

Predicting Student-Teachers Dropout Risk and Early Identification: A Four-Step Logistic Regression Approach

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ABSTRACT Student-teachers' dropout is a complicated and serious issue in the learning process, with its attendant negative implications on students, academic institutions, economic resources, and society. This study investigated the composite and relative impact of personal (student), academic and socioeconomic predictive variables on student-teacher dropout. The study improves the early identification of at-risk student-teachers by developing a model that optimizes predictability. We used questionnaires and adopted a four-step logistic regression procedure on a sample of 1723 student-teachers in public teachers training colleges (TTCs) of a least-developed country (LDC). The study confirmed twin academic performance and aspirations factors as the highest predictors of student-teacher attrition. Academic reasons for choosing TTC were significant, as vocational motivation and goals established by student-teachers early in their education help prevent dropout. Contrary to expectations, student-teachers' cultural values, parents' level of education, and cost of financing education had no significant impact on dropout decisions. This is most likely due to the Government's financial support for student-teachers in LDCs and the widespread belief that higher education can improve one's social and economic status. The findings indicate that early identification and dropout prevention efforts should integrate various support services to foster a healthy learning and retention environment.

INDEX TERMS Dropout risk, early identification, least-developed economy, logistic regression model, prediction, student-teachers, teacher training colleges.

I. INTRODUCTION

Students' dropout is a complicated issue in the learning process, with its attendant negative implications on students, academic institutions, economic resources, and society at large [1], [2]. It is a serious problem in both developed and developing countries, but it is even more so in the least-developed economies [3], [4]. A major concern for many education administrators and authorities is the ability to predict the likelihood of a student dropping out as early as possible. It is an increasingly occurring phenomenon; however, its early prediction remains a major challenge [5].

Students' dropout topic is given scant attention in the teacher training colleges (TTCs), especially in the least developed economies. TTCs, also known as colleges of education, prepare their students to become future teachers

(student-teachers). Student-teachers play a prominent role in developing students' knowledge and skills [6]. So, they are integral elements of an education system's success and contribute to social and economic development [7]–[11]. However, very little is known about student-teachers' decision to terminate their studies, especially in least-developed economies. This research aims to develop a model that optimizes the predictability of student-teachers' dropout, i.e., early identification of student-teachers at the risk of dropping out. This study contributes to the student attrition literature by concentrating on student-teachers dropout in TTCs in Ethiopia, a least-developed economy [12].

Previous studies [13]–[15] show that most dropouts occur during freshman year. Tayebi *et al.* [16] also agree with this assertion but noted that; it is an indication that students quickly perceive if their choice has been wrong or other identified and unidentified factors influence their decision process. It is important to predict the factors that may

influence students' decision to abandon their studies and reduce dropout rates. This paper aims to analyze the factors and improve the early identification of at-risk student-teachers by developing a model that optimizes predictability while employing data collected before college and matriculation year of TTC students via a questionnaire survey and adopting a four-step logistic regression approach. Thus, the study evaluates the extent of influence of these identified potential predictor variables, e.g., age, gender, parent education level, financial situation, academic aspiration, academic achievement, interaction with teachers and peers, the academic reason for choosing TTC, on student-teachers decision to persist or drop out. Consequently, the survey sought to elicit respondents' opinions concerning a host of predictive variables. Therefore, all data were measures of characteristics, opinions, attitudes, and values formed before (the end of) the second semester in the first year of college.

The current paper builds on some earlier studies; specifically, Glynn *et al.* [13], Zhang *et al.* [17], Admassu [18], and Troelsen & Laursen [19], but differs in terms of context and study emphasis. Student-teachers dropout in TTCs is a subject that has received little attention from the academic community or states in general. Previous research has primarily focused on student dropout in developed and developing countries, whereas this study investigates student-teacher dropout in a least-developed country. Studying Ethiopia presents an opportunity to appreciate and analyze student dropout issues in a cultural and social background different from developed and developing nations. Ethiopia is also economically and politically unstable, but conscious of these limitations, it has made a significant investment in education [3]. Ethiopian TTCs are fully funded by the Government, receiving annual allocations for teaching, infrastructure, and administration [20].

With very few exceptions, studies on the Ethiopian educational sector mainly focused on exploring factors that affect student dropout at the primary and secondary levels [18], [21], thereby creating a research gap at the higher education level. This study extends previous research to empirically predict the early identification of at-risk freshmen enrolled into education colleges by obtaining data from a larger sample size. For least-developed economies such as Ethiopia to implement effective policies that will reduce dropout rates while simultaneously increasing the efficiency and effectiveness of their education systems, they must first understand the personal, academic, and socioeconomic factors that influence student dropout. So, we employed logistic regression to analyze the predictive power of personal (student), academic and socioeconomic factors on student-teachers attrition.

We addressed two major research questions (RQs) simultaneously:

RQ1: What is the composite impact of each set or dimension of variables on student-teachers dropout?

RQ2: What is the relative impact of the important predictive variables on student-teachers dropout?

II. REVIEW OF LITERATURE

Several theories and models have examined the twin factors of intention to persist in the education process and, at the other extreme, the intention to or actual drop out of the process. The latter tend to increase along with their attendant consequences [22].

Researchers have used several terms and definitions to describe dropout phenomena. This study adopts the classical definition of student dropout by Tinto, as; "situations where a student leaves the college study in which he has enrolled before having obtained a formal degree" [4], [23].

The most prominent model of student attrition is the Tinto's student integration model [24]. Tinto argues that students' decision to persist or drop out of their studies is strongly related to their degree of academic and social integration at the institution. The model was of great academic value and was used in many works in a generalized way. However, it evolved and incorporated new perspectives because various authors addressed the model's initial limitations by including other explanatory variables external to the academic and social systems and treating them as direct predictors of dropout. Subsequent studies along this line included a wide range of potential predictors: e.g., students' prior academic history [25], sex, and age [25]–[27], tuition fee source [27], domicile [28], GPA and CGPA [17], [29], and in few cases national culture [19].

Despite the development of numerous theories and models by researchers, there has been no general agreement on what factors influence students' decision to discontinue their studies, resulting in inconsistent findings. These contradictory findings have been attributed to the study's methodology, data employed, and context [13]. As a result, we examine some of the previously identified student dropout variables in the context of a least developed economy.

A. STUDENT DROPOUT IN ETHIOPIA

Ethiopia is one of the world's poorest and educationally disadvantaged countries [30]. To overcome these limitations, Ethiopia has strived to improve its student enrolment and graduation rates, especially at the primary and secondary school levels, but this contrasts with its tertiary level [31]. At the higher education level, the country had a gross enrollment rate (GER) and educational attainment rate (EAR) of 8% and 8.8%, respectively, in 2018 [32]. Ethiopia can provide inclusive and equitable quality education by improving indicators such as GAR and EAR [33]. To achieve these objectives, Ethiopia needs to increase the supply of qualified teachers and prevent dropout [34]. However, in the past few years, political unrest in Ethiopia has affected the enrollment rate and has consequently resulted in the rise of dropout rates (especially primary and secondary).

Research on student attrition in Ethiopia has mainly focused on the primary school level [18], [21], [35]–[37] and in a few instances at the secondary level [38]. However, there is a paucity of empirical research at the higher education level.

According to UNESCO [39], one of Ethiopia's education sector's critical problems is a high dropout rate at almost all levels. Numerous factors have been identified as contributing to student dropout in the country. Several previous studies on primary schools and female dropouts [37], [38], [40] indicate various personal, school, and family factors contributed to students' dropout.

Admassu [18] examined primary school enrolment and dropout covariates among primary-school-age children in Ethiopia using the 2004 Welfare Monitoring Survey. He discovered that the likelihood of girls enrolling in school was significantly lower than that of boys. The likelihood of girls completing primary education was also significantly lower than boys. Chaudhury *et al.*'s [41] study showed that girls were less likely to complete primary school in the event of a harvest failure, but this had no significant effect on boys.

Woldehanna *et al.* [42] adopted a Cox proportional hazards model and investigated the relative importance of school, family, and individual child characteristics in determining grade completion and primary school dropout and found that boys faced a smaller risk of dropping out of school than girls. Older children were found to face more risk of dropping out of school, and this risk increased with the number of children in each household. Woldehanna & Hagos [35] suggests that, among other variables, parental education and wealth have a negative association with student dropout and a positive association with study completion.

High dropout out of students from the education system has been one of the main challenges of the education system of Ethiopia. Admassu [18] concluded that various personal, school, and family factors contribute to students dropping out. Several factors mentioned include poor health, malnutrition, low student interest in education, limited employment opportunities for graduates, teachers' instructional methods, various education-related costs such as uniforms, travel, equipment, and students' opportunity costs.

B. DROPOUT PREDICTIVE FACTORS

Several researchers [43]–[45] have extensively studied students' dropout problems and noted that students' retention or dropout occurs due to a combination of factors and not a single factor. Several studies on student dropout have been primarily conducted in developed and developing countries. Most studies in developed countries have focused on high school or post-secondary dropouts, while in developing countries, the emphasis is on primary and secondary dropouts. Results have been conflicting probably because of context, data used, or methodology adopted. For this study, the student dropout predictive factors from the various models have been classified into three sets of personal (student), academic and socioeconomic dimensions.

1) PERSONAL (STUDENT) PREDICTIVE VARIABLES

In personal student factors, age at college entry, gender, marital status, national culture, and encouragement and support from parents are considered significant [25]–[27], [46]–[48].

These predictors constitute characteristics associated with the student and their personal environment that directly influence leaving the learning process unfinished. Ansary [49] identified student's age, gender, and land ownership pattern as significant predictors of study dropout in the least-developed and developing economies.

Prior research [41], [42], [47], [48], [50]–[57] finds gender an important predictor of university students' dropout. However, the effect of gender on dropout decisions is contradictory in the existing literature. Certain research indicates that males are more likely than females to drop out [46], [50]–[55], while other research indicates the opposite [41], [42], [48], [56], [57]. According to Stratton *et al.* [53], men, particularly married men, are more likely to abandon their studies as their family responsibilities indirectly influenced their dropout decision. According to Ashour [55], males are more concerned with having a job to support their families, and thus their employment plays a larger role in their decision to drop out early. Male students tend to devote less time to academic activities, which appears to increase their probability of dropping out [25]. On the contrary, Aina [56] suggests that women demonstrate better study skills and value higher education than men, so less likely to dropout. Casanova *et al.* [48] assert that female students have a higher dropout rate, which appears to be related to balancing family obligations associated with marriage and academic activities. Tinto [25] associated dropout among male and female students due to social integration difficulties and less time on academic activities. Thus, the literature presents contradictory findings regarding the role of gender in dropout decision-making and is therefore inconclusive.

Age is also considered a predictor of student dropout [26], [58]. Hirakawaa & Taniguchi's [58] study on schools in rural Cambodia shows that age is significantly associated with dropout. Older students who had not entered higher education upon completing secondary education are subsequently more likely to fail or dropout [25]. This is corroborated by Rodríguez-Muñiz *et al.*'s [59] study, which reports that older students over 23 years old are likely to dropout. However, the literature is inconsistent regarding the effect of age on male and female student dropout rates. On the one hand, Webster Stratton *et al.* [60] assert that male dropouts are more likely to be older, while the same authors suggest that age does not appear to be a factor in female dropouts. On the other hand, Berg & Nelson [61] suggest that female students who belong to the higher age group are at a higher risk of dropout than their younger counterparts. Thus, the dropout literature is inconsistent in assessing the role of age in student dropout, particularly among female students.

Encouragement and support students receive from parents in their academics have worked against dropout [62]. The quality of relationships within the family, parental expectations, interest, and habitual approaches to communication and decision-making (e.g., an open, democratic, and supportive family climate) are associated with students' persistence in college [63].

A factor commonly overlooked by many authors is the role or influence of national culture in the decision process of students to drop out of the study. National cultures influence educational institutions and academic practices in many ways [19], especially in diverse, multicultural societies. Like many other least-developed and developing countries, Ethiopia is a multicultural society with distinct racial, ethnic, gender, and class differences. National culture can influence higher education in at least two ways. First, it can influence national policy and the design of the higher education system [19]. Secondly, as Hofstede *et al.* [64] suggest, it can directly influence students' study behavior. In their original work, Hofstede & Bond [65] introduced four dimensions of national cultures: individualism versus collectivism, power distance (high to low); femininity versus masculinity; and uncertainty avoidance (high to low). The position on each of these dimensions a country occupies can directly influence students' study behavior. Ethiopian national culture occupies a near extreme position in most of these dimensions (see <https://www.hofstede-insights.com/country-comparison/ethiopia/>) and is likely to influence student academic study behavior relating to retention or dropout decision.

2) ACADEMIC (ACTIVITIES) PREDICTIVE VARIABLES

In the academic dimension, academic performance, post-high school aspirations, interaction with peers at college, bad interaction with teachers, an expectation of academic problems at college, and academic reasons for choosing an institution are predictive factors [28], [43], [48], [61], [66]–[68]. They are the attainment of learning outcomes, the development of competencies, student performance, and other factors (relationships) that affect the teaching and learning process at all levels of education.

Academic performance (achievement) is a process closely related to preceding study levels, impacting further educational achievements [69]. Students who demonstrate good academic performance (grades, reading, mathematical literacy, performance in tests, entrance exams, etc.) are less likely to drop out [48], [61], [66], [67]. Pal's [28] study on university students in India shows that students' performance in grades (CGPA, GPA, etc.) plays an important role in motivating them to continue their studies. Belloc *et al.* [54] confirm low academic achievement in students' early evaluations as a source of stress and dissatisfaction, which leads to dropout. This is corroborated by Al-Shargabi & Nusari's [14] study, which reports that students who obtain poor scores in certain courses in the early stages of university (1st or 2nd year) are more at risk of dropout than those who consistently perform above average.

A related variable to student academic performance is the student's academic aspirations. Aspiration has an element of motivation as reflected in class attendance [68], desire, or effort to achieve academic success [70]. Students' aspirations stem from a variety of factors, including educational objectives, vocational pursuits, and, perhaps most

significantly, their sense of self about what they believe are critical components of success in lifestyles of their choosing [68], [70]. Jepsen & Neuman [71] believe that academic aspirations (such as higher education) are the most potent predictors influencing students' decision to remain or drop out of the institution.

Students quitting education is hardly a unilaterally motivated process. So, a student's decision to drop out is influenced by factors related to the contextual factors within the institution, such as peer interactions and relationships with teachers [13]. If students feel comfortable in their social interactions with peers in the college, they are more likely to stay [24]. Similarly, healthy student-teacher relationships foster a positive learning environment for students and help them avoid dropping out [25].

Finally, vocational issues are also determinants for students' persistence or dropout [13]; that is, the vocational motivation and the goals students establish. Casanova *et al.* [48] state that if students fail to find a place in their first-choice degree course (in this instance, the reason for choosing TTC), they may have fewer developed vocational goals or a diminished dedication to academic activities. This situation could lead to academic dissatisfaction and reduced motivation, resulting in failure and dropout. TTC students' vocation is teaching, and their vocational motivation should be along this line; any expectation outside this might lead to non-attendance at formal teaching sessions [68] and eventually frustration in their academic endeavors.

Students who expect academic difficulties in college are at risk of dropping out. Students' disconnection from their classmates, college courses, and institutions increases as they anticipate academic difficulties [54]. Such disconnect results in their lack of academic motivation and engagement in academic activities [43]. These students have a higher absenteeism rate from the college, which increases their risk of dropping out [59].

3) SOCIOECONOMIC PREDICTIVE VARIABLES

Socioeconomic predictive variables include parents' academic level, financial situation, and social status. They refer to the student's social and economic circumstances, contributing to their failure to complete higher education. Prior literature [4], [44], [56], [72]–[75] depicts that family background (e.g., family's socioeconomic status and financial resources) as important predictors of students' dropout.

Students whose parents have inferior educational qualifications are less likely to graduate, especially first-generation students [26], [73], [74]. According to Aina [56], students from disadvantaged educational families are at a higher risk of dropping out. Students whose parents are less educated report a greater likelihood of dropping out and do not perceive themselves as more competent during their first year of education [56], [74]. Larsen *et al.*'s [4] study confirms that parents' educational attainment significantly impacts students' dropout risk. Educated parents are more aware of the benefits

of education for their children’s future and provide them with the motivation and support they need to continue their studies. Thus, the higher the parents’ educational attainment, the lower the risk of dropping out [4], [56].

Larsen *et al.* [4] present a clear trend of dropouts caused by students’ socio-demographic background, including their parents’ financial status. The study shows that their parents’ financial situation significantly influences students’ dropout risk: the higher the parents’ financial status, the lower the dropout risk. Low family income continues to be a risk factor for dropping out, as students may face financial difficulties due to living expenses or tuition fees [74]. Also, family is the primary source of funding for students’ education [75], particularly in developing and least-developed countries. Thus, financial constraints imposed by a low family income may cause a student to drop out. However, the impact of low family income on student dropout is mitigated by financial aid or assistance from the Government or other sources, especially in countries where education financing is viewed as a social service [75].

Aina [56] concludes that students from disadvantaged social backgrounds are at a higher risk of dropping out. Students from impoverished or dysfunctional families face a greater risk of dropping out [44]. Students from certain social backgrounds may have difficulty comprehending the language used to create the study materials. Thus, the social context in which the student is raised may preclude them from completing studies [75].

C. DROPOUT CONCEPTUAL MODEL

Based on the thorough literature review, we present the conceptual model of dropout in Figure 1.

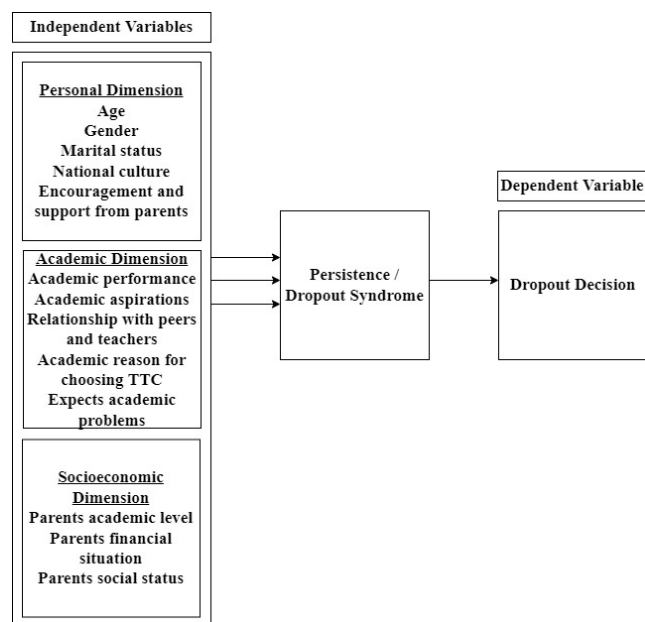


FIGURE 1. Conceptual Model of the Decision to Dropout of the College (Authors Design).

III. RESEARCH METHODOLOGY

The present research aimed to improve the early identification of at-risk students by developing a model that optimizes the predictability of student-teachers dropout. This study assumes that most dropout decisions occur during the freshman year, in line with Al-Shargabi & Nusari [14] and Pascarella & Terenzini [15]. The current study adopted a four-step logistic regression approach.

A. SAMPLE

Participants were a non-probabilistic sample of 1723 newcomers enrolled in five Ethiopian public Teacher training colleges (TTCs) drawn from five districts during the academic year 2019/2020. The respondents in this study were all first-year students, with a mean age of 22.06 (SD = 3.17, min = 18, max = 37), 43.12% male and 56.88% female, while 69.69% of the females are married. Table 1 and Table 2 show the sample distribution and sample characteristics, respectively.

TABLE 1. Sample distribution of the Five TTCs.

Students	Teacher Training College					Total
	1	2	3	4	5	
Enrolled students (questionnaire)	421	534	497	515	518	2485
Respondents	299	388	315	401	396	1799
Response rate (%)	71.02	72.66	63.38	77.86	76.44	72.27
Less unusable data	12	4	21	28	11	76
Final sample	287	384	294	373	385	1723

TABLE 2. Sample Characteristics.

Demographic Variable	Type	Number	Proportion
Age (AG)	18 – 21	986	57.23%
	22 – 25	494	28.67%
	26 – 29	156	9.05%
	30 – 33	57	3.31%
	34 – 38	30	1.74%
Gender (GEN)	Male	743	43.12%
	Female	980	56.88%
Marital Status (MS) (as a proportion of females)	Married	683	69.69%
	Single	297	30.31%

B. PROCEDURE

As per Oltmann [76], the online mode of questionnaires to collect information allows reaching many respondents while excluding interview bias. However, this medium was not utilized because of the erratic nature of internet services in Ethiopia, hence adopting a manual approach. This process entailed manual distribution and collection of questionnaires.

The first step was to contact the authorities of five randomly selected public TTCs. We established the study’s purpose and obtained their permission to distribute questionnaires to willing first-year students. The research team was tasked with visiting the respective TTCs at a time that would cause minimal disruption to classes. As a result, data collection occurred at a single point in time, as agreed upon in advance with each participating TTC.

Before distributing the questionnaires, students were informed of the research's objectives, given specific instructions for completing the questionnaire, assured that their responses would remain anonymous, and reminded of the critical nature of answering each question truthfully. The results of this exercise are summarized in Table 1, which indicates a 72.27% response rate.

The principal researcher's current and previous academic contacts, and knowledge of the country, having lectured in the country's education sector for some years, contributed to the success of this exercise.

C. RESEARCH INSTRUMENT

A self-reporting questionnaire based on the multidimensional construct of student attrition was designed as a data collection technique. It was based on Tinto *et al.* [24], [77] conceptualization of the determinants of student dropout. Tinto's iteration model was adapted to reflect the context of this study, which is the identification of predictive factors for TTC students' dropout in a least-developed economy like Ethiopia. Thus, variables outside Tinto's original iteration model were included. An open answer box was also included for the students to explain their reasons.

The instrument consisted of 39 items, distributed into 12 for predictive variables corresponding to the student (personal), 8 for socioeconomic, and 19 for academic dimensions. The questionnaire was subjected to external validation, even if it is an adaptation of Tinto's previous work and in line with previous studies [13]. The Cronbach's alpha value yielded ($\alpha = 0.769$), higher than 0.7, which means that the questionnaire is reliable [78].

D. MEASURES

The self-reporting questionnaire sought to elicit respondents' opinions concerning a host of variables. Thus, all data were self-reported characteristics, opinions, attitudes, and values formed before and during the first year of college. The model's predictive variables include three sets or categories: student, socioeconomic and academic variables. The continuous variables were measured with an ordinal or ranking scale of five points, using the sum of the respondent's combined level of importance, degree of satisfaction, agreement, or the extent to which these variables contribute towards student dropout. Higher values in the results indicate a stronger expression of the variables.

The outcome or dichotomous dependent variable measure was a single question to indicate respondents' intention to continue (persistence) or drop out, as it is an outcome of a choice process [13]. We, therefore, adapted Dresel & Grassinger [79] five items scale, which determine students' strength of intention into a dichotomous scale, to assess TTC students' dropout intentions (e.g., "I often think about dropping out of college): 1, if yes, and 0 if otherwise.

The predictor variables, drawn from the literature review, were defined as follows: For the student (personal) dimension variables: gender (GEN) and marital status (MS) were

captured by dummies, Male and married, respectively. They were assigned values of 1 if the respondent was male or married respectively and 0 if otherwise. Students' age (AG) at matriculation ranged from 18 to 37 years of age. We measured the influence of National culture (NC) and encouragement and support from parents (ESP), each with an ordinal or ranking scale of five points, using the sum of the respondent's combined level of importance, coded from 1 = not very important to 5 = very important.

The academic dimension or college experience set of variables were also measured. In line with Jepsen & Neuman [71], we considered post-high school degree aspirations (DAS) as a single item, asking respondents to describe their academic aspirations. We recoded this variable as a dummy, where 1 = post-bachelor's education (bachelor's degree, master's degree, doctoral degree, or professional) and 0 = all else (vocational certificate, associate degree).

Motivation for choice (academic reason for choosing TTC) was captured by a dummy, where 1 = professional teacher or 0 if otherwise. We measured each of the variables; the extent of academic performance (AP), bad relationship with teachers (BRT), interaction with peers (IWP), and expect academic problems in College (EAP) on student drop out each with an ordinal or ranking scale of five points, using the sum of the respondent's combined level of extent, coded from 1 = "to no extent" to 5 = "to a very large extent".

Furthermore, socioeconomic dimension variables were also measured. We coded the parent education level (PEL) variable with a reference group of students who do not have parents with a graduate degree (1 = at least one parent has a graduate degree (higher than a bachelor's degree), 0 = neither parent). We also measured parents' financial situation with an ordinal or ranking scale of five points each, using the sum of the respondent's combined extent to which it contributes towards student dropout, coded from 1 = "to no extent" to 5 = "to a very large extent". Finally, parents' social status (SS) was captured by a dummy, where 1 = "working class" or 0 if otherwise.

E. ANALYTICAL STRATEGY

When the dependent variable is dichotomous, logistic regression analyzes the relationship between an outcome or dependent variable and one or more predictors or independent variables using a logistic regression equation to estimate probabilities. Given the dichotomous nature of the dependent or outcome variable and the predictor or independent variables (i.e., a mix of continuous and categorical variables), we employ a logistic regression model to estimate the effect of predictor (independent) variables' on the outcome (dependent) variable. We chose the logistic regression model because it is frequently used in most of the education literature and studies involving dichotomous outcomes, such as 'Yes or No', 'True or False', 'Pass or Fail', 'High or Low', 'Accept or Reject' [13], or in this case, intention to continue in academic studies (retention) or intention to discontinue studies (dropout). According to O'Connell [80],

a logistic regression equation provides a comprehensive and flexible modeling strategy for analyzing binary outcomes expressed as dichotomous. Prior research indicates that a logistic regression model is an effective tool for accurately predicting academic performance and identifying at-risk students, as it enables valid conclusions for appropriate decision-making [51], [80]. Thus, logistic regression is a suitable model for this study.

The logistic regression model used in this study was built using data from the freshman class and assigned each freshman a chance or probability of attrition. Because the model allows for the estimation of each student’s probability of dropping out of college [51], [53], it is particularly useful when a retention office or department needs to prioritize students for intervention interviews to increase retention or reduce student dropout.

In logistic regression, a mathematical model of a set of explanatory variables is used to predict a logit transformation of the dependent variable. O’Connell [80] believes that a logistic regression equation provides a comprehensive and flexible modeling strategy for analyzing binary in the form of dichotomous outcomes. Probabilities under this equation are bounded by an upper and lower limit (0 to 1). If p is the proportion of observations with an outcome 1, then $1 - p$ is the probability of the outcome of 0. The ratio $p/(1-p)$ is called the odds, and the logit is the logarithm of the odds. The general form of the logistic regression model is:

$$\ln \{P_i / 1 - P_i\} = \beta_0 + \beta_1 X_1 + \dots + \beta_p X_p + \varepsilon$$

P_i = Probability that y is 1;

$1 - P$ = Probability that y is 0

For an impact of a unit increase in X , the logistic regression equation becomes

$$\ln(P_1/1 - P_1) = \beta_0 + \beta_1(x + 1) = \beta_0 + \beta_1 x + \beta_1$$

The study predictive model is presented as follows:

$$CD = \beta^0 + \beta^1 AG + \beta^2 GEN + \beta^3 MS + \beta^4 NC + \beta^5 ESP + \beta^6 AA + \beta^7 MTTC + \beta^8 IWP + \beta^9 BRT + \beta^{10} EAP + \beta^{11} FS + \beta^{12} PEL + \varepsilon$$

where;

CD is the college dropout, AG is age, GEN is gender, MS is marital status, NC is national culture, ESP is encouragement and support from parents, AA is the academic aspiration, $MTTC$ is the motivation for choosing TTC, IWP is interaction with peers, EAP is expected academic problems, BRT is a bad relationship with teachers, FS is financial status, PEL is parents’ education level, and ε is the error term.

IV. RESULTS

We used a four-step logistic regression procedure as illustrated in models I, II, III, and IV. Table 3 (Model I) contains personal (student) variables, while Table 4 (Model II) contains the academic variables. We estimated the effect of the combined sets of personal and academic predictive variables in Table 5 (Model III). In Table 6 (Model IV), we added the

TABLE 3. (Model I). Logistic Regression Analysis of TTC Students’ Attrition for Personal (student) Variables.

Predictor Variables	R	B
Age	0.163	0.503
Gender	-0.197	-0.487
Marital status	0.143	0.198
National culture	0.086	0.252
Encouragement and support from parents	-0.245	-0.536
Constant		21.992
Negelkerke R ²	0.149	

TABLE 4. (Model II). Logistic Regression Analysis of TTC Students’ Attrition for Academic Variables.

Predictor Variables	R	B
Post high school aspirations	-0.328	-0.414
Academic performance	-0.358	-0.283
Interaction with peers	-0.094	-0.477
Bad interaction with teachers	0.217	0.394
Expects academic problems at college	0.083	0.207
Academic reason for choosing institution	-0.282	0.416
Constant		20.569
Negelkerke R ²	0.206	

TABLE 5. (Model III). Logistic Regression Analysis of TTC Students’ Attrition for Personal (student) and Academics Variables.

Predictor Variables	R	B
Age	0.094	0.385
Gender	-0.101	-0.492
Marital status	0.086	0.175
National culture	0.079	0.218
Encouragement and support from parents	-0.191	0.457
Post high school aspirations	-0.314	-0.398
Academic performance	-0.321	-0.279
Interaction with peers	-0.086	-0.395
Bad interaction with teachers	0.201	0.486
Expects academic problems at college	0.066	0.194
Academic reason for choosing institution	-0.272	0.439
Constant		21.675
Negelkerke R ²	0.254	

socioeconomic variables. For models I, II, and III, the values of interest are R² (explanatory power).

Table 3 (Model I) explains only about 14.9% of the variations, suggesting that personal variables, especially age, gender, marital status, and national culture, have a negligible effect or contribute very little to the prediction of dropout of TTC students. This finding is in line with Rotem *et al.* [81], which states that while background (personal) variables (in the model I) do not directly influence dropping out outcomes, they do have an impact on academic performance. In contrast, Table 4 (Model II) suggests that academic variables are essential for predicting the dropout of TTC students. Specifically, academic variables explain 20.6% of the variation in dropping out. Five variables serve as the main predictors; post-high school aspirations, academic performance, academic reason for choosing TTC, bad interaction with teachers, and expected academic college problems.

Table 5 (Model III) combined personal and academic variables to jointly explain 25.4% of the TTC students’ dropout variation. Finally, the inclusion of socioeconomic variables in

TABLE 6. (Model IV). Logistic Regression Analysis of TTC Students' Attrition for all Variables.

Predictor Variables	R	B	SE β	Wald's χ^2	P	Odds Ratio e^b
Personal (student) dimension						
Age	0.088	0.647	0.079	0.662	0.058	1.910
Gender	-0.107	-0.464	0.092	0.698	0.059	0.629
Marital status	0.078	0.183	0.012	1.533	0.086	1.201
National culture	0.095	0.228	0.036	2.031	0.098	1.256
Encouragement and support from parents	-0.192	-0.502	0.027	2.042	0.053	0.605
Academic dimension						
Post high school aspirations	-0.311	-0.369	0.021	2.333	0.049	0.691
Academic performance	-0.331	-0.371	0.015	3.974	0.043	0.690
Interaction with peers	-0.129	-0.499	0.064	1.592	0.053	0.607
Bad interaction with teachers	0.208	0.554	0.078	0.884	0.048	1.740
Expects academic problems at college	0.089	0.121	0.083	0.779	0.082	1.129
Academic reason for choosing institution	-0.297	-0.476	0.073	0.175	0.050	0.621
Socioeconomic dimension						
Parents academic level	-0.165	-0.315	0.021	2.384	0.066	0.730
Parents financial situation	-0.104	-0.621	0.059	1.623	0.088	0.537
Parents social status (Dummy)	-0.116	-0.273	0.077	0.492	0.059	0.761
Constant		21.32	3.062	0.000		
		4				
Model evaluation				χ^2	P	
Likelihood ratio test				11.03	0.011	
				4	5	
Wald test				9.772	0.009	
					4	
Hosmer & Lemeshow				7.601	0.453	
					0	
Nagelkerke R ²				0.317		

model IV explains variation by increasing it by approximately 6.3% (31.7% – 25.4%).

Since the main objective is to improve the early identification of at-risk students by developing a model that optimizes predictability, Table 6 (Model IV) is the main emphasis of the study as it contains all the predictive variables. It presents the full logistic regression results of the predictive capacity of all the variables. For ease of interpretation, each predictor variable is listed, along with the R statistic (a measure of the partial correlation (strength and direction) between the variable and the likelihood of dropping out); the B value (the logistic regression coefficient); the SE B (the standard error of B), the Wald statistics and the odds ratios. The Wald's chi-squared test (also known as Wald's χ^2) is used

to determine the significance of explanatory variables in a model. The odds ratios tell us that for a one-unit change in the predictor variable, the odds change for that variable by the stated odds ratio factor. The coefficients of particular interest in this result are the R statistics that indicate the strength of the partial correlation between the predictor variable listed and the dependent variable (likelihood of dropping out), and B, the logistic regression coefficient.

On the personal (student) level, Table 6 (Model IV) reveals that age (R = 0.088, B = 0.647, gender (R = -0.107, B = -0.464), marital status (R = 0.028, B = 0.183), national culture (R = -0.095, B = 0.228), and lack of encouragement and support from parents (R = -0.192, B = -0.502) have a relatively low predictive value for student-teachers' dropout. The academic dimension's results in Table 6 (Model IV) indicate that interaction with peers (R = -0.129, B = -0.499) and anticipating academic difficulties in college (R = 0.089, B = 0.121) have a relatively low predictive value for student-teachers' dropout. However, the study's findings indicate that postsecondary aspirations (R = -.311, B = -0.369), academic performance (R = -.331, B = -0.371), negative interactions with teachers (R = 0.208, B = 0.554), and academic reason for choosing institution (R = -.297, B = -0.476) all influence dropout. The socioeconomic dimension's results in Table 6 (Model IV) depict that parents' academic level (R = -0.165, B = -0.315), financial situation (R = -0.104, B = -0.621) and social status (R = -0.116, B = -0.273) could have a limited effect in predicting student-teachers' dropout.

V. DISCUSSION

We address the following research questions in this discussion: RQ1 and RQ2.

A. RQ1: COMPOSITE IMPACT OF DIMENSION OF VARIABLES

RQ1 can be addressed using the information from models I, II, III, and IV. Personal (student), academic, and socioeconomic dimensions explain 14.9% (model I), 20.6% (model II), and 6.3% (deduction from models III and IV) respectively of the variation in TTC student-teachers' dropout. The academic dimension combined variables had the highest impact, followed by the personal (student) dimension and the socioeconomic set of variables.

This demonstrates and supports extant literature that the academic dimension is most critical for predicting student dropout [14], [28], [43], [48], [54], [61], [68]. The results suggest that student-teachers' perceived academic difficulties or early academic challenges precipitate a dropout decision. Therefore, higher education administrators should forge the necessary intervention academic strategies to improve the student-teachers' academic performance. The intensity of intervention strategies should be increased in the early stages of education to prevent dropout.

The personal dimension is the second most critical for predicting student-teachers' dropout. Even though higher

educational institutions have a limited influence on the personal dimension, they should still assist to the extent possible. Finally, the current study finds the socioeconomic dimension as least important in predicting student-teachers dropout.

B. RQ2: RELATIVE IMPACT OF IMPORTANT PREDICTIVE VARIABLES

The Wald statistics in Table 6 (Model IV) reveal that all the variables predict TTC students' retention/dropout, though some relationships are moderate and insignificant. Student-teachers' decision to drop out of college is negatively influenced by academic performance ($R = -0.331$, $B = -0.371$). This is the most important predictor variable for the likelihood of student-teachers dropping out of TTC. This means that as academic performance increases, the likelihood of dropout decreases. In other words, student-teachers' immediate previous and current academic achievement is more closely and negatively associated with the chances of dropping out than any of the other predictor variables in this study. This finding is consistent with several other studies [28], [81], [82]. Specifically, Rodríguez-Muñiz *et al.* [61] and Belloc *et al.* [54], in their respective empirical studies, report students' academic performance in the first year of their study as a factor that affects students' retention/dropout rate. The result is also in line with Tinto's student integration theory [24] which states that students' decision to persist or drop out is strongly related to their degree of academic integration through their academic performances.

The second-highest impact on study dropout is the importance respondents attributed to post-high school aspirations ($R = -0.311$, $B = -0.369$). The interpretation is that an increased level of higher education aspiration leads to a lower study dropout level. Aspiration has an element of motivation, desire, or effort to achieve academic success [70]. This result aligns with Jepsen & Neuman [71], which states that students' motivation is critical for effective studying.

The third most important factor influencing dropout in this study is the academic reason for choosing an institution ($R = -0.297$, $B = -0.476$). This shows that the higher the students appreciate the college as an academic institution preparing them for a teaching profession, the lower the likelihood of dropping out. It reflects the value and love they have for their chosen career. This result is in line with Glynn *et al.* [13]. This also supports Dewberry & Jackson's [83] assertion that students' attitudes toward courses and success expectations are congruent with academic or vocation reasons.

Previous research state that the degree to which students' parents were exposed to formal education affect students' education aspirations [84] and hence lower level of study dropout. Larsen *et al.*'s [4] study also shows that students' dropout risk is significantly influenced by their parents' educational attainment or occupational level. The respondents' response for parents' education level ($R = -0.165$, $B = -0.315$), encouragement and support ($R = -0.192$, $B = -0.502$), and social status ($R = -0.116$, $B = -0.273$) in this study show that they have limited effect on dropout,

as the effect is not significant at p values of 0.066, 0.053 and 0.059 respectively. The students matured age (mean = 22.06) at the time of matriculation may be responsible for these results. However, parents' encouragement and support matter more than other factors in the personal dimension. Education authorities and policy makers should look out for other factors that increase dropout risk than parents' education and status levels for TTC students. Also, they should sensitize the parents on the importance of providing necessary encouragement and support to student-teachers, as this may have some, albeit limited, impact.

The positive signs of coefficient B and R-value for bad interaction with teachers' variable ($R = 0.208$, $B = 0.554$) indicates that higher scores for this variable are associated with higher chances of dropping out. This finding is in line with Gablinske [85], who argues that the greater the interaction between students and teachers (Integrationist's approach), the more likely would students complete their studies.

As a measure of student-teachers' financial stress, the financial situation's ($R = 0.104$, $B = 0.621$) predictive power is not as expected in this study. This indicates that concern for financing education is not a serious factor in TTC student-teachers' decision to leave studies. This result contradicts Tan & Shao's [27] findings, which consider the availability of financial resources/cost of financing college studies to be a key factor for students' academic decisions. This outcome may be explained by the numerous financial interventions and assistance provided to student-teachers in least-developed countries (such as Ethiopia) during their studies [3]. Secondly, higher education is seen as the only asset to improve economic and social status, which is true for most least-developed countries. Therefore, the perceived benefits are considered to be more than the costs. The rest of the other predictive variables identified in our model showed marginal degrees of significance on TTC student-teachers' attrition in the context of this study.

The relatively low influence of cultural values ($R = 0.095$, $B = 0.228$) on the decision to drop out of the study is of interest and contrary to expectations given the nature of Ethiopian society. This result may have been influenced by the Ethiopian Government's stand on education, as the country has invested enormously in the educational sector and given financial incentives to student-teachers to acquire education and ensure a successful future [3]. Despite the lack of significant influence of the cultural factor, the respondents' importance indicates that higher scores for this variable are associated with higher chances of dropout. However, the result is not statistically significant but aligns with Troelsen & Laursen's [19] finding.

Unlike previous research [25], [26], [41], [42], [47], [48], [50]–[58], [61], the current study did not find that personal (student) variables such as age ($R = -0.088$, $B = 0.647$), gender ($R = -0.107$, $B = -0.464$), or marital status ($R = 0.078$, $B = 0.183$) were significant in influencing student-teachers' dropout decisions, as their effect is not

significant at p values of 0.058, 0.059, and 0.086, respectively. Therefore, these personal variables may not be considered significant in all contexts when it comes to influencing dropout decisions.

The findings of this study generally corroborate previous research [14], [28], [48], [54], [61], [66]–[71] on the impact of academic factors, as the study confirmed that the twin factors of academic performance and aspirations are the strongest predictors of student-teacher attrition. However, study results differ in other factors, such as the cultural values of student-teachers, their parents' level of education, and the cost of financing education, on dropout decisions. Although the current study used logistic regression, the rigor of the findings is comparable with previous studies that used alternative methods [2], [7], [14], [16], [17], [27]–[29], [47]–[48], [53], [72]. Despite the slightly contradictory findings, as previously stated, early identification and intervention efforts cannot be unilateral and straightforward but must incorporate a variety of support services to address dropout risks, as observed in the model.

The study's empirical findings have significant implications for policymakers, educators, and regulatory authorities in least-developed countries. First, they must comprehend the academic, personal, and socioeconomic factors (in that order) that contribute to the early identification of student-teachers at risk of dropping out as previous research [13]–[15] has demonstrated that most dropouts occur during the freshman year. Second, intervention efforts following early identification of at-risk students cannot be limited to a single intervention strategy but must integrate various support services to address dropout risks. Finally, policymakers and regulatory agencies should implement effective policies that reduce dropout rates while increasing the efficiency and effectiveness of their educational systems. Recognizing that each country has its own characteristics, and that overgeneralization should be taken with caution, this study has some implications for countries with similar characteristics to the study's context and future research, as stated in the subsequent sections.

VI. CONCLUSIONS

This study considered variables related to personal, academic, and socioeconomic factors predicting student-teachers' dropout in a least-developed economy and adopted a four-step logistic regression approach. Since prediction is the main goal of this study, it attempts to identify the degree of impact of the specified predictor variables on student-teachers' dropout to enable academic authorities to direct scarce resources in that direction. Our model identified student-teachers academic performance as the most important determining factor. This result underscores the importance of the first year in higher education institutions, especially TTCs. The early academic difficulties contribute to the decision to drop out, highlighting warning signs that education administrators and teachers should monitor. It challenges academic authorities to pay special attention

to students' first semesters' perceived confidence or performance to adopt preventive measures.

The second most predictive variable is the student-teachers academic aspirations factor. Aspiration is characterized by a sense of motivation, desire, or effort directed toward academic success. The twin factors of student academic performance and aspirations help create a good fit between the student and the academic environment, resulting in positive academic integration, commitment, and motivation. These values and attitudes, directly and indirectly, work against the decision to drop out of studies.

A third novel significant factor identified in our model that may increase or decrease dropout risk but has received insufficient attention in previous research is the academic reason for choosing TTC. Students' vocational motivation and goals are essential at the early stages of the education process and work against the dropout decisions. The more student-teachers value TTC as a means of preparing them for a career in teaching, the less likely they are to drop out.

The study results support prior research [13] in suggesting that negative interactions with teachers are associated with increased chances of student-teachers' dropout. So, education authorities should encourage teachers to develop a congenial learning environment. Further, results indicate that predictive variables such as national culture values [19] and the cost of financing education [27] that have been identified as critical in previous studies are not considered significant in the context of this study (least-developed country). This is most likely due to the Ethiopian Government's substantial investment in education and the financial assistance provided to student-teachers in order to complete their studies. Also, higher education is viewed as the only way for people in least-developed countries (such as Ethiopia) to improve their economic and social standing. Lastly, the study results found no significant relationship between student-teachers dropout risk and their parents' educational attainment [73] and social status [56]. However, the policymakers should sensitize parents about the importance of encouraging and supporting student-teachers education, even if the impact is relatively small.

Early identification and intervention lie at the heart of retention and reduce dropout rates [86]. The current research results support the importance of early identification and interventions to promote the permanence of first-year students. This is critical for least-developed countries like Ethiopia, where the Government has made significant investments in the education sector despite limited resources. Therefore, staff and college administrators should recognize the importance of reception for new students and identify their learning difficulties to improve their knowledge up to appropriate levels. Academic institutions should pay attention to students in terms of academic guidance and personal counseling and support, as both intrinsic and extrinsic factors intertwine to influence the student dropout decision process. Hence, intervention efforts cannot be simple and

singly applied but must combine various support services to encourage a robust learning and retention environment.

While the findings of this paper are based on Ethiopia's status as a least developed economy, they should not be extrapolated to similar countries without caution, as each country has its unique characteristics.

VII. LIMITATIONS AND FUTURE RESEARCH

The findings of this research are subject to some limitations. First, the generalization of our findings is restricted to public higher education institutions, particularly colleges of education. The sample is also limited to a select group: TTC students in their matriculation year. This study assumes that most dropout decisions occur during the freshman year [14], [15] and do not include higher classes. The sample size is quite large, but a greater sample size would increase accuracy in predictions. The study only examined early identification of students who may be or become candidates for dropping out and not intervention strategies. Despite this limitation, as soon as a satisfactory logistic regression model has been attained based on responses and scores on the predictor variables, students can be assigned predicted probability attrition as they progress to higher classes.

Nonetheless, we consider our results to have significant implications, especially for higher education institutions, and particularly colleges of education (TTCs), from a similar social and economic context to the one we investigated. However, caution should be exercised when extrapolating the study findings to similar countries, as each country has its unique characteristics. Future research may use different techniques, determinants and include senior classes. Studies may especially focus on behavioral and cultural barriers to the effective prediction of student attrition. Finally, future research should explore the possibility of using institutional systems that can provide real-time data to identify students at risk of dropout.

CONTRIBUTION OF AUTHORS

The authors' contributed as follows:

Harman Preet Singh: Conceptualization, methodology, software, validation, formal analysis, investigation, data curation, writing—original draft preparation, writing—review and editing, supervision, project administration.

Hilal Nafil Alhulail: Conceptualization, validation, investigation, resources, writing—review and editing, supervision, project administration.

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