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Rethink Education: The Opportunities and Challenges of Artificial Intelligence

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Formative Assessment Supported by Artificial Agents

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1 Introduction

Recent scholarly investigations have highlighted the critical importance of feedback in enhancing educational outcomes [1; 2; 3; 4]. Feedback empowers students' autonomy in the learning process, enables informed institutional decision-making, ensures continuous improvement, fosters engagement and motivation, and enables personalized learning experiences [5; 6; 7]. Nevertheless, despite its acknowledged importance, the practical implementation of feedback processes in everyday teaching is often hampered by large class sizes and time constraints. Recent technological advancements have led to the development of diverse computer tutoring systems designed to support the feedback process across various educational domains and tasks [8; 9]. These systems, characterized by their distinctive designs, have emerged as valuable tools in addressing feedback implementation challenges. Notably, plenty of tools investigate multiple-choice questions and relatively few on open-ended questions [8], thus leaving room for improvement. In order to meet this challenge, the didactic research group from the Department of Education, Cultural Heritage and Tourism at University of Macerata, initiated an investigation exploring the use of Artificial Agents in the evaluation of open texts [9; 10; 11; 12]. This research is carried out under the PRIN AI&F "*Artificial Intelligence and Feedback for Effective Learning*" project, in collaboration with teams from the Universities of Bari and Padua. This paper presents an experimental work, conducted in the academic year 2023/24, which involved 264 students attending the first year of the Master's Degree course in Primary Education.

2 Methods

The research aims to construct a recursive pathway between human and artificial agent that allows the analysis of short open-ended responses, making the process more sustainable and favoring a formative evaluation using generative feedback.

The process consists of several steps:

1. The teacher prepares the tasks (open ended questions) and, at the same time, the rubric and one or more target texts in order to train the system with possible answers.

2. The tasks, together with the rubric, are assigned to the students who will answer the questions.

3. The LLM-based system operates on both target texts and student responses. In both cases, the texts are segmented (*tokenization*) and each segment is transformed into a vector (*embedding*). The system then compares each text vector with the target text vectors and, based on their similarity, ranks the answers.

4. The teacher examines the classification made by the artificial agent, focusing on the border areas between the classes and identifies new target texts from the students' answers in order to refine the classification.

5. The artificial agent re-classifies the answers after being trained with the new target texts. It also indicates the scores where the margin of uncertainty is greatest.

6. The teacher examines the new classifications and can either accept them or propose new target texts with which the system repeats the previous cycle (steps 5-6).

7. The teacher analyzes the answers given by the system and, if the new classification appears acceptable, ends the recursive process between human agent and artificial agent. If not, a new cycle begins.

8. Once the recursive process ended, answers are sent to the students, together with an indication of the parts of each answer which deserves further attention.

9. The students, having received timely feedback on the different parts of their work, with an indication of the answer's strengths and weaknesses, can start the feedback cycle with the teacher if they have any doubts.

The process is therefore characterized by three phases: 1) the preparation of the task by the teacher and the execution of the task; 2) the recursive cycle between human and artificial agent to arrive at a classification of the papers; 3) the interaction between teacher and students in which the classifications are discussed.

3 Conclusions

The research is still ongoing, but, at the moment, three points seem to require special attention: 1) The selection of the LLM to be used by artificial agent for the incorporation and classification of the answers. For instance, using an LLM specifically trained on the Italian language, ensures that the model can handle the unique aspects of the language, leading to more accurate results. 2) The preparation of the target texts to train the artificial agent on meaningful examples of texts. These should avoid generic and ambiguous sentences. The training of the system using a large number of texts from the reference literature have been tried and tested for some time. In our case, in correcting short open-ended responses, we obtained better results by using target texts specially prepared by the teacher. 3) The definition of procedures to obtain a final agreement between the human agent and the artificial agent on the evaluation of the text. First results from two tasks completed by 264 students seems to indicate that the artificial agent can support the feedback process by suggesting a useful classification of students' answers in more than the 80% of the sample; within this percentage, the convergence with the human agent's correction is total in 90% of the cases. Further development of the research will include the testing of other LLMs and trials in different subject areas.

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