Sociocultural factors, academic performance, and intercultural university education in the Peruvian Amazon

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The educational context in the Peruvian Amazon is moderately complex
because of the interaction between students from 23 indigenous peoples,
with a preponderance of Shipibo-Conibo, Ashaninka, Awajun, Shawi,
Yanesha, Wampis, Quechua, and Cacataibo, among the most representative
and in that order, with culturally different knowledge and worldviews. Thus,
the university becomes a center of tolerance, recognizing and accepting
the identity of others and coexisting with mestizo students from urban
areas. This study aimed to determine the sociocultural and educational
factors influencing academic performance in a virtual teaching context for
intercultural university education in the Peruvian Amazon. A neural network
model was applied to a sample of 162 students from a population of 1,835
students at an intercultural university in the Peruvian Amazon. Furthermore,
54% of the students are of mestizo origin, and 46% belong to the indigenous
population. It was concluded that economic dependence on the family,
failing midterm exams, feeling isolated and alone, and conflicts with a family
member influence academic performance.

KEYWORDS

academic performance, intercultural education, e-learning, indigenous peoples,
Amazon

1 Introduction

In the last two decades, the indigenous and Afro-descendant people of Latin America
have made significant progress in several areas that affect their quality of life. However,
these advances are insufficient, given the effects of centuries of discrimination. Education
is a field in which insufficient progress has been made (Mato, 2008). The framework in
which the first intercultural or multicultural education programs could be implemented
(Ballesteros and Abril, 2019) and the number of universities in Peru that offer special
access or teaching programs for the Amazonian indigenous population have significantly
increased (Espinosa, 2017). Education in Peru has faced significant challenges in
implementing and strengthening an accessible university education. Peru is a pluricultural

and multilingual country because, in its geographic spaces, there are collectivities that possess a variety of cultures and languages (Rebaza and Seminario, 2018).

Owing to the educational gaps in Peru, the government warned about the need to create intercultural universities to address comprehensive professional training. This will develop cultural extension activities in ethnolinguistic groups in the Peruvian Amazon and contribute to the preservation of indigenous culture in the context of plurality and sociocultural diversity, thereby indispensably guaranteeing the cultural identity of the progressive development of indigenous peoples. In Peru, there are 55 native peoples, 51 of them belong to the Amazonian area and 4 of them belong to the Andean area (Rebaza and Seminario, 2018). In the University of the Peruvian Amazon, 32% are from the Shipibo-Conibo ethnic group, 16% from Ashaninka, 9% from Awajun, 5% from Shawi, 4% from Yanesha, 3% from Wampis, 3% from Cacataibo, 2% from Quechua, and 26% from other native peoples.

The training center has become a place for academic coexistence; it is a space for integration, dialogue, knowledge, and ancestral practices that allow students to preserve their identity with their ethnicity by recognizing the other and preserving the native language. In recent years, owing to technological progress, academic performance has been studied from different perspectives. These sociocultural and educational factors make the teaching-learning process different with didactic resources based on the reality, experience, and knowledge of the student, such that the educational institution becomes the center of formation, growth, and development with a dynamic of academic coexistence.

Higher education institutions have the potential to contribute significantly to the development of intercultural competencies; however, there is a lack of empirical research on how students learn and the process of intercultural learning. The research determines that the motivational factors and intercultural experience were teamwork, multicultural classroom, and cultural informants. It also indicates that learning occurred through experience, reflection, abstract conceptualization, and experimentation and concludes with recommendations for intercultural course design (Vromans et al., 2023). Learning experiences from an ecological perspective provide a much broader understanding of the relationships between culture, learning, and academic achievement and justify that programs and services must be developed to respond to the diverse sociocultural and linguistic backgrounds of students to achieve equally meaningful educational experiences (Garcia and Dominguez, 1997).

Technological development has transformed nations in their social, economic, cultural, and educational contexts (Sánchez, 2014); therefore, information and communication technology is a vehicle that allows access to education for people without access (Román, 2018). However, Sánchez points out that students' learning does not depend on their educational modality but on how thematic content is presented to them, the activities that reinforce their learning, and the coherence that exists between the educational material and their educational needs and objectives (Sánchez, 2014).

Ajibade and Hayes explore the sociocultural perspectives that impact self-reported transitions to United Kingdom higher education by Nigerian students (Ajibade and Hayes, 2022). They conducted an interpretative phenomenological analysis by integrating qualitative research methods. The sample comprised 20 participants. The findings revealed the extent to which sociocultural acclimatization is important

for transitioning to United Kingdom higher education. Students reported that the perceived complex ambiguity surrounding the design and delivery of academic curricula is a challenge. Furthermore, they revealed that the *a priori* existence of negative learning experiences, including a lack of information technology facilities and culturally embedded family expectations and responsibilities influence the perceptions and experiences of learning and teaching in the United Kingdom. The researchers assert that prior experiences can influence pedagogical experience, which corresponds with the principles of social constructivism. Most participants stated that their experience of the transition period of entering United Kingdom education varies between individuals; perhaps most significantly, the perceptions of acculturation, acclimatization, and the overall transition to the UK took 4–6 months for a program that may be only 1 year long.

Mittelmeier et al. (2018) explore an evidence-based solution to encourage computer-supported collaborative learning participation: the internationalization of online academic content used for collaborative activities. A randomized control testing method was used with 428 undergraduate students in an introductory statistics course to compare individual and group participation in an online collaborative task when students used content from local contexts versus content from international contexts. The results suggest that the internationalization of online content can encourage participation at the individual level and decrease participation disparity within small groups when the content is from countries that are personally relevant to students' backgrounds. Furthermore, participation was influenced by individual demographics and group dynamics.

Gomez et al. (2018) characterize, from the perception of teachers, the relationship between the institutional conditions of the Universidad de la Amazonia and the irregular tenure of the Faculty of Accounting, Economics, and Administrative Sciences. The study was quantitative; the information was collected using a file search technique, and the teachers' perception of the phenomenon was determined using surveys. The factors that most frequently influence irregular tenure are academic performance, administrative management, curriculum, and teaching practice. The study concluded by affirming that the intervention of academic authorities, the establishment of institutional policies, and the articulation of processes are required to eradicate irregular tenure.

Expósito and Marsollier (2020) explore the strategies and pedagogical and technological resources used by teachers in virtual education during the confinement and closure of educational institutions, with the participation of 777 teachers from educational institutions in Mendoza, Argentina. The study shows inequalities in the use of technology and digital pedagogical resources, which are shown in relation to the type of management, educational level, socioeconomic status of students, academic performance, and support from the student's family. This shows that there are socioeducational inequalities among students, and it is necessary to understand the conditions and consequences in the educational system in the context of social isolation.

Jurado and Fellman (2020) implement a model based on a neural network and a natural language processing algorithm that facilitates the virtual evaluations of students in the seventh and eighth semesters in the subjects of Programming II and Computer Security I, supporting the process in times of pandemic (COVID-19). The evaluations are presented on the virtual platform Moodle of the

Universidad Privada Domingo Savio. The neural network identifies students with an appropriate psychological profile for specialization in the mentioned subjects to achieve a high academic level.

Incio et al. (2021) implement an artificial neural network to predict the academic results of the physics course of the students of the II cycle of Civil Engineering at the National Intercultural University Fabiola Salazar Leguía of Bagua-Peru. This neural network is designed and implemented in MATLAB, consisting of input, hidden, and output layers, achieving prediction percentages of 70% and 86%. It predicts the academic results of the students and allows the teachers to look for techniques and strategies during the teaching and learning process, thereby improving the achievement of competencies in their students.

Gil and Quintero (2021) present an artificial neural network that predicts students' academic performance using the academic, demographic, social, and institutional information of 395 Colombian students of the Villa del Socorro Educational Institution, Medellín (Colombia), obtained using surveys and institutional reports. Predicting academic performance allows the development of didactic and pedagogical strategies to make the teaching and learning process more efficient.

Mondaca et al. (2017) establish guidelines to identify and characterize the distribution of the ethnic ascriptions of undergraduate students and their correspondence at the Universidad de Tarapacá using the type of education, indigenous certification, and participation in associations and groups. This supports the importance of having information on the ethnic affiliations of students to promote policies in relation to the inclusion of the indigenous variable in the curricular redesign and strategic management plan of the university from the perspective of cultural relevance rather than a declaration of principles.

Valdivieso et al. (2020) explore the perceptions of 85 Colombian university students on how the coronavirus and confinement significantly affect academic performance. It is determined that virtuality, mood, and family coexistence affect academic performance, indicating that quarantine affects the performance of students.

The study is supported by valid bibliographic sources to theoretically or scientifically validate the variables. Current intercultural education is considered and applied in restricted contexts, exclusively for indigenous education or learning foreign languages (Pinto et al., 2020). Navarrete-Cazales and Alcántara-Santuario (2016) indicate that intercultural education is the interaction between two or more cultures, both horizontally and synergistically. Therefore, none of the cultures is above the other, which is a condition that favors the integration and harmonious coexistence of individuals. Krainer et al. (2017) indicate that intercultural education is a principle that seeks the formation and awareness of individuals committed to life but recognizes the coexistence of diverse methods of constructing knowledge and understanding the world and diverse logic. The objective of intercultural education is to foster dialogue between these diverse perspectives to achieve an equitable society.

Intercultural education is defined as education that is not specifically aimed at indigenous people and does not focus primarily on language. It aims to enable people to acquire knowledge and appreciate the diverse cultural traditions of their country. Intercultural education seeks to promote understanding, respect, and appreciation of cultural diversity to build an inclusive and equitable society in which all cultural traditions are recognized and valued (Lehmann, 2015). Conversely, modern Russian pedagogy uses the concept of

intercultural education based on an understanding of the possibility of the peaceful, reasonable, and fruitful coexistence of different ethnic people and nations based only on the dialogue of culture (Valeeva and Valeeva, 2017).

Intercultural education focuses on differences and cultural diversity, not on those who are culturally different (Aguaded, 2017). Men and women from other cultures are human beings with whom we build a new and different society. From the concept of multiculturalism as a model of diversity management, intercultural education is an educational approach from which we can address issues related to the treatment of cultural diversity in education. It goes beyond the boundaries established by race, ethnicity, or nationality, considering diversity as a valuable strength and mutual enrichment and not as a weakness to be overcome.

Dirección General de Educación Superior Universitaria (DIGESU) conducted a national survey of university higher education students in 2019 to characterize the socioeconomic, academic, and cultural levels of university students, understand the evolution of the indicators in educational service, and provide feedback on the implemented policies (DIGESU, 2021). The study sample comprised 63,412 students from 18 public universities.

According to Barreto et al. (2012), "academic achievement is a complex and multidimensional theoretical construct, crossed and determined by multiple social, economic, historical, institutional, and individual factors" Barreto et al. (2012). Academic performance is influenced by the interaction of factors linked to socioeducational and cultural characteristics, which affect the performance of students and are determinants in their formation from the moment they enter the educational system (Porcel et al., 2018). It is the habitus and field where social structures are related through dialectical structures (Pinto et al., 2020).

Academic performance results from the teaching-learning process, which expresses students' achievements during the formative process facilitated by the teacher, educational stimuli, and motivation provided in this process (Cordero and León, 2020). Complex skills that include thoughts and behaviors help one consider one's experiences through cognitive, metacognitive, and affective-emotional components (Sagredo et al., 2021). The use of strategies is important when experimenting with new knowledge because it allows the strategic use of procedures, skills, and techniques for learning (Garcia et al., 2016).

According to León and Collahua (2016), the results of research in the field use composite indices to measure the socioeconomic level of families, and the standard deviation of students is 0.03, whereas the standard deviation for the effect of the socioeconomic composition of the school is 0.21. Thus, the effect of the socioeconomic composition of the school on achievement is relatively high. This is interpreted as the socioeconomic level directly influencing the performance of Peruvian students.

Neural networks are tools used to solve complex problems, significantly reducing processing time; they are used by different researchers to make predictions and classifications (Gil and Quintero, 2021). Studies have shown that the parameters of neural networks are difficult to interpret, requiring indisputable empiricism in their construction process because there is no clear and univocal formula regarding the general architecture of their design. They are algorithms that can associate or classify patterns, compress data, control processes, and approximate non-linear functions (Asogwa et al., 2020). These models are formed by input, output, and hidden layers,

which comprise artificial neurons and are interconnected by synapses with their respective weights (Incio et al., 2021). The neural networks work like the human brain and are capable of learning through repetitive training (Shaik et al., 2021; Maier et al., 2023).

This study aimed to determine the sociocultural and educational factors influencing academic performance in a virtual teaching context for intercultural university education in the Peruvian Amazon.

2 Method

The participants were 162 students who were randomly selected from a population of 1835 students from a university in the Peruvian Amazon. The students were from professional schools of Bilingual Initial Education, Bilingual Primary Education, Agroforestry Aquaculture Engineering, and Agroindustrial Engineering.

The research presents a quantitative approach with a non-experimental cross-sectional design, to answer the research question: What are the most important sociocultural and educational factors that influence the academic performance of students in a virtual teaching context for intercultural university education in the Peruvian Amazon? A three-layer neural network was used: an input layer with 81 units, a hidden layer with two units, and an output layer with one unit.

A digital questionnaire was designed and validated as a data collection instrument using a Google platform form, which consisted of 30 items. For the validation of the instrument, the criterion of expert judgment was used, and for reliability, the Kuder–Richardson 20 test (KR20) was applied to a pilot sample of 15 students with a coefficient of 0.892, which is rated as good (Wang et al., 2022). The online questionnaire was sent to each participant through their institutional e-mail, which is one of the university's communication tools. Filling out the digital questionnaire was voluntary. The academic performance variable was determined according to the students' semester averages and the information obtained from the university's academic system.

The instrument used in this study consisted of three parts. The first part contained academic information comprising 14 items: difficulties in being punctual, failure of midterms, difficulties working in a group, difficulties in exposure, difficulties doing work, relationship with a teacher, study techniques, study habits, vocation and identification with the career, study materials and supplies, problems due to the remote education methodology, low grades on jobs and tasks, computer availability for personal use, and Internet availability and connectivity for class sessions. The second part consisted of 15 items: health and fitness problems; difficulties due to a disability; feeding problems; housing problems; difficulties joining the group; conflicts with fellow students; conflicts with other close personal relationships; insecurity fears; permanent stress; emotional problems; limitations in setting personal goals and aspirations; problems due to beliefs, spirituality, and religion; little autonomy and decision-making; feeling discriminated against; and feeling isolated and alone. The third part consisted of nine items: conflict in relationship with a family member, living only affects you, having suffered the loss of a close family member, having a sick family member, having family members who are financially dependent on the student, coexistence problems as a couple, overload in responsibilities of the paternal or maternal role, economic problems, and conflictive coexistence at home.

The data were analyzed using R software and a spreadsheet. First, the data were downloaded to a file with a comma-separated value extension and subsequently exported to the statistical software. Second, the data were processed using a neural network consisting of input, hidden, and output layers to determine the most important sociocultural and educational factors affecting the academic performance of students in a virtual teaching context for intercultural university training in the Peruvian Amazon.

Informed consent was not required for this study because it was designed in such a way that no personally identifiable data were collected, thus guaranteeing the privacy and confidentiality of the participants, and with supervision for the application of the data collection instrument by the director of the Quality Management Office of the Universidad Nacional Intercultural de la Amazonia. In addition, all responses were treated in a general manner, which means that no individual-level data were analyzed. This methodology allowed us to obtain valuable information on certain aspects without compromising the identity of the participants, which was essential to preserve their anonymity and, at the same time, comply with the ethical norms of privacy in research.

3 Results

The results of this study are presented according to the objective of the research: to determine the sociocultural and educational factors that influence the academic performance of students in a virtual teaching context for intercultural university education in the Peruvian Amazon. The characteristics of the neural network model are described, through which the most important factors are determined. After neural network processing, the following results were obtained (see Table 1).

Table 2 shows the characterization of the neural network model consisting of three layers: an input layer with 39 factors and 1 covariate; it has 81 input neurons and uses the normalized method for the change in the covariate. The hidden layer has two units, or nodes, with a hyperbolic tangent as the activation function. The output layer contains the dependent variable (academic performance), and a standardized method was used for the change in scale in the dependent variable, with the identity function as the activation function and the sum of squares as the error function.

Table 3 shows the evaluation of the neural network, which has a sum of squares error of 30.956, indicating that the model is adequate for determining the most important sociocultural and educational factors that affect the academic performance of university students.

TABLE 1 Interpretation scale for KR-20.

KR-20 reliability	Description
≥0.9	Excellent
≥ 0.8 - <0.9	Good
≥ 0.7 - <0.8	Acceptable
≥ 0.6 - <0.7	Questionable
≥ 0.5 - <0.6	Poor
<0.5	Unacceptable

KR-20, Kuder–Richardson Formula 20.

TABLE 2 Neural network information.

Input layer	Factors	39	
	Covariates	1	
	Number of units[a]		81
	Scaling method for covariates		Normalized
Hidden layers	Number of hidden layers		1
	Number of units in the hidden layer		2
	Activation function		Hyperbolic tangent
Output layer	Dependent variables	1	Rendimiento académico
	Number of units		1
	Scale change method for scale dependents		Standardized
	Activation function		Identity
	Error function		Sum of squares

[a]Bias unit is excluded.

TABLE 3 Summary of the model.

Training	Sum of squares error	30,946
	Relative error	0.520
	Stopping rule used	1 consecutive step(s) without error reduction[a]
Tests	Sum of squares error	12,797
	Relative error	0.676

Dependent variable: academic performance. [a]Error calculations are based on test sample.

FIGURE 1
Importance of features in the neural network.
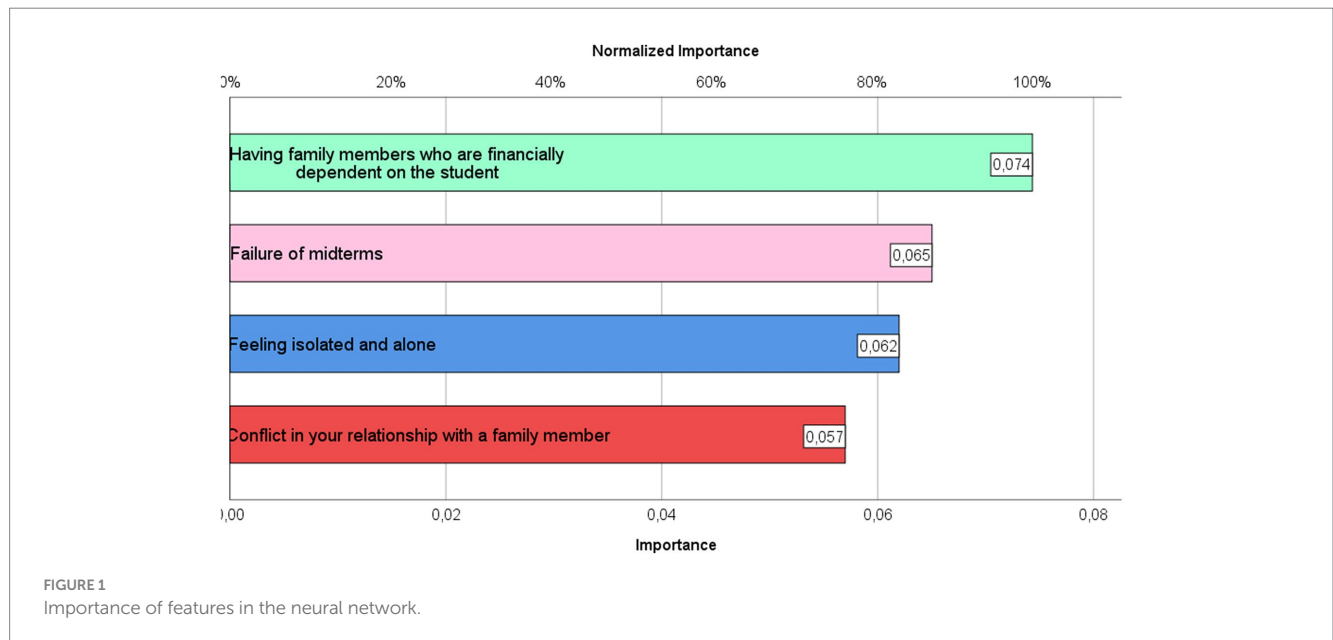
As shown in Figure 1, the analysis of the importance of the independent variables calculates the importance of each predictor to determine the neural network. The most influential variables in the final result are having family members who are economically dependent on the student, failing midterm exams, feeling isolated and alone, and having conflicts in the relationship with a family member.

Table 4 presents the academic performance predictions using the neural network model. Bilingual Initial Education vocational school students had significantly lower academic performance (mean = 10.47, standard deviation (SD) = 3.60) than their current academic performance (mean = 12.56, SD = 5.62). The Bilingual Elementary Education vocational school students had significantly lower academic achievement (mean = 9.56, SD = 4.02) than their current academic

TABLE 4 Prediction of academic performance.

Professional schools	Academic performance			Predicted value for academic performance	
	N	Mean	Desv. standard	Mean	Desv. standard
Initial Bilingual Education	39	12.568718	5.625417	10.477654	3.602654
Bilingual Primary Education	39	10.055385	5.865149	9.569542	4.026579
Agroforestry Aquaculture Engineering	41	11.053415	3.976308	10.356322	3.495027
Agroindustrial engineering	43	11.699535	4.819743	11.816293	2.075197
Total	162	11.349444	5.137833	10.583645	3.423333

TABLE 5 Descriptive of academic performance.

	N	Mean	Standard deviation
Mestizo student	86	12,48,546,512	4,441,498,331
Indigenous student	76	10,06394737	5,581,643,266
Total	162	11,34,944,444	5,137,832,911

TABLE 6 Factors influencing academic performance according to age.

Age	Having family members who are financially dependent on the student	Failure of midterms	Feeling isolated and alone	Conflict in your relationship with a family member
Under 24 years old	30.8%	50.0%	33.3%	63.6%
25 to 32 years old	33.3%	16.7%	26.7%	9.1%
33 to 40 years old	25.6%	11.1%	20.0%	18.2%
41 to 48 years old	5.1%	11.1%	20.0%	9.1%
Over 49 years old	5.1%	11.1%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

performance (mean = 10.06, SD = 5.86). Students in the professional school of Agroforestry and Aquaculture Engineering had significantly lower academic performance (mean = 10.35, SD = 3.49) than their current academic performance (mean = 11.05, SD = 3.97). Conversely, Agroindustrial Engineering professional school students had a significantly higher academic performance (mean = 11.81, SD = 2.07) than their current academic performance (mean = 11.69, SD = 4.81). In general, if the sociocultural and educational problems continue to remain among the university students of Amazonia, their academic performance would significantly decrease (mean = 10.58, SD = 3.42) compared with their current academic performance (mean = 11.34, SD = 5.13).

Table 5 presents a comparative analysis of the students' origins. Students of mestizo origin demonstrated significantly higher academic achievement (mean = 12.48, SD = 4.44) than students of indigenous origin (mean = 10.06, SD = 5.58).

Table 6, according to the age of the students, shows the factors that influence academic performance. In the group of students under 24 years of age, 30.8% have family members who are economically dependent on them, 50% have problems failing midterm exams, 33.3% feel isolated and lonely, and 63.6% have conflicts in their relationship with a family member.

4 Discussion

The study has sufficient statistical power as it uses a neural network model consisting of three layers: an input layer with 39 factors and 1 covariate, 1 hidden layer, and the output layer containing the dependent variable (academic performance of university students). They are represented by their average grades in all subjects and segmented by the specialties of professional schools. The neural network applies the standardized method for the change in scale in the dependent variable, with the identity as an activation function and the sum of squares as the error function.

Our results indicate that among the sociocultural factors related to academic, personal, and family aspects that affect students, in the hierarchy of importance, having family members who depend economically on the student, failing midterm exams, feeling isolated and alone, and having conflicts with other close personal relationships have the highest adverse effects. This relationship of variables is corroborated by León and Collahua (2016), who determined that the socioeconomic level directly influences the performance of Peruvian students. In the present research, the group of students older than 24 who have family dependents show an interest in achieving monthly economic income in parallel with meeting the basic needs of their family, which affects their

academic performance as they assume the double responsibility of working and studying. Finally, academic performance is influenced by the interaction of factors linked to socioeducational and cultural characteristics, which affect the performance of students and are determinants in the formation of the student, as shown in previous studies (Barreto et al., 2012; Porcel et al., 2018).

Additionally, DIGESU indicates that the main academic problems of university students who belong to an indigenous people are difficulty in the use of computer or information technology tools (60.6%), difficulty with the teaching methodology (37.1%), and difficulty with the content of the courses (29.3%) (DIGESU, 2021). However, this study determines that the academic problem with the greatest preponderance is the failure of partial exams (65%).

Furthermore, the study determines significant adverse effects on the prediction of students' academic achievement, which are corroborated by the following projections: Professional School of Bilingual Initial Education (from $M = 12.56$, $SD = 5.62$ to $M = 10.47$, $SD = 3.60$), Professional School of Bilingual Elementary Education (from $M = 10.06$, $SD = 5.86$ to $M = 9.56$, $SD = 4.02$), and Professional School of Aquaculture Engineering (from $M = 11.05$, $SD = 3.97$ to $M = 10.35$, $SD = 3.49$). In terms of academic performance, Mestizo students have a higher mean (12.49) than indigenous students (10.06) on a vigesimal scale. This perception of academic disadvantage is corroborated by a previous study (DIGESU, 2021).

However, the same factors may have significantly favorable effects in predicting the academic performance of students in the Professional School of Agroindustrial Engineering who would have significantly higher academic performance ($M = 11.81$, $SD = 2.07$) than they currently do ($M = 11.69$, $SD = 4.81$).

Regarding the average age scale at the national level, according to DIGESU, 18.6% of students are in the age range of 17 to 20 years, followed by 66.7% aged between 21 and 25 years, and only 14.7% are 26 years and older. However, because of the characteristics of the intercultural university under study and its origin from indigenous people, the average age of the students in the sample is between 25 and 40 years, represented by 58.9% of the students. This corroborates the trend determined by the Ministry of Education-DIGESU that the age range in the same educational entity is 17 to 20 years (17.7%), 21 to 25 years (37.3%), and 26 years and older (45%).

Students under 24 years have the greatest conflicts with a family member or close friend (63.6%) and fail midterm exams (50%); students between 25 and 32 years have, as an incidence factor in academic performance, the presence of economically dependent family members (33.3%) and feeling isolated and alone (26.7%). This information contributes to the current reality of the effects of e-learning in the context of a health emergency, combining their learning with their family role and greater interaction with members of their household.

Valdivieso et al. (2020) consider that the factors of mood and family coexistence positively affect academic performance. This is contrary to the present research, which shows that students were emotionally positive with fellow students before the health emergency. Afterward, the perception of isolation from the academic social group affected their emotional state, making them feel isolated and alone (62%), in addition to having conflicts in their relationship with a close relative (57%) because of the increased amount of time at home.

Expósito and Marsollier (2020) investigate the socioeconomic situation of students, academic performance, and support from the student's family, evidencing that there are socioeducational inequalities for students as well as social isolation. This study highlights a similar scenario in terms of socioeconomic factors, particularly in a sample of students characterized by the realization of their studies in an intercultural university in the Amazon, with homes located in native communities and with the practice of native languages and different sociocultural conditions.

Ajibade and Hayes (2022) highlight the process of sociocultural acclimatization upon joining an educational institution and engaging in the complexity of curriculum design and delivery, which reveals the negative learning experience, and more so with culturally embedded family responsibilities that influence the teaching and learning processes. In the intercultural university, there are differentiated conditions with respect to family support. The mestizo students have urban origins and live in the city with greater comfort for better academic performance and with family members who work in employment centers in the public or private sector or develop their own commercial activities. However, the indigenous students mostly assume activities of fishing, agriculture, crafts, and forestry close to home, which stand out in the research with regard to the presence of conflicts in their relationships with a close family member.

This study determined the need to investigate emotional aspects rather than the effects of computer availability or Internet and connectivity problems in virtual class sessions, which is consistent with previous studies. Additionally, new variables or factors are required to determine failure in midterm exams related to university didactics, pedagogical training of teachers, deficient student training at the regular basic education level, and other factors that affect the teaching-learning process.

As new findings complement the studies of Vromans et al. (2023), the problems in the National Intercultural University are still pending, such as the strengthening of the education process in terms of implementation of learning facilitators, use of intercultural didactic tools, limited multicultural classrooms, systematization of intercultural experiences, and not considering sociocultural factors in the induction and training stages of the university system, as well as the difficulties of accessibility in the admission process due to limitations in training at regular basic education levels, which determine the negative impacts on academic performance. Complementing the studies of Garcia and Dominguez (1997), the research gap arises and a different characterization is added by considering native students from lowland jungle and border areas of the country as the object of study, who perceive academic difficulties when examining different learning experiences in an urban environment together with mestizo students as a consequence of the lack of articulation of the educational system and curricular designs with an apparent intercultural model regarding the implementation of educational programs and services that do not correspond to the sociocultural and linguistic origins, creating gaps in the learning process of the students and with unsatisfactory impacts on academic performance.

The greatest strength of the research lies in obtaining primary information from students at an intercultural university in the Amazon in a virtual learning scenario, whose information is processed by applying an artificial neural network. The greatest limitation lies in the application of qualitative methodologies within the entity under study.

5 Conclusion

The implementation of the artificial neural network promotes the prediction of the academic results of students in different professional schools of education and engineering in the context of an intercultural

university in the Amazon. This allows us to understand the problems and guide the educational organization to reduce the gaps in sociocultural factors to improve performance and design new strategies in the teaching–learning process. Furthermore, it can facilitate the implementation of educational policies oriented exclusively to intercultural universities that have different characteristics from classic and traditional urban universities.

The results of the research conducted at the intercultural university of the Peruvian Amazon show that the sociocultural and educational factors that mostly adversely influence the academic performance of students are the economic dependence of the family on the student, failure of partial exams, feeling isolated and alone, and conflicts in their relationship with a family member. This information is necessary for stakeholders to overcome sociocultural gaps to achieve better learning, increase the grade point average, and decrease the level of academic dropout.

The factors that do not affect the academic performance of students are vocation and identification with a career as a result of adequate selection in the admission process and previous leveling of basic knowledge; problems with the distance education methodology; availability of computers for personal use; insecurity, fear, and apprehension; difficulties in working in groups; and respect for the identity of others in an intercultural bilingual context. In general, if sociocultural and educational problems continue to remain among students at universities in the Amazon, their academic performance would decrease significantly.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical approval was not required for the study involving human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was not required from the participants in accordance with the national legislation and the institutional requirements.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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