information and Communication Technologies (ICT) in general and therefore for the equal use of e-learning by individuals in particular (UNESCO, 2020; UNICEF, 2020). Individuals who do not have adequate technological equipment for e-learning can be sources of poor academic performance or poor academic results, unlike those who do (Jones et al. 2021, Dreesen et al., 2020). Thus, with regard to the

results of the Logit regression, there is a strong positive and significant relationship at the 1% level between the use of e-learning by women and having an income allowing them to live very comfortably with a probability of use which increases by 18.1%. On the other hand, this probability of using e-learning decreases by 15.6% when the woman's income allows her to live with difficulty or to live sufficiently.

Other factors also prevent women from using e-learning, such as being in a couple and having children in charge. This constitutes another inequality suffered by women in Sub-Saharan Africa. Most women when they are in a couple stop their studies (customs sometimes oblige them to do so) to fully take care of the home all day long, that is to say the housework of the family, of the husband (who leaving in the morning to return late at night in most cases) and children (taking full care of them throughout the day) to the detriment of achieving their educational goals. This would thus explain the high rates of school dropouts by young girls in Sub-Saharan Africa. The results show that the probability of the use of e-learning by the woman decreases by 21.7% when she has children in charge. We also find that when a woman's age varies between 19 and 25, her love of e-learning increases. At this age, we assume that the woman may be at university, at least for those lucky enough to go to school. So when a woman is aged between 19 and 25, e-learning use increases by a probability of 3.6%. This confirms the result found between e-learning use and possession of a higher education diploma.

The Religion variable remains to be clearly specified in terms of its decrease or its negative effect on the use of e-learning by women. This could be due to the discourses held on the evils of the digital world by the leaders of the Churches. Some, and especially the new churches, rather present this negative side of the use of the Internet by categorically prohibiting their faithful and committed followers from joining it. But the internet does not only harm society, this technology or innovation has many benefits and better advantages provided like e-learning for inclusive education for all.

Table 3: Results of the Dichotomous Regression model

	Dependent Variable: Use of e-learning by women	
Variables	**Coefficients**	**Marginal Effects (dy/dx)**
Francophone education system	1.571**(0.894)	**0.1159**(0.0712)**
Anglophone education system	1.554**(0.890)	**0.0781**(0.0513)**
Bilingual education system	1.345(0.881)	0.0217 (0.0103)
Primary Diploma	-0.185(0.5769)	-0.036(0.124)
Secondary diploma	0.9786(0.269)	0.093(0.164)
Higher Diploma	1.176**(0.801)	**0.024**(0.073)**
Read/write English	0.1364*(0.372)	0.0283*(0.089)
Read/write French	0.232**(0.713)	0.044**(0.151)
Read/write English and French	0.350(0.292)	0.042(0.036)
Student	1.262***(0.348)	**0.371***(0.323)**
Mobile phone	1.455***(0.644)	**0.209***(0.464)**
Broadband internet	1.279***(0.601)	**0.280***(0.104)**
Single	1.321**(0.628)	**0.279**(0.364)**
Children in charge	-1.045**(0.942)	**-0.217**(0.192)**
People living in the household	-0.902*(0.431)	**0.041*(0.010)**
Job	1.651***(0.731)	**0.131***(0.213)**
Monthly income	1.270**(0.543)	**0.055**(0.099)**
Live Very Comfortably	0.930***(0.445)	**0.181***(0.171)**
Live Sufficiently/Averagely	-0.805**(0.386)	**-0.156**(0.260)**
Urban	0.940***(0.579)	**0.331***(0.445)**
Committed Christian	-0.818**(0.813)	**-0.094**(0.0631)**
Committed Muslim	-0.904***(0.211)	-0.166***(0.108)
12-18 years old	0.885(0.055)	0.091(0.026)
19-25 years old	1.099**(0.079)	**0.036**(0.012)**
Constant	-13.589(8.178)	

Note: Log likelihood:	*-272.06696*
Y = Pr (Use of e-learning) (prediction)=	*0 .28820099*
LR chi2(24):	*88.99*
Prob > chi2:	*0.0000*
Pseudo-R^2:	*0.778*
Observation:	*1057*

Source: Authors from PRANOME data and Stata software. Note: Standard deviations in parentheses, significance: *** =1%; ** =5%; * =10%.

4.2.3. Heckman Regression: Correcting Selection Bias

Heckman's (1976) two-step model regression solves the problem of sample selection bias. This bias comes from the fact that we have in our database on the one hand women who used e-learning before 2021 and those who did not use e-learning before 2021 and on the other hand women who used e-learning in 2021 period of high internet use and high consumption of e-learning in Cameroon because the COVID-19 pandemic had reached its peak and those who did not use e-learning in this period 2021. However, we want to observe a certain continuity of women in the use of e-learning. Women who have both used e-learning before 2021 and during 2021 are in a logic of continuity which are considered to have a certain habit of using e-learning and can thus be considered as a sample giving fairly high robust results for this study. Hence the importance of Heckman's model, which makes it possible to take into account women who have used e-learning both before 2021 and during the 2021 study period. Thus, this model makes it possible to observe a harmonization in the use of e-learning and finally to correct this selection bias.

The two stages of the model are specified as follows, on the one hand in the first stage we calculate the inverse of the Mills ratio for each of the observations using the Probit model, on the other hand in the second stage we regress the positive values of the explained variable and the inverse of the Mills ratio.

The model to be estimated is: $Y_i^* = \beta' X_i + \varepsilon_i$ (1). With a latent variable Y_i^* variable use of e-learning in 2021 Y_i which corresponds to the usefulness when women douse of e-learning in 2021. This variable Y_i^* depends on the use of e-learning before 2021, access to digital e-learning platforms, the academic success of women using these e-learning platforms, the economic and socio-demographic characteristics of women (Xi) and an error term (ε_i). Y_i^* is observable only if the woman i satisfies certain criteria defined previously.

We define a variable Z_i^* whose variations can be explained by variables other than those explaining the variations in Y_i^* and considered as a variable of the selection equation that captures the use of e-learning by women before 2021 we can write : $Z_i^* = \gamma' W_i + u_i$ (2). W_i is made up of the economic and socio-demographic characteristics of women, the reasons women have for use of e-learning and u_i represents the error term. Y_i^* is observed only if Z_i^* takes certain values. The observed values of Y_i^* are with a selection bias. We have :

$$\begin{cases} Y_i = Y_i^* \text{ if } Z_i^* \succ 0 \\ Y_i = 0 \text{ if } Z_i^* \leq 0 \end{cases} \quad (3) \qquad \text{with} \qquad \begin{cases} Y_i^* = \beta' X_i + \varepsilon_i \\ Z_i^* = \gamma' W_i + u_i \end{cases} \quad (4)$$

Only the sign of Z_i^* being observed, we define a binary variable Z_i as the selection equation that captures the use of e-learning by women before 2021 such as:

$$\begin{cases} Z_i = 1 \text{ if } Z_i^* \succ 0 \\ Z_i = 0 \text{ if } Z_i^* \leq 0 \end{cases} \quad (5)$$

We assume that the error terms (u_i, ε_i) have normal joint density with means 0 and 0, variances σ_y^2 and σ_z^2 whose correlation is ρ. Using the traditional results of the moments of a truncated joint density (Greene, 1993) we can write:

$E[Y_{i|} \mid Z_i = 1] = \beta' x_i + \rho\sigma_z \lambda(\gamma' W)$ (6).

We must then estimate the following model:

$Y_i = \beta' x_i + \rho\sigma_z \lambda(\gamma' W) + v_i$ (7).In this model Y_i is observed only if $Z_i = 1$. In other words the use of e-learning in 2021 can only be a continuity for women if they have made use of the e-learning before 2021. The estimation of the model is done in two steps. In the first step we estimate the Probit model by the maximum likelihood in order to obtain an estimate of the parameters γ, as well as an estimate of the inverse Mills ratio λ_i, as following :

$\hat{\lambda}_i = \frac{\phi(\gamma' \hat{W}_i)}{[1 - \Theta(\gamma' \hat{W}_i)]}$ (8) ,With ϕ and Θ being respectively the density function and the distribution function of the normal law. In the second step, we estimate β and $\beta_\lambda = \rho\sigma_\varepsilon$. In this study, the variables were grouped into two categories as established in the *PRANOME* survey data. On the one hand those which are directly linked to the determinants which lead to the first use of e-learning (Selection model). And on the other hand those which are related to the determinants which express the continuity and the academic success of the woman in the process of use of the e-learning with a consideration of the behavior of the women in the habits of use of the e- learning (interest model).

Table 4: Results of the Heckman Two-Step Regression Model

Variables	**Step2 (Interest Model)**	**Step 1 (Selection Model)**
	Women's e-learning in 2021	**Women's e-learning before 2021**
Francophone education system	0.187***(0.098)	0.0912**(0.081)
Anglophone education system	0.129***(0.089)	0.0919**(0.082)
Bilingual education system	0.0910*(0.105)	0.078(0.085)
Primary Diploma	-0.349(0.251)	-0.045(0.259)
Secondary diploma	0.097(0.116)	0.033(0.240)
Higher Diploma	0.093**(0.176)	
Read/write English		0.0919**(0.095)
Read/write French		0.085**(0.469)
Read/write English and French		0.089**(0.178)
Student	0.591***(0.212)	0.458***(0.127)
Mobile phone	0.490***(0.169)	0.318***(0.191)
Broadband internet	0.403***(0.195)	0.321***(0.089)
Single		0.420*(0.202)
Children in charge		-0.395***(0.459)
People living in the household		-0.039***(0.099)
Job	0.207***(0.193)	0.111**(0.123)
Monthly income	0.128***(0.197)	0.105***(0.100)
Live Very Comfortably	0.210***(0.099)	
Live Sufficiently/Averagely		-0.207***(0.195)
Urban	0.583***(0.678)	0.498***(0.777)
Committed Christian		-0.108**(0.055)
Committed Muslim		-0.210***(0.125)
12-18 years old		0.241(0.193)
19-25 years old	0.108***(0.093)	0.058**(0.104)

Constant	0.974(0.889)	-20.902(10.415)
Mills Ratio	0.20027***	
Rho	0.90723	
Sigma	0.20027	
Censored Observations	39	
Wald chi2 (20)	77.08	
Prob > chi2	0.0000	
Observations	1018	

Source: Authors based on PRANOME data and Stata software, Robust standard errors in parentheses, *** = significant at 1%; ** = significant at 5%; *= significant at 10%

In view of the results of the Heckman model presented in Table 4 above, we observe that there is a strong correlation between the use of e-learning by women before 2021 and the use of e-learning by women in 2021 with a correlation coefficient of these two variables being equal to 0.90723 and tending towards 1. This result of rho (rho = 0.90723) also shows that the problem of selection bias has been well taken into account in the Heckman regression, in other words the model selected and took into account only women who had used e-learning before 2021 and in 2021. This would testify to the existence of a continuity of women in the use of e -learning. Most of the significant variables in the original dichotomous Logit model are also significant with the Heckman two-step model. So, this model refined and/or improved the results obtained from the dichotomous Logit model by making the coefficients of the variables robust. The use of e-learning by women is probably explained by Heckman's regression showing without a doubt that there is a positive and significant relationship between the use of e-learning by women and the Francophone and Anglophone education subsystems, but also by the bilingual education subsystem. The use of e-learning by women also has a positive effect on obtaining a higher education diploma with a slight increase in the probability. However, Heckman's model also confirms the result that there is no link between the use of e-learning by women and obtaining a primary diploma and/or a secondary diploma. This would justify the inadequacy of policies related to the use of e-learning to improve success or even school performance in these educational subsystems.

5. Conclusion

The objective of this work is to analyze the determinants of women's participation in the use of e-learning in Cameroon. Specifically, it was a question of showing that the use of e-learning by women has a positive influence on the educational systems of French-speaking, English-speaking and bilingual teaching, in other words that women adhere to online teaching on these educational systems. And to show that the use of e-learning by women has a positive influence on obtaining primary, secondary and higher education diplomas. To achieve this objective, we used primary data from the survey on the practice of new digital media carried out in 2021 in Cameroon by the Center for Research Studies in Economics and Management (Cereg) with the technical support of the National Institute of Statistics (Ins). The results are obtained using the dichotomous Logit regression model and deepened by the Heckman regression which made it possible to highlight the participation of women in the use of e-learning in Cameroon.

First of all, there are inequalities in the use of e-learning between women and men. Descriptive statistics show that the use of e-learning among men is almost double that of women. The results of the econometric regression show that there are significant links between the dependent variable use of e-learning by women and certain explanatory variables

of the model. Thus, there is a positive and significant relationship between the use of e-learning by women and the Francophone and Anglophone education subsystems. This would testify to the acceptance of e-learning technology by women in these two educational subsystems. This is how the use of e-learning has had a positive effect on obtaining a higher education diploma. But contrary to what was expected, there is no link between the use of e-learning and obtaining a primary diploma and/or a secondary diploma. This would justify the inadequacy or ineffectiveness of policies related to the use of e-learning to improve academic success or performance. These policies being mitigated remain to be reviewed and to be well implemented by the public authorities in order to be well addressed to the schools for a success for all in terms of education.

Other variables can positively frame this use of e-learning by women such as access to broadband internet, having a mobile phone (smartphones), income. The absence of these infrastructures and/or equipment would systematically prevent the use of e-learning with an increase in inequalities between rich and poor. Because those who are more affluent have this opportunity to acquire adequate equipment and to do the lessons remotely or online, unlike those from poor families who may abandon their studies later despite their taste/love for education. However, certain factors such as having children in charge have a negative impact on the use of e-learning by women. This would lead to inequalities in education between women and men. This is also the case when the people lives in rural areas where telecommunications infrastructure is often almost non-existent. Inequalities can therefore widen between urban and rural populations in terms of education. Religion can also be a factor that would reduce the use of e-learning by women; this could be due to the discourse of the misdeeds of the digital world held by the leaders of these churches by prohibiting their followers from joining it.

6. Strategic Economic Policy Recommendations

With regard to the recommendations with regard to the results obtained, we recommend that the public authorities further improve equality in the education sector by advocating inclusive education policies for all and for all with the construction of adequate infrastructure both in urban areas than in rural areas which are home to millions of learners. Because there is a strong presence of inequalities in the use of e-learning which continue to widen between women and men, between rich and poor and between urban and rural areas. If nothing is done, this could have a negative effect in the future in terms of the level of education and in terms of access to employment. We also recommend that public policies conduct more awareness campaigns to show economic agents the role of education for the future of a country in general and the importance of online education (e- learning) in a particular way to achieve the Sustainable Development Goals (SDGs) (inclusive and egalitarian education for all). The education sector remains an essential key for access to employment for young people.

Finally, this study has some limitations in its exploratory attempt to study the use of e-learning by women in Cameroon. Our sample was limited to the Cameroonian context and was oriented towards two regions, those of the Center and the Littoral which include the two main cities of the country in terms of cultural diversity and population that are Yaoundé the capital and Douala the main economic city. We would therefore like to carry out this diagnostic study of the use of e-learning throughout Cameroon and even extend it to other developing countries in Africa thanks to your support, accompaniment, and multiform aid (financial, material, human capital, etc.) international and national partners in order to better understand the pockets of failure or even resistance in the use of e-learning in Africa in

general and in Cameroon in particular. And to allow you, thanks to the results of the research obtained, you, major international and national institutions, to better address your policies in an effective and efficient way in education, distance learning such as e-learning for an inclusive education for all in a logic of gender equality.

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