The University of Texas at Dallas

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Research Survey:

"Students' Attitudes towards the Use of Algorithms in Educational Environments"

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Students' Attitudes towards the Use of Algorithms in Educational Environments

Recent advances in Artificial Intelligence (AI) and its current adoption in different sectors and organizations undoubtedly pose challenges and state new questions (AI Now Institute, 2019). The growing datafication of the most unthinkable human practices adds fertile development conditions in terms of data availability (Newell and Marabelli, 2015; van Dijck, 2014) as well as the computing capacity of the new machines makes possible analysis previously unimagined (Gandomi and Haider, 2015). Consequently, many of Automated Decisions Systems (ADS) are effectively included to carry out predictive analysis and make data-driven decisions.

Algorithms behind ADS, when studied from a critical perspective, are approached not merely as abstract mathematical formulas but as socio-technical artifacts that have real effects upon people's lives (Kitchin, 2017). For this reason, it is essential to analyze the perceptions and attitudes of ordinary people since they are the ones who would eventually be impacted by the adoption of ADS. This research interest is particularly present in the Public Administration domain where, with increasing force, not only the organizational factors that influence the implementation of these systems are examined, but also the effects that promising e-governance technologies have from the perspective of citizens (Androutsopoulou, Karacapilidis, Loukis, and Charalabidis, 2018; Margetts and Dorobantu, 2019; Vogl, Seidelin, Ganesh and Bright, 2020; Young, 2020).

In this context, recent research on the use of ADS in several fields has increased after studies were published focusing on how these systems can be biased (Noble, 2018; O'neil, 2017). Since then, an important group of research has centered on attitudes towards AI, considering how people evaluate the performance of algorithms in terms of fairness, usefulness, transparency, privacy,

among others (Araujo, Helberger, Kruikemeier and de Vreese, 2021; Charbonneau and Doberstein, 2021; Miller, and Keizer, 2021; Zarsky, 2016).

Particularly interesting is the work developed by Schiff, Schiff and Pierson (2021[a,b]). These authors offer data from a recent survey for the evaluation of situations that involve the use of algorithms in public administration. In their experimental survey, respondents are faced with different vignettes that refer to hypothetical but realistic situations of algorithm uses in the public sector. Specifically, participants should evaluate algorithms performances based on their feelings, trust, perceived quality of government services, impact on their own personal situations, interest in signing a petition, and interest in attending a community meeting with the purpose of discussing the algorithm. Overall, the results provided by Schiff et al. (2021[a]) show that certain public value failures associated with AI have significant negative impacts on citizen evaluations of the government, especially when fairness and transparency are violated in ADS implementation.

In addition, other research results show that when users evaluate algorithmic decisions, different factors influence their attitudes towards them: their prior knowledge of mathematics/programming and general level of education, age, income level, concerns about data privacy, perceived online self-efficacy, etcetera (Logg, 2017; Smith, 2018; Zhang and Dafoe, 2019). Even phenomena related to these assessments have been studied in more experimental settings. For example, there are studies focused on instances in which ADS were more trusted than human non-experts but less trusted than human experts (Madhavan and Wiegmann, 2017) or situations in which, although the algorithm made mistakes, the human was preferred, even when the algorithm performed in general better than the human (Dietvorst, et al., 2015; Log, Minson, and Moore, 2019).

However, it is still not clear to what extent different dimensions encompassed by algorithmic use for decision-making (such as transparency in access to data and analysis mechanisms, level of

data privacy, degree of automation of decisions, unfair results, etc.) affect the attitudes that subjects have toward them in educational environments. Indeed, attitudes toward AI in educational scenarios are still a vacant area of research when analyzing public values appreciation.

In this context, this work develops a survey study to answer the following research question: Do different conditions of algorithms use in decision-making in educational settings affect the attitudes that university students have towards them? The general hypothesis states that (a) the lack of transparency in access to data and analysis mechanisms, (b) the infringement/violation of the student data privacy policy and (c) the high degree of decision automation negatively impact the attitudes that students have towards the use of algorithms for decision-making in educational settings.

In the following sections the methodology will be presented focusing on the main decisions taken for the development of the survey instrument using Qualtrics. Then, the results of the pilot study carried out are shown including an initial analysis of the functioning of the survey, alternatives for the improvement of the instrument, and some preliminary results analyzing the main relationships between variables of interest. Finally, in the discussions, future research plans are included such as the conversion of the current survey into an experimental survey.

Methods

A survey research instrument was designed and implemented in a pilot version to analyze university students' attitudes towards algorithmic use in different educational scenarios.

The target population of the study is all National University of Cordoba (Argentina) students (including, pre-grade and grade) which represents a total of N=157,919 students. The sampling frame can be obtained in the institution which will facilitate the extraction of a representative sample

of the population. Regarding the sampling technic, Systematic Random Sampling will be used with the objective of extracting a sample size of n=1580 students. Additionally, characteristics of the population in terms of gender, age, occupation, and distribution in schools can be consulted in the Statistical Yearbook of the National University of Cordoba, which will be important when adjusting weights of the data obtained.

For conducting the analysis, regression models will be used. The independent variables to be considered are dichotomous and correspond to three situations: lack of transparency (situation 1), violation of students' data privacy (situation 2), automation of decisions (situation 3). The dependent variables will be students' attitudes toward the use of algorithms which include general feelings, trust on algorithms, and opinions on quality of services provided by the university. These dependent variables are measured with Likert-format items ranging from 0 (extremely negative attitude) to 10 (extremely positive attitude). Additionally, other variables will be incorporated into the models as controls: being female, age, monthly familiar income level, perceived previous knowledge about algorithms, employment status.

Survey Instrument Design

The survey was developed using Qualtrics. The administration of he pilot was online and presented to the respondents in its Spanish version (the equivalent English version can be consulted here). This translation was prepared using the specific function in Qualtrics. Subsequently, the material was reviewed to ensure high quality in the translation. Contextual aspects for adaptation were also considered (for example, the level of income in Argentina was presented according to prevailing wages in Argentine pesos).

The design of the instrument was mainly based on the works presented by Schiff, Schiff and Pierson (2021[a,b]) and Zhang and Dafoe (2019) considering adaptations to educational settings. Basically, the survey confronts students with different situations of using algorithms to make decisions in university settings. Then, the respondents are asked to express their personal opinions about these algorithmic applications.

The survey is structured in 8 blocks and is made up of 18 questions for which the forced response function was not used (Table 1). The first block includes a presentation of the survey, the mention of its objective, the stipulated time of response (10-15 minutes), and the legal text of the consent form. Then, a question about respondents' previous knowledge of AI and algorithm use at universities is incorporated. After that, the next 4 blocks present different hypothetical situations of use of algorithms to make decisions in universities and require the respondents to rate their feelings (from negative to positive considering a scale from 0 to 10) and the trust towards the algorithms (from low trust to high trust considering a scale from 0 to 10).

Table 1. Question Structure of the Survey

Question/s #	*Content of the block*
Q1	Presentation, survey objective, stipulated time, and consent form.
Q2	Respondent's prior knowledge of algorithms.
Q3, Q4, Q5	Situation 1 and questions about feelings, trust, and quality.
Q6, Q7	Situation 2 and questions about feelings and trust.
Q8, Q9	Situation 3 and questions about feelings and trust.
Q10, Q11, Q12	Situation 4 and questions about feelings, trust, and quality.
Q13	Overall opinion about the impact of these systems.
Q14 to Q18	Sociodemographic block (age, gender, employment status, family monthly income). Gratitude message after submission.

Using a 5-point Likert format, question number 13 asks students' general opinion about how they think algorithmic systems would impact their personal lives in educational settings. Finally, questions 14 to 18 include the sociodemographic block (age, gender, employment status, family monthly income). When the survey is submitted, the respondent receives a thank you message for participating in the study.

In general terms, one of the biggest challenges were related to the wording of the questions, especially those that present the hypothetical situations (Table 2).

Table 2. Description of the Hypothetical Situations Presented in the Survey

Vignette #	*Variation*	*Text*
Situation 1	**Neutral scenario**	Imagine that your university is considering using a predictive computer algorithm to make decisions. The new predictive algorithm makes **automatic recommendations to instructors and administrators about which students may be at risk for dropping out**. The university members hopes that this information will help them decide which student may be most in need of support and intervention.
Situation 2	**Lack of transparency**	Finally, the new predictive algorithm that makes automatic recommendations to instructors and administrators about which students may be at risk of dropping has been implemented at your university. A few months later, an investigation pointed out that **students and community members do not have much knowledge about how the predictive algorithm works**.
Situation 3	**Not preservation of students' data privacy**	Consider again the new predictive algorithm that makes automatic recommendations to instructors and administrators about which students may be at risk of dropping out. Notice now that a few months after its implementation, another investigation indicated that **the privacy of student data has not been fully preserved**.
Situation 4	**Automatic decision-making**	Now, let's think about a different type of algorithm. Imagine that your university is considering using a predictive computer algorithm that **automatically selects students who get scholarships and fellowships**. By using it, the decisions of who obtain grants would be solely made by the machine based on the data provided by the applicants. This algorithm would **completely replace human decision-makers** and the discretion they use to make their decisions.

As the target population is not supposed to know technical details about automatic decisions systems, the scenarios needed to be presented in a clear, straightforward, and brief way. For that reason, phrases in bold were used to highlight the specific variations of each scene with the purpose of focus the respondent's attention. Although Schiff, Schiff and Pierson (2021[a,b]) developed situations for health and judicial domains, their questions were adapted to be considered in the educational sphere. At the same time, the number of situations included should be the minimum necessary so as not to excessively lengthen the survey. Finally, it was decided to include the four situations presented in Table 2 with evaluation questions for each one aimed at qualifying general feelings and confidence in the algorithm.

As can be seen, the first situation posits a neutral scenario of the use of an algorithm that identifies students at risk of dropping out and recommends actions to instructors and administrators. The second situation presents the same scenario as in 1 but with the addition of the proven lack of transparency regarding how the algorithm works. The third situation shows a scene of not preserving students' data privacy. Finally, in the last situation is included the of use of an algorithm that selects autonomously students for academic grants without the intervention nor discretion of human agents.

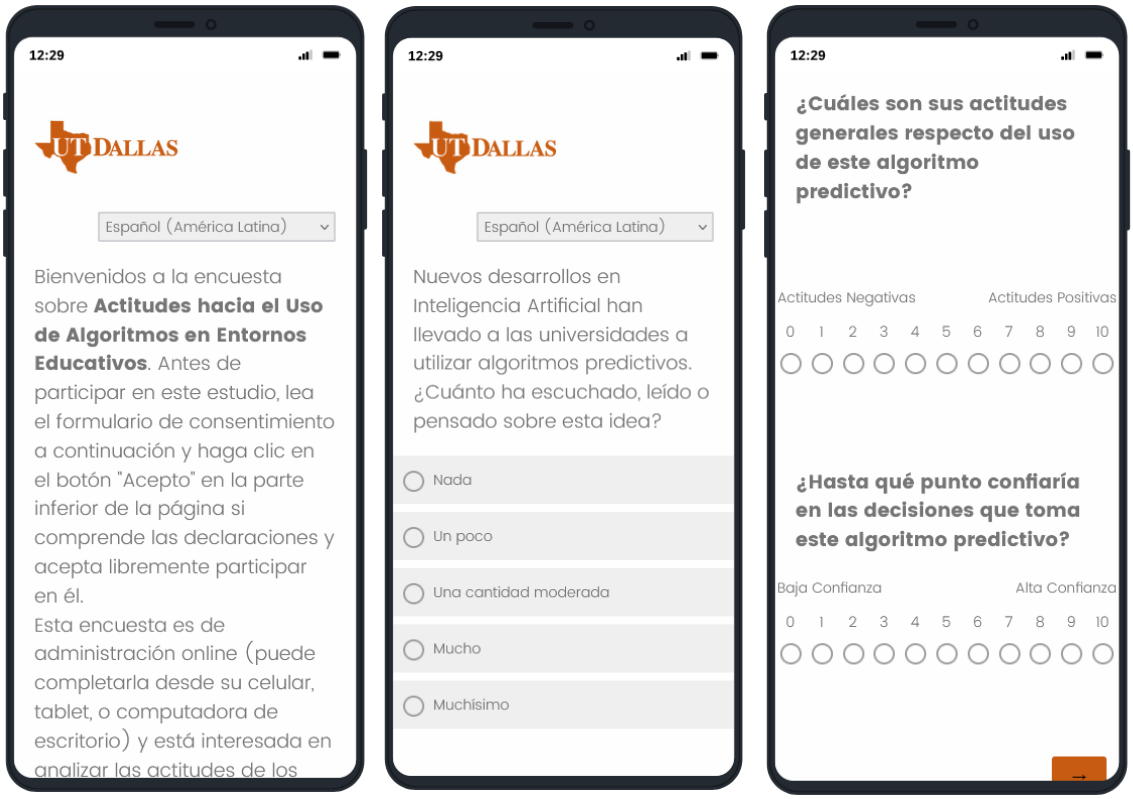
Furthermore, the order of the situations was carefully designed starting with a neutral scene and then incorporating variations. The underlying idea was not to condition the respondent's answers employing a well thought progression of the cases under analysis. Anyway, this contamination issues could be totally avoided if the instrument were posited as an experimental survey, issue that will be resumed in the final discussions of this report.

To ensure a user-friendly experience for potential survey takers, the survey preview in mobile view was carefully reviewed using Qualtrics. UTD branding was also applied for a professional appearance (Figure 1).

Pilot Study

In this opportunity, a pilot study was conducted to analyze the functioning of the survey instrument as well as preliminary results gathered. The survey in its Spanish version was administered online to a convenience sample of Argentine university students. The gathering of data extended from the 14th of April to the 28th of April, 2022. A total of 135 students from Argentine universities participated in the pilot study.

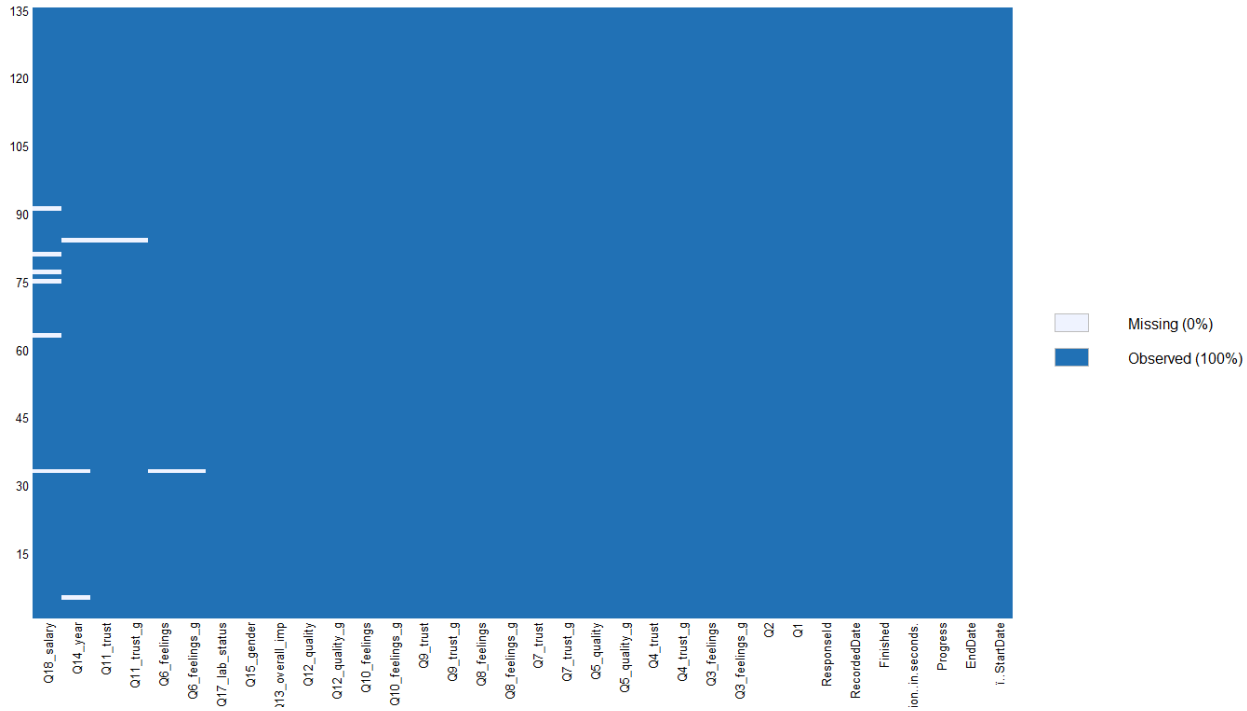
Figure 1. Preview of the Survey in Mobile View



Regarding time of administration -and excepting for 4 outlier observations that spent more than 3 hours in the response- the average time of responses was of 7.24 minutes. This shows that the survey was even shorter than the theoretically stipulated 15 minutes, which suggests that perhaps other questions could have been included without exceeding the time considered appropriate.

With respect to missing data, Figure 2 shows the missingness map. As can be clearly seen, all the questions referring to the hypothetical vignettes were answered, which is a good indicator that the questions were understood and allowed each one to respond according to their attitude. Only situations 2 (in assessing feelings) and 4 (in assessing trust) show a missing value each (corresponding to P6 and P11). Additionally, by the end of the survey, the sociodemographic block shows some missingness in variables such as Year of Birth and Family Monthly Salary. A simple mean imputation was employed to guarantee the conservation of the 135 observations.

Figure 2. Missingness Map



Pilot Study Results

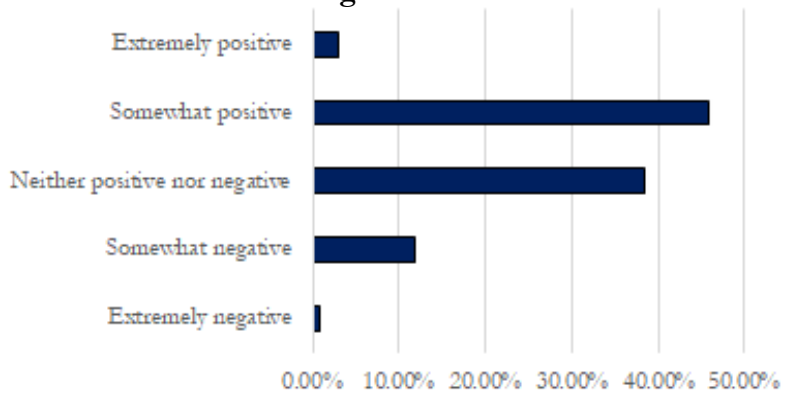
Descriptive statistics from the pilot study are shown in Table 3. With an age range of 18 to 66 years, the average age is 26 years. As can be seen, the convenience sample obtained is predominantly female and in terms of employment status, the average corresponds to students who are jobless and looking for work (category 4). Additionally, the average monthly family income of those surveyed is medium-high (from $66,00 to $96,000 ARS).

Table 3. Descriptive Statistics

Variable		*Observations*	*Mean*	*Std. Dev.*	*Min*	*Max*
Age		135	26	9.685731	18	66
Gender		135	Female	0.667661	1	4
Female (1)	58.52%					
Male (2)	36.30%					
No-binary (3)	2.96%					
Prefer not to answer (4)	2.22%					
Employment Status		135	4	1.460291	1	5
Employee for salary (full-time) (1)	14.07%					
Employee for salary (part-time) (2)	14.81%					
Self-employee (3)	14.81%					
Out of work and looking for (4)	20.00%					
Out of work but not currently looking for (5)	36.30%					
Family Monthly Income		135	3	1.071156	1	4
Less than $33,000 ARS (1)	12.59%					
$33,000 - $65,999 ARS (2)	24.44%					
$66,000 - $96,000 ARS (3)	22.96%					
More than $96,000 ARS (4)	40.00%					

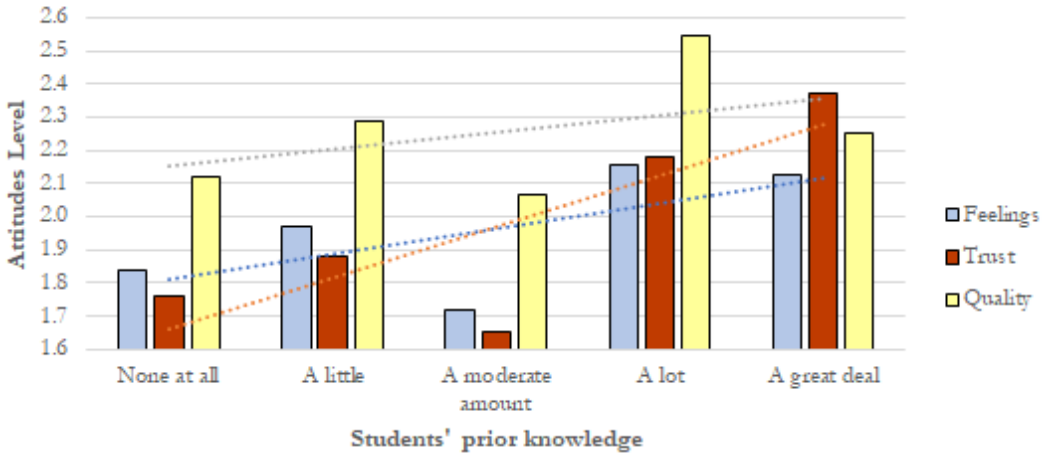
Regarding overall students' opinions towards the use of algorithmic systems in their universities (Figure 3), the majority see that possibility as "somewhat positive" (45% of the respondents). Anyway, the skeptical and neutral views are also considerable in amount (38% of the students).

Figure 3. Overall Students' Attitudes towards the Use of Algorithms in Education



After codification of attitudes (general feelings, trust, and quality of university services) into 3 levels (1 for negative/low, 2 for neutral, and 3 for positive/high); Figure 4 shows the relationship between students' attitude levels and self-perceived prior knowledge about algorithms. The bar graph indicates a clear tendency: the more prior knowledge they say they have, the more positive attitude they show, especially in terms of trust where the increasing tendency is steeper.

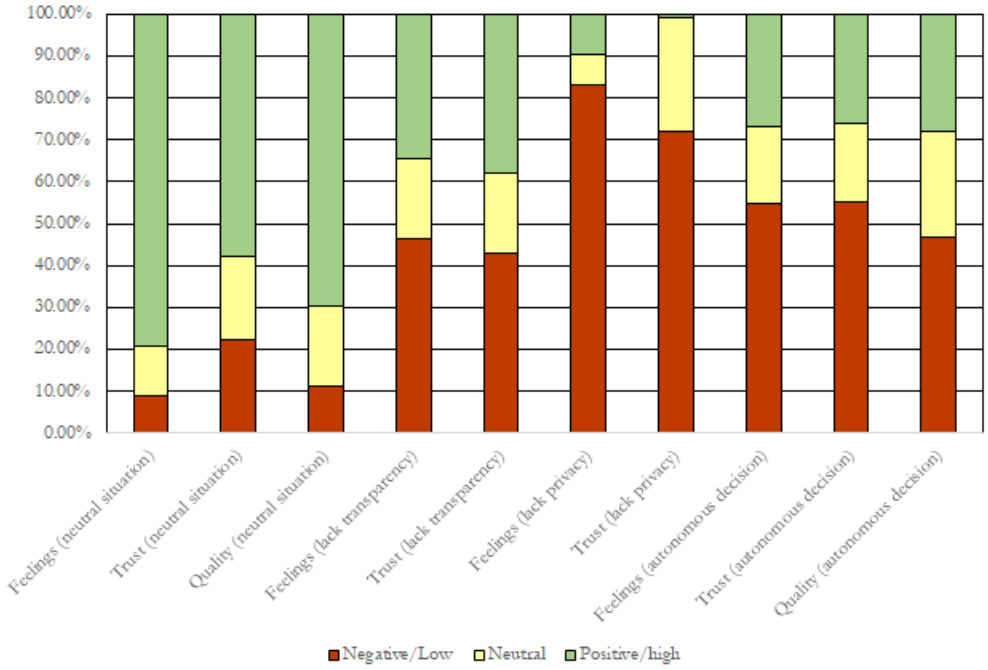
Figure 4. Students' Attitudes towards the Use of Algorithms in Education According to their Prior Knowledge of the Subject



Finally, Figure 5 analyzes respondents' attitudes towards the use of data-driven systems in education according to the different vignettes presented to them. Situation 1 (neutral) shows that positive attitudes predominate (first three bars on the left side). When analyzing situation 2 (lack of

transparency), more than 40% of students show negative opinions, 15% have neutral attitudes, and around 35% are favorable. Situation 3 (failure in the preservation of students' data privacy) indicates that at least 70% of students show negative attitudes, becoming the worst situation evaluated by the respondents.

Figure 5. Students' Attitudes towards the Use of Algorithms in Education According to Different Situations



Attitudes on situation 4 (automatic decision-making) are represented in the three bars at the right of the graph and reveal that negative opinions predominate although around 25% of respondents see these systems positively. In this last case, maybe the lack of favoritism and human discretion in the selection is something valued by the students who consider the use of the algorithm fairer.

Final Discussions and Future Research Plans

This work proposed to explore what are the attitudes of university students towards the use of algorithms in educational environments. In doing so, a survey was designed and implemented in a pilot study. The instrument confronted Argentine university students with specific hypothetical

situations of use of an Early Warning System for the detection risk of dropping out as well as an evaluation system to select students who obtain scholarships and fellowships. Different variations in the situations sought to find different reactions in terms of attitudes.

The pilot study showed that the instrument is adequate in terms of wording, sequence, and structure. However, an additional situation could have been added due to the quick average response of the students. Considering O'Neil's (2016) suggestions, unfair situations could have been incorporated into the survey showing how the use of specific algorithms can affect certain groups according to ethnic identities, social classes, etcetera. The challenge with the design of this type of vignette will be not to posit a very obvious situation that does not obtain variation in responses.

On the other hand, when considering results at least in descriptive terms, differences in students' attitudes seem to be related to distinct scenarios of algorithmic application in educational settings (considering especially data privacy, lack of transparency, and automation of decisions). However, since all the situations were presented to all the respondents in our pilot study -which means that there was no variation in the treatments or independent variables-, this work cannot conclude statistically significant differences. Consequently, future research contemplates the conversion of the current survey into an experimental survey design to test the aforementioned causal hypothesis.

In addition, in a next stage of this project, it is expected to obtain the approval of the Institutional Review Board (IRB) in UTD as well as to advance in the request for a grant to finally carry out the study with a representative sample of our target population of students.

Appendices

- Survey (English version)
- Survey (Spanish version)
- Pilot Study Data
- Final Project Presentation (slides)
- Assignment # 1 (Qualtrics) by Federico Ferrero
- Schiff, D., Schiff, K. J., & Pierson, P. (2021)[b]. *Replication Data for: Assessing Public Value Failure in Government Adoption of Artificial Intelligence* [Data set]. Harvard Dataverse. Available online at: https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/LIGARA

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