



A GAME-BASED APPROACH TO DEVELOP ENGINEERING STUDENTS' AWARENESS ABOUT ARTIFICIAL INTELLIGENCE ETHICAL CHALLENGES

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Conference Key Areas: *Artificial Intelligence in Education, Ethics in Engineering Education*

Keywords: *Ethics education, Game-based learning, Artificial Intelligence*

ABSTRACT

The past few decades have seen important efforts to introduce more ethics into engineering education programs around the world, while adapting to the evolution of ethical concerns, notably in relation to digital technology and artificial intelligence. Even if pedagogical approaches based on the use of case studies or code of ethics remain among the most popular, other less well known techniques such as game-based approaches have also been identified as effective. The goal of this workshop is to offer participants an opportunity to explore how games can be used as learning experiences to develop students' ethical knowledge and skills. Participants will first get to play an online game which focuses on ethical issues in the domain of artificial intelligence, before reflecting on their experience and discussing the potential of game-based approaches for engineering ethics education.

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1 BACKGROUND AND RATIONALE

There is an overall agreement that, besides technical knowledge, engineering graduates should have skills that would enable them to better serve humanity in their future jobs [1] and to deal with the uncertainties of future challenges [2]. Meta-analyses indicate that significant efforts have been made to introduce science and engineering students to ethics in the last decades [3, 4]. However, staggering developments in digital technology, particularly in the field of artificial intelligence (AI), create new ethical challenges for engineers [5]. The specific nature of the ethical issues arising from digital technology (e.g. privacy, algorithmic bias or transparency issues) require engineering students to develop new knowledge and skills to be able to walk through the dilemmatic process of decision making that significantly impacts the users of digital designs.

While the most popular teaching methods in engineering ethics education rely on the use of codes of ethics, case studies or discussions / debates [6], other less well known techniques using films and videos, science fiction or games have been explored recently [7]. The use of games – notably digital games – for learning and education has generated increasing interest in the last two decades [8]. Educational games have been used in a range of disciplines, and meta-analyses have shown positive effects of educational games on cognitive, affective or motivational skills [9, 10]. In particular, some studies suggest that games could be used to foster problem-solving and critical thinking skills [11] or to develop moral sensitivity [12]. However, prior research also shows that, to achieve ethics education goals, games should implement specific strategies such as providing “ethical choices and decision-making, which have an effect on the game play,” or integrating personal reflection through the use of diaries or other devices [13].

In this workshop, participants will explore how a game can be used as a learning experience to develop engineering students’ ethical knowledge and skills, and investigate more generally the potential of games for engineering ethics education. In the following, we first present the game that participants will play, before describing the learning outcomes and the format of the workshop.

2 THE GAME

Based on an original idea by two Master students at our institution, Ester Simkova and Alexandre Pinazza [14], the game that participants will play in the workshop is an online interactive story. Players play the role of a data scientist who faces design dilemmas while developing machine learning models. The decisions that players make (see example on Figure 1) change the course of the story and lead to different ethical consequences. The narrative includes two applications of machine learning technology, based on real case studies of algorithmic bias: criminal recidivism prediction (inspired by the COMPAS case [15]) and automated translation (inspired by the Google Translate case [16]).

Aiming to develop students’ ethical awareness in the domain of machine learning, the game is accessible *without any background in machine learning or in ethics*. It is

specifically designed as an educational tool by implementing a series of well-documented ethics education strategies [13]: players are guided to analyse their decisions before committing to a choice, they get a chance to reflect after observing the consequences of their decisions, and they are led to identify their emotional reactions at specific points in the unfolding story. Particular attention has been paid to the gamification of these features in order to preserve the immersive properties of the game.

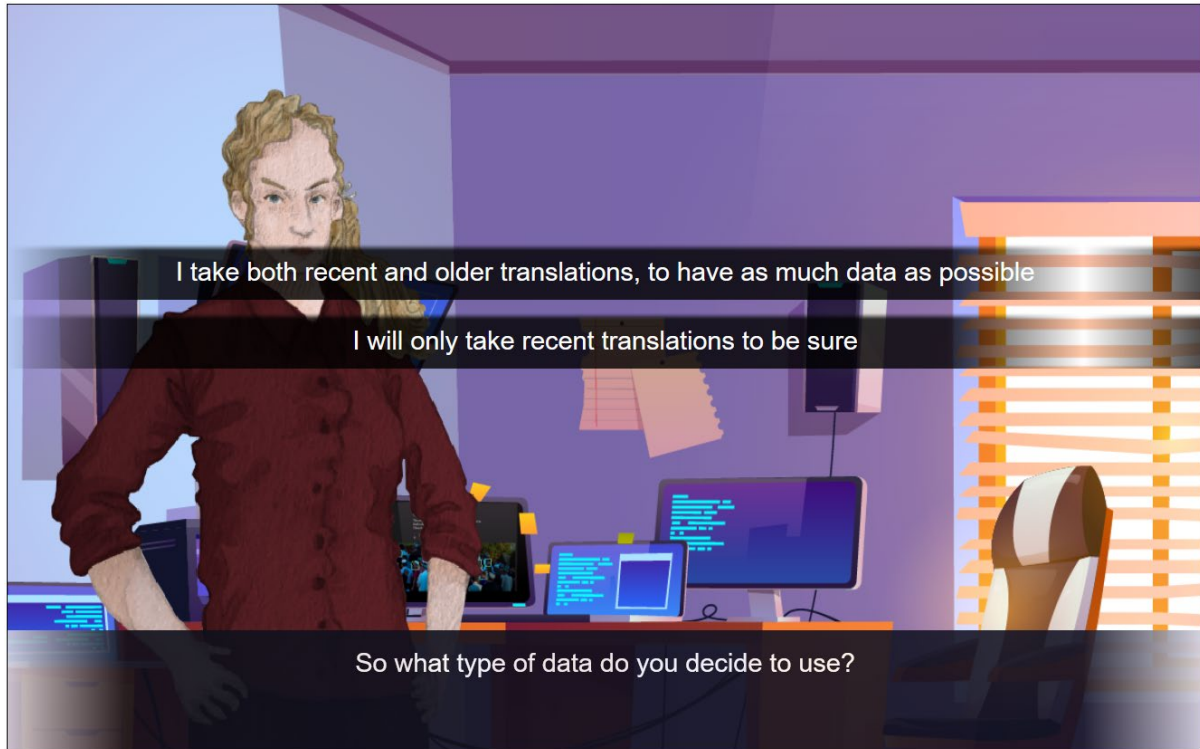


Figure 1: example of a decision that players can make in the game.

3 LEARNING OUTCOMES

Through letting participants first experience the game as users and then reflect on this experience, the workshop aims to develop participants' knowledge and skills both in the domain of ethical artificial intelligence and in the domain of game-based approaches to engineering ethics education.

At the end of this workshop, the participants should be able to:

- Explain some of the ethical issues which arise in the domain of artificial intelligence design.
- Identify features of a game that can foster students' ethical knowledge and skills.
- Evaluate how a game can be used as a formal learning activity in the context of a course to foster students' ethical sensitivity and decision-making skills.

4 WORKSHOP DESIGN

The workshop will implement an interactive and hands-on format with the following program:

- Introduction: structure of the workshop (presentation, < 5 minutes)
- Discovering the game (participants individually play the game online, 15 minutes)
- Identifying ethical questions in the game (think-pair-share, 10 minutes)
- Using a game as a teaching activity: reflection in groups and evidence from research on game-based approaches to engineering ethics education (think-pair-share and presentation, 20 minutes)
- Conclusion: take-home messages (collective summarization activity, 5 minutes)

Note: Participants will need a laptop with a web browser and internet connection to play the game. No specific prior knowledge is expected.

5 SUMMARIZATION OF THE RESULTS

More than 40 participants attended the workshop in total and played the game on the online demonstration platform hosted at EPFL (<https://go.epfl.ch/MLethicsgame>).

The discussions during the workshop highlighted that the game includes content related to different types of ethical issues, not only in relation to AI ethics.

Participants identified questions at several levels of granularity, from individual perspectives on decision making (e.g. personal values) to more global systemic issues (e.g. inequalities), including questions of organizational culture.

Using the EPIC framework [13] as a lens for analysis, the participants identified that the features of the game support a number of the ethics education goals identified by Karen Schrier, albeit in different proportions. Overall, the game was seen as an effective way to raise awareness about ethical issues related to AI, thanks to its narrative based on realistic case studies. A number of participants indicated that the game also enables students to practice ethical reasoning and ethical reflection to some extent. Although some participants noted that the use of emojis to report emotions could lead to variations in interpretations, the “mood meter” feature of the game was thought to be useful for practicing emotion identification.

In terms of the limits of the game, some participants argued that the options offered in the decisions points of the game are too limited to be realistic. Others felt that being able to actually make these decisions and see their consequences has pedagogical value since it creates a feedback cycle in a low-stakes environment that allows for mistakes. To compensate for the individual nature of the game, some participants suggested that students play the game in groups to be able to discuss the different decisions. Overall, participants concluded that the game should be used with a follow-up debriefing activity to highlight both its underlying principles and its limits in order for students to consolidate their learning.



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