HCI International 2024

26TH INTERNATIONAL CONFERENCE ON
HUMAN-COMPUTER INTERACTION

LCT: Learning and Collaboration Technologies | Interactive Learning Ecosystems - I

Anticipating Tutoring Demands Based on Students' Difficulties in Online Learning

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Introduction

Student Engagement Challenges

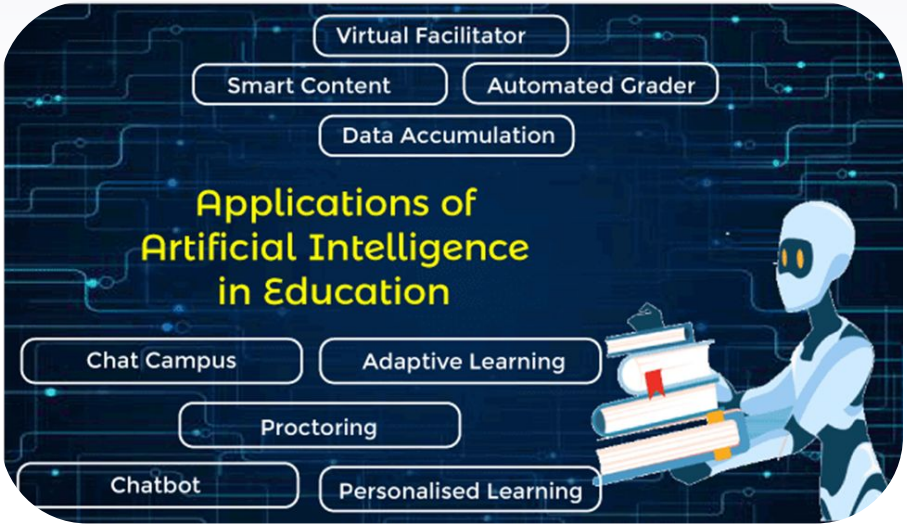
- Various difficulties affect student engagement in online learning.
- Importance of early identification to better direct tutoring activities.

Role of Human Tutors

- Establish contact to understand student difficulties.
- Absence of instructors and feeling of loneliness impact students.
- The challenge for human tutors to direct their tutoring efforts, especially in educational contexts with many students.

AI in Education

More than 2 decades of **Artificial Intelligence in Education (AIEd)**



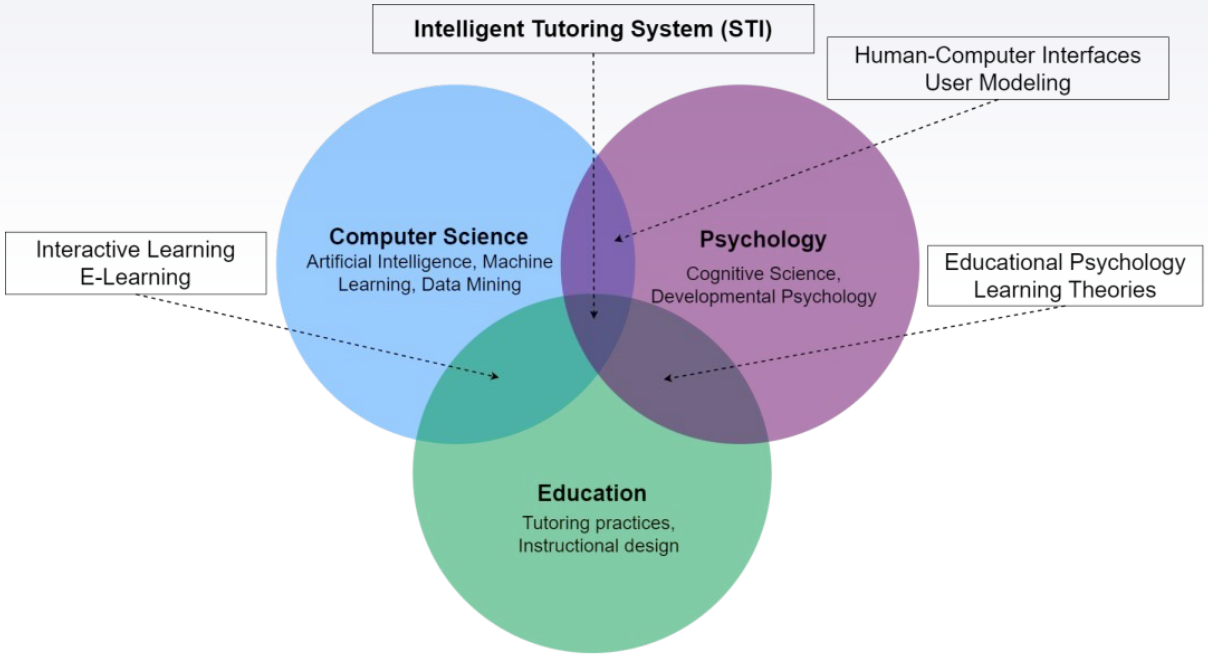
Need for Individualized Attention

- Approaches needed for efficient and broad handling of student demands.
- Natural Language Processing (NLP) techniques in AI for Education (AIEd).

Research Question

How can student difficulties in online learning, mediated by Educational Social Networks (ESN), be supervised and classified?

Related works



NLP and Intelligent Tutoring Systems (ITS)

- NLP used to classify reported student difficulties.
- ITS features assist tutors in managing student engagement data.

Challenges and Necessities:

- NLP deciphers textual information, highlighting student difficulties.
- Need for approaches supporting human tutoring.
- Social dimension of learning difficulties revealed through interaction and communication.

Method

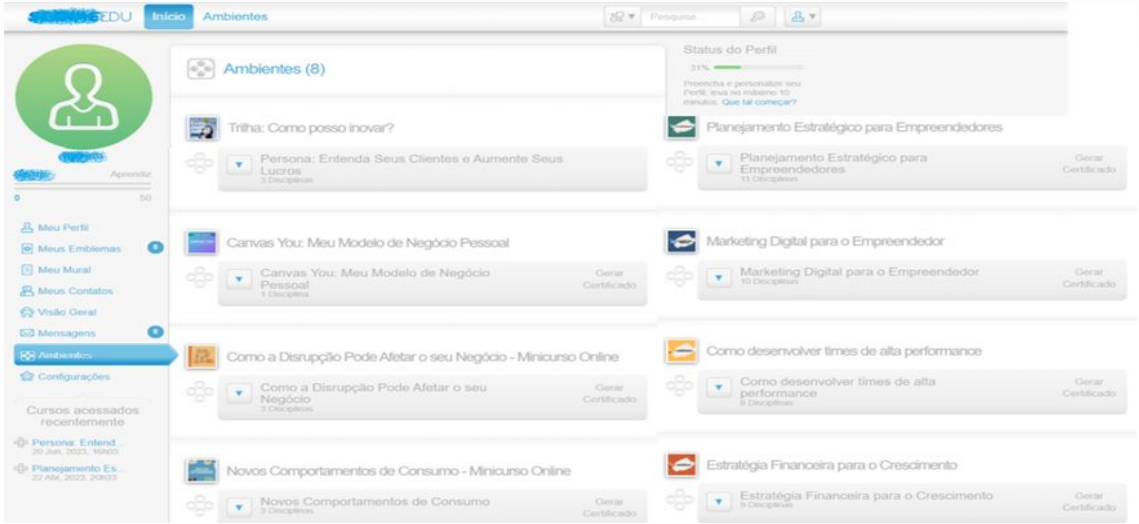
Objectives of the study

- To help human tutors identify student difficulties to provide personalized and relevant tutoring.
- Assist in the learning process and individual monitoring of students.

Study context

Online Learning | E-learning **(Recife, Pernambuco, Brazil)**

- 8 courses for micro and small businesses
- 25 tutors, and more than 4 thousand students
- Study duration: **6 months**



Educational Social Networks (ESN)

redu.digital

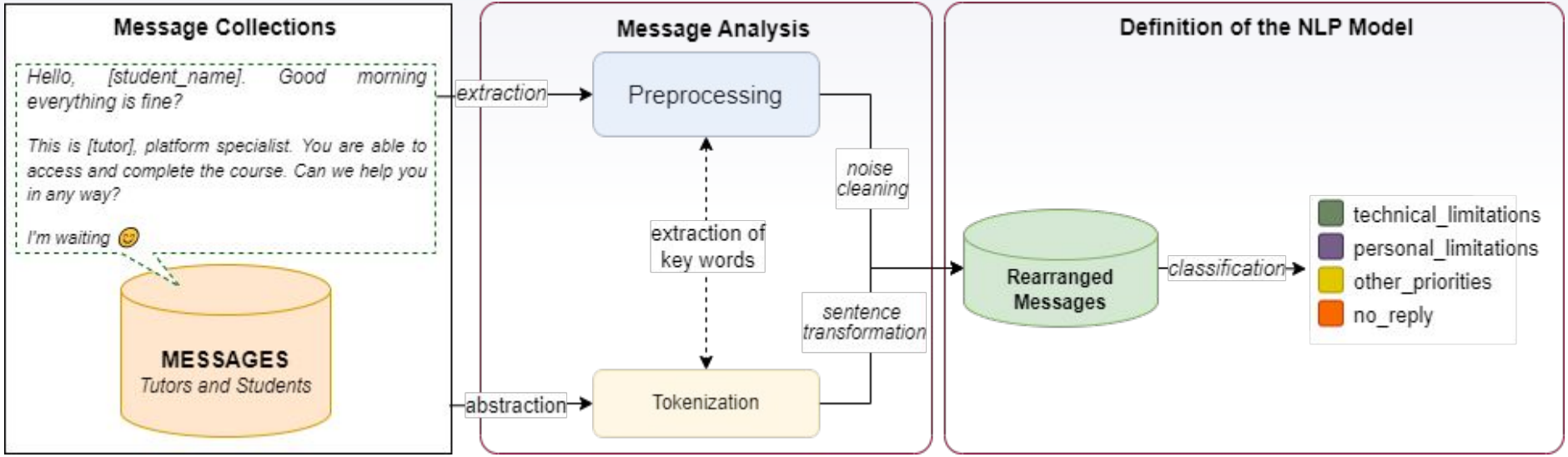
Characteristics of AVA and Social Network

- Manage users
- Profiles, posts
- Communication
- Engagement
- Collaboration

Tools

- Connect people
- Establish interaction
- Chat, messages
- Video conferences
- Share posts
- Community (Openredu)

Data collection and analysis



Flowchart of data collection, analysis, and model definition for the analysis of tutoring messages and classification based on different types of difficulties.

Definition of the NLP model

NLP Approaches Considered

- CNN, RNN, MLP

Experimental Model

- Keras Sequential: Word sequences for classification
- Parameter Variations Tested:
  - Embedding Sizes: [64, 128, 256]
  - LSTM Units: [64, 128, 256]
  - Dropout Rates: [0.2, 0.3, 0.4]
  - Optimizers: ['adam', 'rmsprop', 'sgd']

Final Model Configuration

- Dense Layer: 3 neurons with sigmoid activation (technical, personal, others)
- Training/Evaluation:
  - **Data Split**: 80% training, 20% testing
  - **Best Parameters**: Based on highest accuracy during iterations

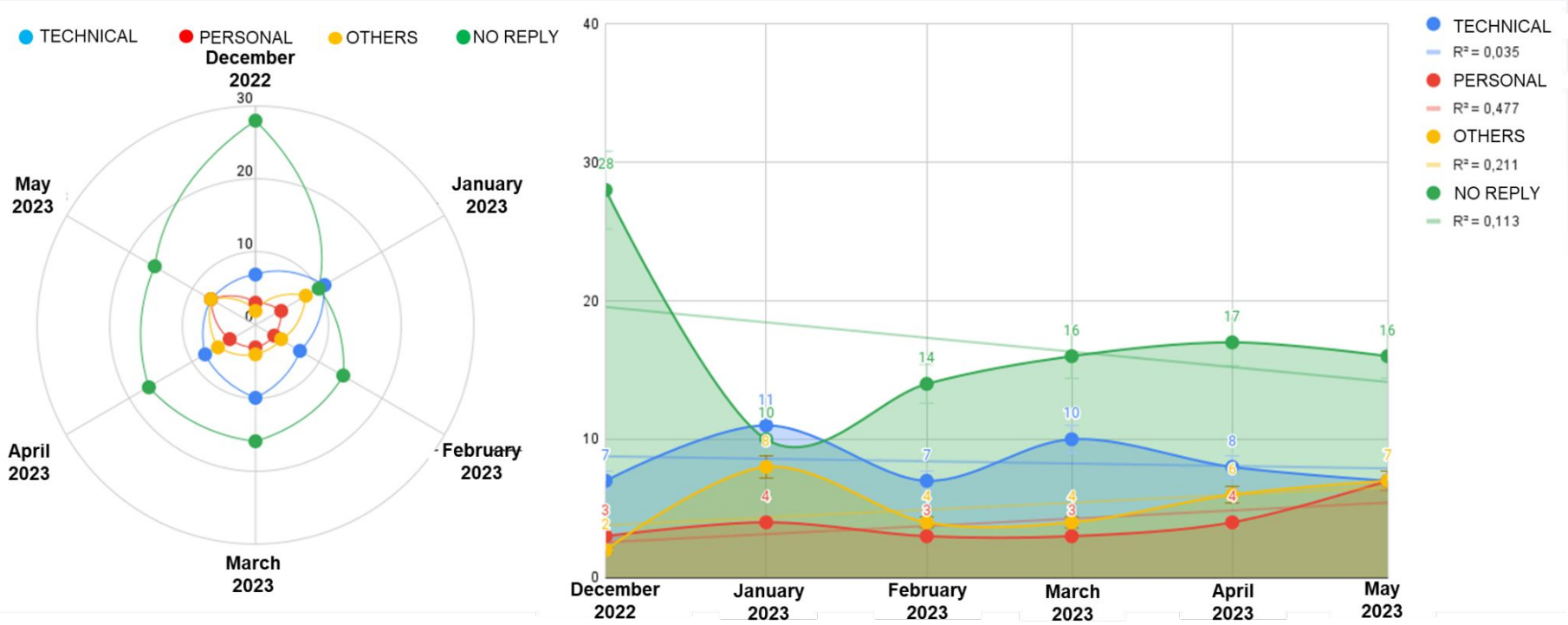
Results

The main results involved:

- Development of the NLP Component.
- Supervise and classify student difficulties in ESN environments.
- Collects the trained model's ability to identify "personal", "technical" and "other" difficulties.

Results

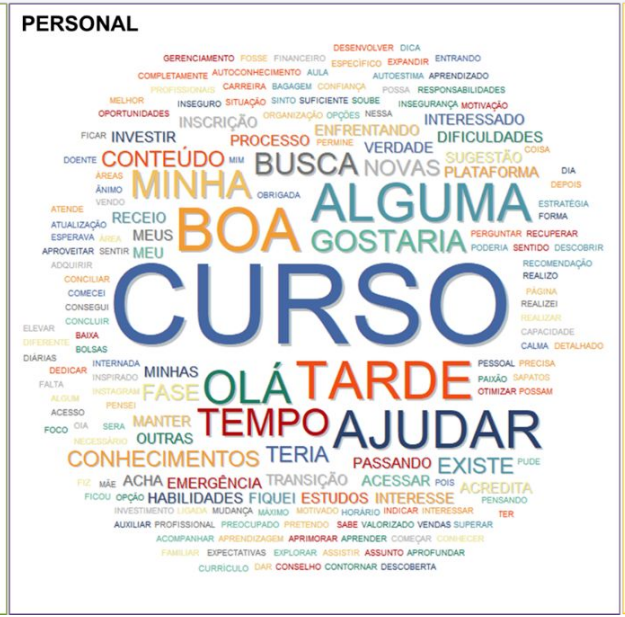
“Active search” by students: "technical", "personal", and "others"

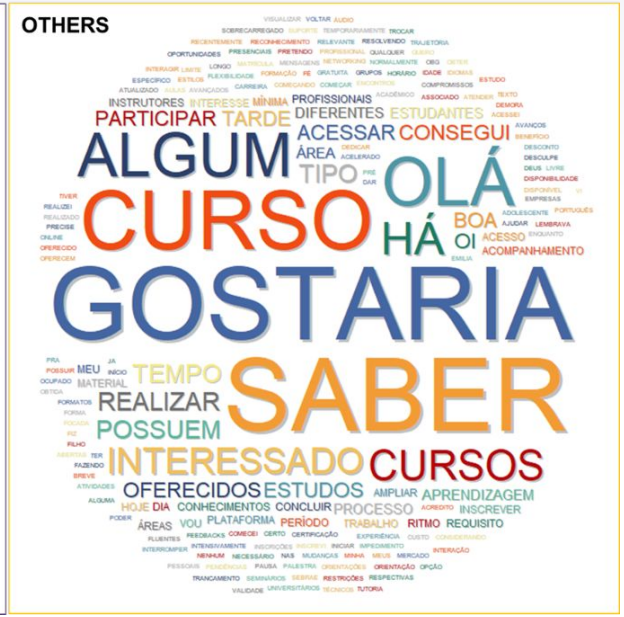


Frequencies by types of difficulties classified over the course of the six-month monitoring period of human tutor activities.

Results

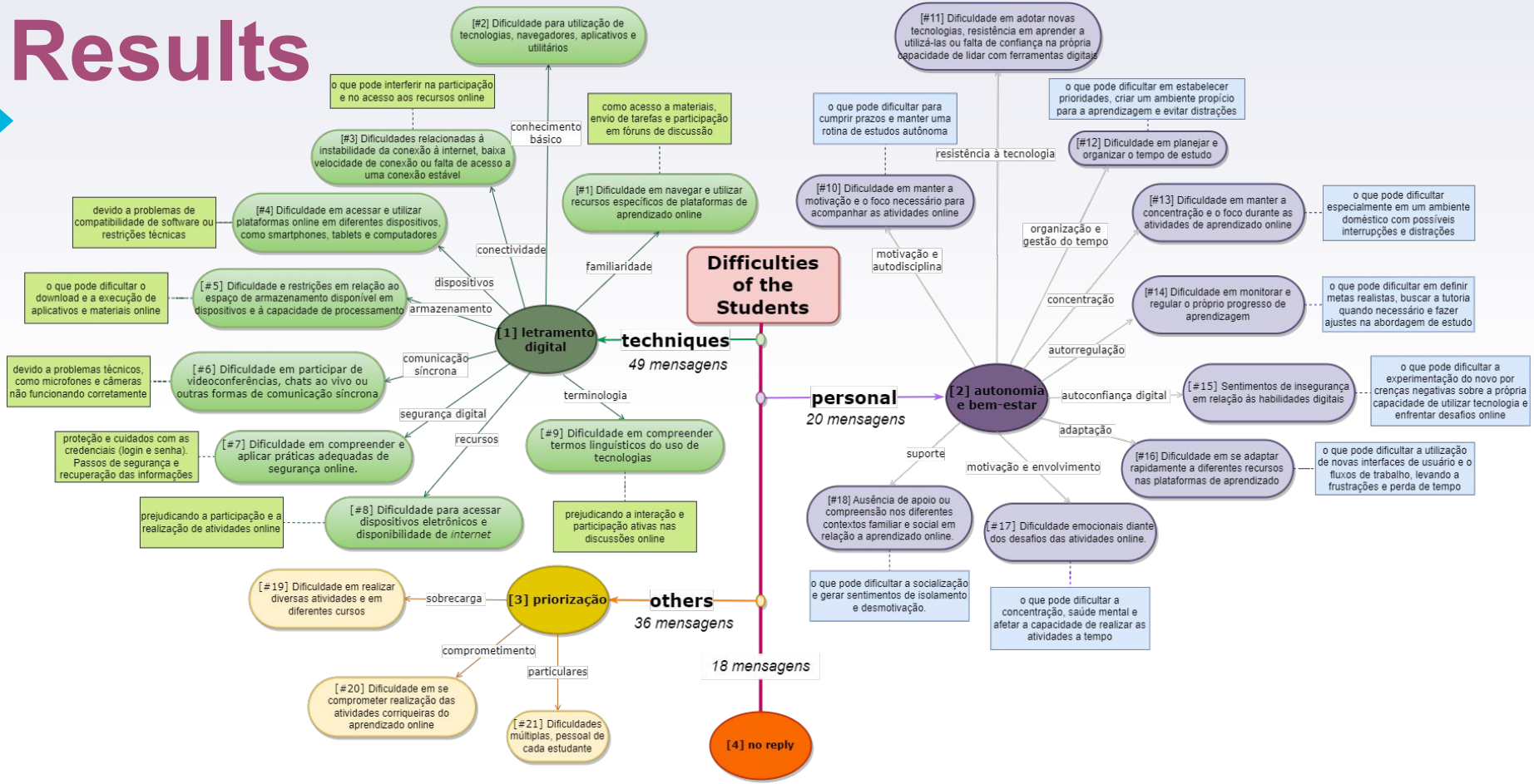
“Active search” by students: "technical", "personal", and "others"





Most frequent words in each type of difficulty.

Results



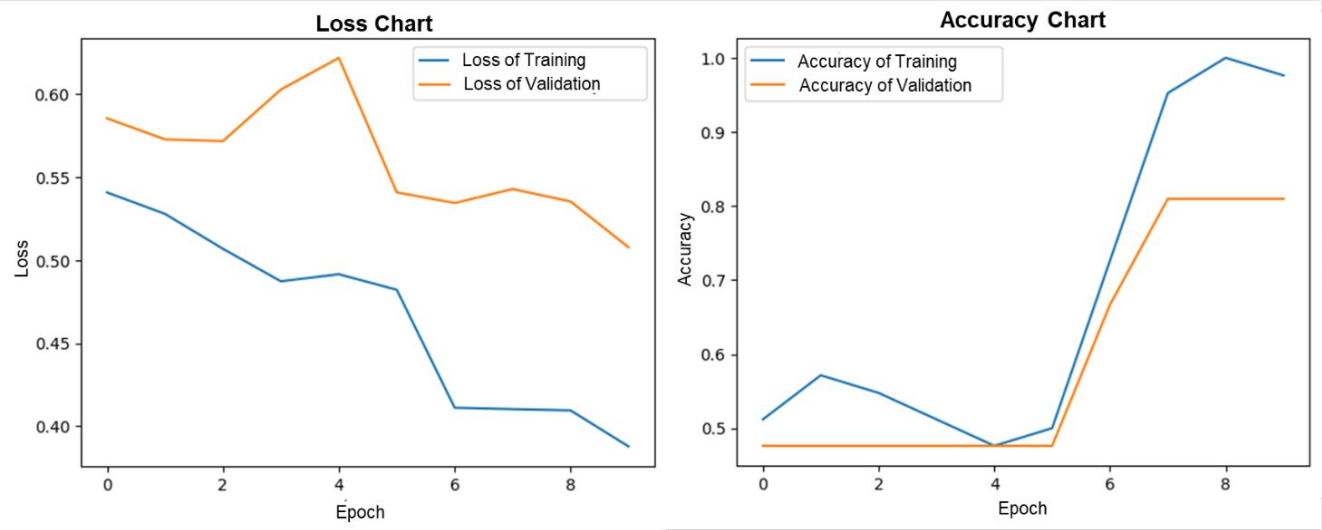
Conceptualization of the types of student difficulties identified from interactions with human tutors in online learning.

Results

Classification of difficulties

Model Performance and Classification Challenges

Accuracy Levels:
Testing phase: Acc ≈ 0.97
Validation phase: Acc ≈ 0.81



Loss, accuracy, and confusion matrix of the model.

Considerations

The approach was able to classify students' difficulties: "technical", "personal", "other", enhances opportunities for: digital literacy, student satisfaction, and engagement.

NLP approach collaborates with human tutors for identifies and classifies difficulties from: help requests, comments, discussions

For direct students to specialized tutors, recommend specific materials, and suggest peer collaboration

Future Work:

- Expand dataset for training/testing
- Incorporate data from various online learning contexts

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Thank you

For attention

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