

IMPACT OF THE "ETHICS WORKSHOP" COURSE ON THE DECISION MAKING OF COMPUTER SYSTEMS ENGINEERING STUDENTS

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Abstract-- Academic training in engineering should be given in an integral sense, in which the field of ethics is covered, which seeks to guide the actions of students, based on reflections in the academic, personal and professional fields. This research shows the relationship between decision making, which students carry out in the three mentioned areas, with the reflections made in the subject "Ethics Workshop", in order to have better understanding of the impact of the subject in the students' decision making.

Keywords--Ethics education, engineering ethics, decision making, professional ethics.

PROBLEM STATEMENT

There are some behaviors and actions on the part of students of the Computer Systems Engineering course, observed in the technological institutes of Milpa Alta, Milpa Alta II and Tláhuac, which lead to questioning the impact on students of the reflections made based on the contents of the *Ethics Workshop* course.

Some of the behaviors that are constantly observed are the plagiarism of information in the preparation of research papers; constant non-attendance without any justification; the

copying of answers in written evaluations as well as in assignments and homework; as well as some particular actions such as breaking into the Integral Information System causing the saturation of the re-enrollment process and the threat to professors due to disagreement with grades obtained at the Technological Institute of Tláhuac, episodes of violence among students at the Technological Institute of Milpa Alta, among others.

JUSTIFICATION

Despite the fact that the Tecnológico Nacional de México decided to make the *Ethics Workshop* a compulsory subject in all its undergraduate programs since 2004, 14 years after the implementation of this measure, we have not found any information that would provide us with feedback on the impact of this strategy.

Specifically, we are interested in knowing if the reflections made in the ethics workshop, based on the contents, influence decision-making in the personal, academic and work environment, in order to have information that can be used to improve the students' training in the field of ethics.

GENERAL OBJECTIVE

To identify the level of impact of the reflections made in the subject of Ethics Workshop in making, in the students of Computer Systems Engineering the Technological Institutes of the southeast zone of Mexico City.

SPECIFIC OBJECTIVES

- Design an optimal questionnaire to measure the level of impact of the reflections made in the Ethics Workshop on decision making.
- To determine a significant sample in the three Technological Institutes that offer a career in Computer Systems Engineering.
- Present conclusions based on the results of the surveys.

THEORETICAL FRAMEWORK

At the beginning of this century, the issue of rethinking the role of universities in the society of the 21st century has been on the rise, especially in response to the urgent need to integrate the notions of professional ethics, training of citizens responsible for the problems of society [1]. Such training is centered on the concept of ethics, which is particularly multifaceted. However, it can be said that ethics is a body of knowledge that deals with the nature of human actions in social life, from the point of view of moral concepts (goodness, truth and moral precepts (reciprocity) [2]. This serves to reflect on human behavior. Thus, ethical reflection seeks to guide man in what allows him to act "better", i.e. in accordance with the good [3]. More specifically, the inclusion of ethics teaching in higher education is based on normative ethics, which bases its research on what is good and bad to determine moral codes, and on moral theory, which is responsible for its origin and development, from which ethics is considered a science of morality [4].

Unfortunately, the risk of turning the teaching of ethics into the mere transmission of rules is latent and is more common than one would like to accept. In fact, one of the major problems with regard to ethics courses that operate ancillary to theory- or technically-oriented training is that they are restricted to the consideration of the more contractual aspects of professional development, in the

which, on the other hand, have always emphasized professional codes of ethics, thus eliminating in principle any critical view of practice in a given context [5].

Speaking more specifically about professional ethics according to Fernandez and Hortal cited in [6], it can be understood as the systematic inquiry about the way to qualitatively improve and raise the degree of humanization of social and individual life, through the exercise of the profession, so that it not only includes duties (as in deontology) but also recommendations, goals, ideals and virtues [7].

Professional ethics starts from understanding what is the meaning of the profession in the first place, a profession seeks to achieve a good or a purpose, which is indispensable for social life [8]. Therefore, according to Ibarra, R. (2008), professional ethics is based on the goods and virtues, from which the question arises as to what satisfaction or benefit a profession can provide to society, from which it follows that the principle of beneficence is part of the *raison d'être* of professional activity [9].

The human being develops in a variety of professional fields, in each one there is an order based on laws and moral norms, from the latter the ethics form the foundations of each profession, according to Silva, C. [10] the moral behavior, and therefore that of professional ethics, is by essence free, conscious and responsible for the consequences, regardless of good intentions. Thus, all professional activity should be based achieving the common good and this requires the implementation of habits and virtues in a given context, so the ethical component is not an addition or an addition that does not affect the essence of the profession [8].

In this scenario, the institutes that make up the Tecnológico Nacional de México implemented the Educational Model for the 21st Century in 2004, which is based on three dimensions: the philosophical, which focuses the attention of the model on the human being; the academic, which integrates the reference parameters of professional training, the conception of learning and its conditions, (...); and the organizational dimension, which contributes to the fulfillment of the purposes of the model and guarantees that the resources are substantially dedicated to the educational purposes.

[11]. These ideas can be interpreted, as David, Castroff and Perrulli (2005) mention it, as an effort to break once and for all the traditional dichotomy that the mentality

technical-instrumental established between scientific-technological and humanistic training [12]. Since its implementation, the *Ethics Workshop* has been included as a compulsory subject in all undergraduate programs, with the objective of exercising students' reflective and analytical capacity on their actions in social, personal and professional contexts, order to make decisions with an ethical sense.

This strategy has antecedents in the Universidad Real y Pontificia de Comillas, in Madrid [13], to mention just one example, and although it is perhaps the most common, it is not the only one implemented by various higher education institutions around the world. For example, the National University of Colombia, Manizales campus, implemented a strategy that seeks to strengthen ethical training from the hidden curriculum, which according to Jackson can be understood as the continuous interactions that generally lead to unintended results or learning, i.e., not planned neither by the institution nor by the teacher, this being a form of socialization or educational adaptation cited in [14], that is, through activities outside the curriculum, such as volunteer programs, cultural and recreational events, etc., that through activities outside the curriculum, such as volunteer programs, cultural and recreational events, etc., the implementation of ethical training is encouraged. There is also a strategy at the Illinois Institute of Technology called "Ethics across the ", consists of teaching all teachers of engineering, accounting, computer science, biology and all the more "technical" subjects to include the subject of ethics in their courses [15]. It is clear, then, that the issue of ethics in professional training is a subject that has been the subject of much reflection, with various points of view and different approaches to address it.

Félix Lozano defines engineering ethics as the study of cases and moral decisions faced by individuals and organizations in the field of engineering, as well as the study of issues related to moral ideals, character, politics and relations between people and organizations engaged in activities related to technology [16]. Thus, by incorporating an ethics course in the curriculum of their engineering , various institutions of higher education seek to link the student's reflection to real situations in the field of their profession that they will face when practicing engineering. This is how they seek to increase the student's capacity to make moral judgments and thus provide him with

moral autonomy to the engineer, i.e., to be able to make decisions on his own when faced with moral dilemmas in the exercise of his profession, this being the main objective and purpose engineering ethics [16].

The ethical structure of the individual implies, according to Galdona, cited in [17], the development of a series of contents that must be defined with responsibility and competence by the individual him/herself. The constant practice of these principles may lead to greater self-knowledge, personal development and ethical professional development. Finally, there is no more guarantee on the ethical practice of the professional, because once the engineer graduates, he/she is at the mercy of his/her information, conscience and responsibility [18]. In this sense, according to the general objective of Computer Systems Engineering program of the Tecnológico Nacional de México (ISIC-2010-224), the aim is to train professional leaders with strategic vision and a broad ethical sense; capable of designing, developing, implementing and managing computer technology to provide innovative solutions for the benefit of society; in a global, multidisciplinary and sustainable context [19].

In the characterization of the Ethics Workshop course, its integration to all the careers of the National System of Technological Institutes (now Tecnológico Nacional de México) is based on the objective set forth in the XXI Century Model of the National System of Technological Higher Education, which seeks a professional training that integrates, in a dynamic totality, the competence in professional work with the exercise of an active, responsible citizenship and the psychosocial development of the person [11].

This ability to exercise responsible citizenship is specifically sought through the Ethics Workshop course, in which students, through ethical reflections, will have to understand that the exercise of their profession is not only the application of scientific knowledge and technical skills, but also a practice with responsibilities as citizens and as people in the construction a better society [20].

Thus, it can be affirmed that, in this subject, it is clear that the intention is not to modify the student's convictions, but rather to provide him with elements, methods to better support his decision making, through ethical reflection of the situations in which he finds himself [20].

METHODOLOGY

Unlike other methods found to evaluate a course on ethics for higher level students, which sought to test the knowledge of students who are about to finish their Psychology degree, in relation to different ethically problematic situations at two points in time (before and after a training program on ethics and deontology) [21]. Ours is a descriptive research, through the inductive and deductive method, using the survey technique through the Likert-type questionnaire instrument with 24 items. The Likert scale was used for the design of the instrument (questionnaire), since it is useful for measuring specific attitudes regarding a specific situation [22].

This questionnaire was validated internally by the Kendall method, also known as Kendall's W concordance coefficient, which is used when one wants to know the degree of association between k sets of ranks according to Siegel & Castellan (1995) cited in [23], as Escobar and Cuervo point out, is particularly useful when experts are asked to assign ranks to the items [23], as was the case of the designed questionnaire. In addition, the same instrument was validated using the Delphi method, which is a structured methodology to systematically collect expert judgments on a problem, process the information and, through statistical resources, build a general group agreement. It allows the transformation during the investigation of the experts' individual appraisals into a superior collective judgment [24].

Taking as a reference the study conducted by Mateo (2015) with students and teachers of Industrial Engineering and Computer Systems Engineering at the Instituto Tecnológico Superior Purépecha [25], to build our own instrument, this questionnaire seeks to measure the frequency with which students make certain decisions and consider for this purpose the reflections made in their classes of the subject Ethics Workshop.

Based on the definition of universe, which establishes that it is the real or hypothetical series of elements that share defined characteristics related to the research problem [26], the Computer Systems Engineering student community of the Technological Institutes of Tláhuac, Milpa Alta and Milpa Alta II was determined as the universe, because they are

who share the characteristic of taking the Ethics Workshop in the first semester according to their reticule. In the same way, considering that the population is the set of all the elements that meet certain properties, among which we wish to study a certain phenomenon according to Azorín & Sánchez Crespo in [27], the population of the present research was defined as the seventh and eighth grade students in [27]. Sánchez Crespo in [27], the population of the present research was defined as the seventh and eighth semester students of the Computer Systems Engineering course, since they are the ones who are closest to graduating, and it is in them that the characteristics of the graduate profile should be manifested, one of which states that they will be able to perform their professional activities considering ethical aspects, among others [19].

Finally, to determine the sample, which is the group of individuals that will actually be studied [28], the following formula corresponding to the sample calculation was applied when the population size is known [29]:

$$n = \frac{N \times Z^2 \times p \times q}{d^2 \times N - 1 + Z^2 \times p \times q}$$

Where:

n= population size
z= confidence level

p=probability of success, or expected proportion

q=probability of failure

d=precision (maximum admissible error in terms of proportion)

n= 170

z= 2.576 since the certainty is 99% p=

50%=0.5

q=1-p =1-

0.5=0.5=0.5

d=2%.

To do so, we substitute the values

$$n = \frac{170 \times (2.576)^2 \times 0.5 \times 0.5}{0.02^2 \times (170 - 1) + 2.576^2 \times 0.5 \times 0.5} =$$

$$n = \frac{170 \times 6.635776 \times 0.5 \times 0.5}{0.02^2 \times (170 - 1) + 2.576^2 \times 0.5 \times 0.5}$$

The following scale was used: 1) Never, 2) Few times, 3) Half of the , 4) Many times and 5) Many times.

5) Always, in the 24 Likert-type items of the survey. In the survey, three themes are addressed decisions in the academic field, decisions in the work field, and decisions in the personal field.

DEVELOPMENT

The questions asked to evaluate the decisions in the academic setting and how they influenced the reflections made in their Ethics Workshop subject were:

Table 1. Items used to evaluate the impact of the Ethics Workshop on the academic environment of ISC students of ITT, ITMA and ITMA II.

1. Have you ever handed in a homework assignment copied from another colleague
2. When you have decided whether or not to turn in an assignment or work copied from another colleague, have you ever taken into consideration the reflections that were carried out in your Ethics Workshop classes?
3. Have you ever used information from the internet to prepare an assignment or paper, without using quotations or references
4. When you have decided whether or not to use information from the internet to prepare an assignment or paper, without using citations or references, have you ever taken into consideration the reflections that led to in your Ethics Workshop classes?
5. Have you ever asked for any support or special consideration from your teachers to pass an evaluation that you failed for some reason? irresponsibility on your part.
6. When you have decided whether or not to request some support or special consideration from your teacher to pass an evaluation that you failed because of some irresponsibility of yours, have you ever taken into consideration the reflections that were carried out in your Ethics Workshop classes?
7. Have you ever offered a bribe to any of the following? teacher to accredit a subject?
8. When you have decided whether or not to offer a bribe to a professor to accredit a subject, have you ever taken into consideration the reflections that took place in your Workshop classes? Ethics?
13. Have you ever threatened a teacher to modify a rating of yours.
14. When you have decided whether or not to threaten a teacher to change a grade, have you ever taken into consideration the reflections that were carried out in your classes of Ethics Workshop?

The questions asked to assess personal decision making and the manner in which

influenced the reflections made in his Ethics Workshop course were:

Table 2. Items used to evaluate the impact of the Ethics Workshop on the personal environment of the ISC students of ITT, ITMA and ITMA II.

9. Have you ever shared information, images and/or videos that could damage the reputation of your company? of another person.
10. When you have decided whether or not to share information, images and/or videos that may damage another person's reputation, have you ever taken into consideration the thoughts that are carried out in your Ethics Workshop classes?
11. Have you ever offered a bribe to a authority to avoid a sanction.
12. When you have decided whether or not to offer a bribe to an authority to avoid a sanction, have you taken into consideration the reflections that are carried out in your Ethics Workshop classes?
15. Have you physically or verbally assaulted to another person within your institute?
16. When you have decided whether or not to assault another person within your institute, have you ever taken into consideration the reflections that took in your Ethics Workshop classes? Staff
19. Have you ever found something that someone else forgot, and you decided to keep it, having the possibility to return it to the owner or give it to any authority?
20. When you have decided whether or not to keep something that someone else forgot, have you ever taken into consideration the reflections that took in your Ethics Workshop classes?
21. Have you ever lied for profit of any situation?
22. When you have decided whether or not to lie in order to take advantage of a situation, have you ever taken into consideration the reflections that are carried out in your Ethics Workshop classes?
23. Have you ever altered a document official?
24. When you have decided whether or not to alter any official document, have you ever taken into consideration the reflections that were carried out in your Ethics Workshop classes?

And the questions asked to evaluate decision making in the professional setting and how it was influenced by the reflections made in their Ethics Workshop subject were:

Table 3. Items used to evaluate the impact of the Ethics Workshop on the professional environment of ISC students of ITT, ITMA and ITMA II.

17. Have you ever used the knowledge of your career to harm other people?
18. When you have decided whether or not to use your career knowledge to harm other people, have you ever taken into consideration the reflections that took place in your classes of Ethics Workshop?

As is can be observed, also from this classification of the items in three areas in which the student makes decisions, it is also possible to grouped in pairs, where one question is refers to the frequency with which a student has decided to take an action, which in general we can consider as actions bad o immoral; followed by a question that refers to the frequency with which the student takes in consideration of the reflections of the Ethics Workshop to the to decide to do or not to do such action. Thus, to begin with, we have to present the results of each of the items, first grouped by decision-making area, and we will comment on some of the findings.

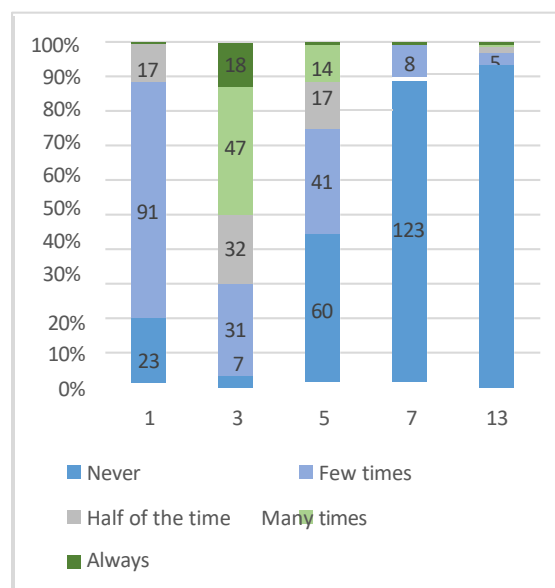
However, it should be remembered that, ultimately, the intention of this research is to find some relationship between the decision not to take an action (the cases in which the answer was never or less than half the time), with the fact of taking into consideration the reflections of the Ethics Workshop course (the cases in which the answer was always or more than half the time). For this purpose, we specifically counted the total number of cases in which they never or less than half of the time decide to take an action, and which in turn always or more than half of the time take into consideration the reflections of the Ethics Workshop, and thus determine whether or not there is any relationship between the reflections of the subject with the decision making of the students, in which areas.

DISCUSSION AND ANALYSIS OF RESULTS

Once the results were obtained, Cronbach's alpha was calculated and a value of 0.878 was obtained, which according to George and Mallery (2003) cited in [30], being greater than 0.8, is good.

With respect to academic decisions, we can observe that the majority of the responses indicate that they never or decide to make the

example actions from the questionnaire, as shown in Figure 1.

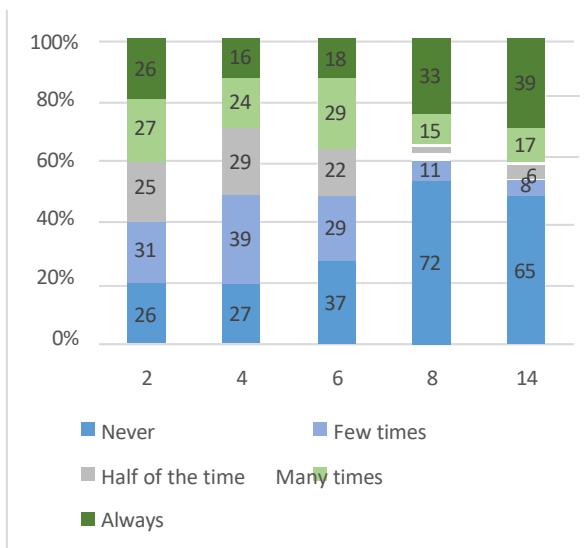


Graph 1: Frequency with which they decide to carry out actions in the academic field (Own elaboration).

It should be noted that there is a considerable difference between the number of responses indicating that they never decide to do actions 7 and 13, with respect to the other three actions in this domain; in fact, they correspond to the most serious actions, which are bribing and threatening a teacher. It is also noteworthy that in actions 1 and 5 the number of responses indicating that they decide to do the actions is more visible, and more particularly in action 3, whose responses indicating that they decide to do the action many times or always together constitute 50 percent of the total responses, which means that this action is decided to be carried out quite often.

These results corroborate the problem posed in this research, since these actions, 1, 3 and 5, are about handing in an assignment or work copied from another classmate; using information from the Internet for an assignment or work, without making citations or references; and requesting some support or special consideration from teachers to pass an evaluation that they failed due to some irresponsibility on their part.

Now, regarding the frequency with which they take into consideration the reflections of the Ethics Workshop course in making decisions in the academic field, the results obtained are as follows:



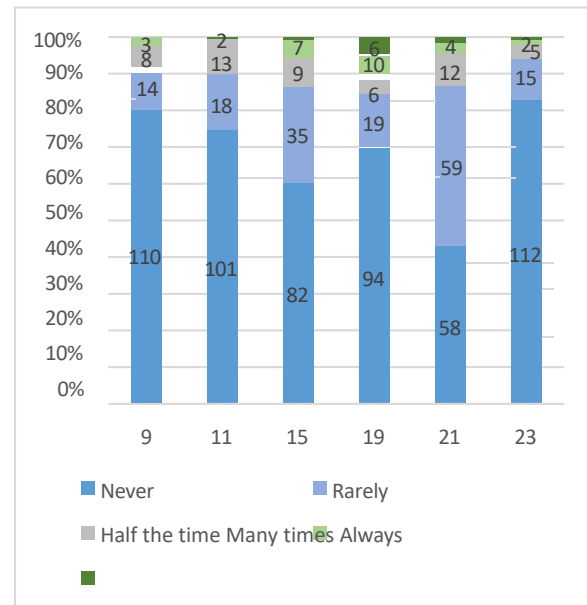
Graph 2: Frequency with which reflections of the Ethics Workshop are taken into account in academic decision-making (Own elaboration).

In this regard, we can point out that in items 8 and 14, which refer to the decision to bribe and threaten a teacher, is where there were more responses indicating that they always take into consideration the reflections of the Ethics Workshop, which at first glance may seem to be an indicator that shows a positive impact of the Ethics Workshop subject on decision-making.

However, it is also notable that in those same two items is where there are more responses indicating that they never take into consideration the reflections of the Ethics Workshop, and in fact there are more total responses indicating that they never, compared to the total indicating that they always take into consideration the reflections of the Ethics Workshop, therefore, it is not possible to conclude that the reflections of the subject are a determining factor in making those two decisions.

On the other hand, in the rest of the items of the academic domain, a fairly homogeneous distribution is observed among the five response options, which implies that it is not clear that the reflections of the subject are a determining factor in the making of these other three decisions of the academic domain.

With respect to decisions in the personal sphere, the results for the items dealing with the frequency with which they decide to perform actions in this sphere are as follows:

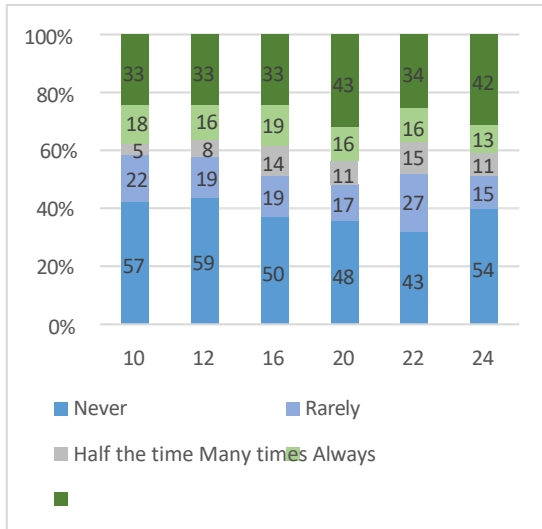


Graph 3: Frequency with which they decide to carry actions in the personal sphere (Own elaboration).

As can be seen, the responses indicating that they never decide to do the actions are the great majority, exceeding 60% of the total responses in each item except item 21, in which the responses indicating never are equivalent to 43% of the total responses.

That is to say that the actions of sharing information, images and/or videos that can damage the reputation of another person; of offering a bribe to an authority to avoid a sanction; of physically or verbally assaulting another person within the institute; of finding something that another person forgot, and keeping it while having the possibility of returning it; and altering an official document, which correspond to items 9, 11, 15, 19 and 23 respectively, are rarely done; while the action of lying to take advantage of a situation, 57% of the respondents decide to do it from a few to many times.

Thus, in relation to these actions, the frequency with which reflections of the Ethics Workshop are taken into consideration in the decisions in this area, resulted as follows:

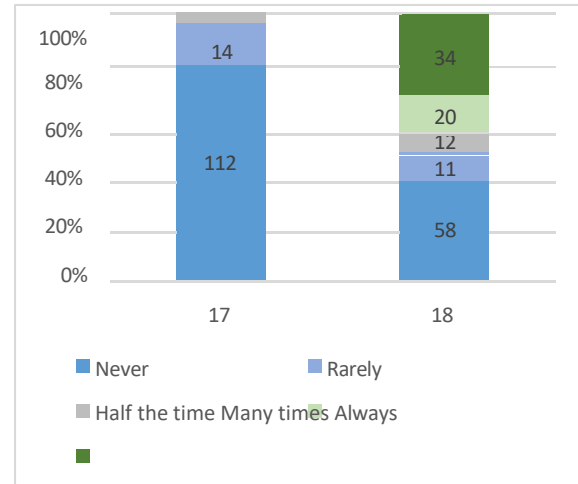


Graph 4: Frequency with which reflections of the Ethics Workshop are taken into account in personal decision making (Own elaboration).

In the case of these items, a very homogeneous distribution is observed among the five response options. It should be noted that in comparison with the frequency with which the reflections of the subject are taken into account for decisions in the academic field, in the decisions in the personal field, in all the items there are more students, over 20% of the total, who responded that they always take them into account.

However, the percentage of students who respond that they never take them into account is still slightly higher, so there is nothing conclusive that we can infer from these regarding the impact of the subject on decision making.

For the work-related decision, we present in the same graph the results of the item that asks how often they decide to take an action in this area, together with the graph of the item that asks how often they take into consideration the reflections of the Ethics Workshop in this decision; and the results are as follows:



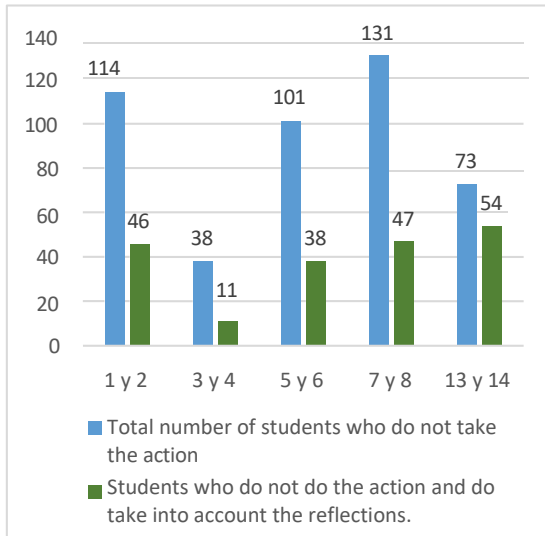
Graph 5: Frequency with which they decide to take actions in the work environment and frequency with which the reflections of the Ethics Workshop are taken into account making decisions in the work environment (Own elaboration).

In this area the results are very similar to those of the personal area: a very high percentage of the total number of students indicate that they never decide to do the action, which is to use the knowledge of their career to harm other people; while 25% of the total indicate that they always take into account the reflections of the subject, and 43% of the total indicate that they never take them into account.

After analyzing these results, the inferences that can be drawn from them are not so solidly grounded. Therefore, it was decided to make a more detailed review in order to find a more admissible relationship between the reflections of the Ethics Workshop and the students' decision making.

Thus, we proceeded to count the cases in which the student who responded that he/she never or rarely decides to do an action, which we will refer to as the students who do not do an action; and who also responded that he/she always or often takes into account the reflections of the subject, which we will refer to as the students who do not do the action and do take into account the reflections.

Thus, with respect to decisions in the academic field, the results of this accounting are as follows:

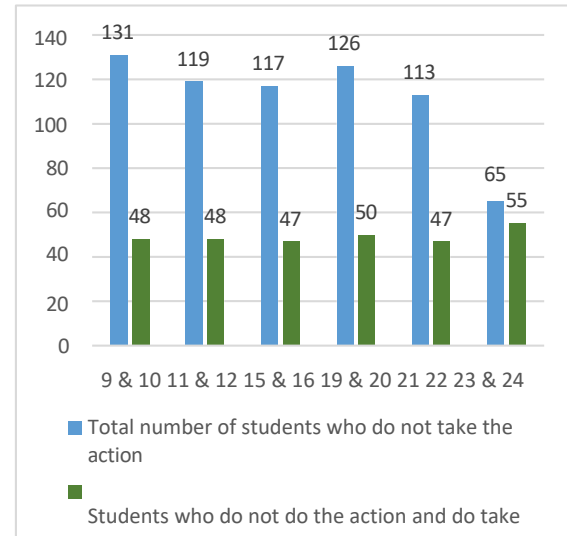


Graph 6: Total number of students who do not take action and that do take into account the reflections in the academic environment (Own elaboration).

The first thing to note is that the number of students who do not do the action and who do the reflections into account is reduced with respect to the total number of students who responded that they do take the reflections into account, shown in graph 2. However, if we consider the relationship shown in this graph 6, we see that over 35% of the students who do not do the actions are taking into account the reflections of the subject, except in items 3 and 4, where it is 29%, which is not so low, considering that action three is a very common action to which our students have unfortunately become accustomed since high school.

But most interesting relationship is shown by items 13 and 14: 74% of the total number of students who do not take the action, do take into account the reflections of the subject. Recall that item 14 in graph 2 shows both the highest number of students who never take reflections into account and the highest number of students who always take them into . This, in isolation does not reveal much, but in light of the cases in which the not to take the action and to take the reflections into account coincide, we can conclude that the impact of the subject reflections is great.

At the personal level, the relationship between those who decide not to do the actions and also take into account the reflections, results as follows:

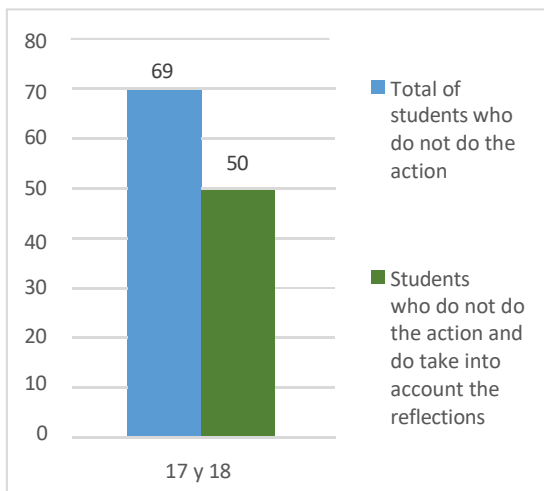


Graph 7: Total number of students who do not take action and that do take into account reflections in the personal sphere (Own elaboration).

In the case of personal decisions, what is observed is that the total number of students who take into account the reflections, as shown in Figure 4, and the total number of students who take into account the reflections and decide not to take the actions, shown in Figure 7, barely differ. Moreover, these cases in which coincidence occurs represent between 37% and 42% of the total number of students who decide not to take an action, which is higher than what occurs in the academic environment, and shows a more stable and perceptible direct relationship between the reflections of the subject and those who decide not to take the actions.

And just as in the academic field, there is an action in which 85% of the students who decide not to do it, do take into account the reflections, which is the case of action 23, about altering official documents. This also shows a significant impact of the subject reflections and decision making, now at the personal level.

And finally on the work environment, the result of counting the cases in which the students decide not to do the action and do take into account the reflections, are shown as follows:



Graph 8: Total number of students who do not take the action and who do take into account the reflections in the professional field (Own elaboration).

As in the personal area, practically the total number of students who do take into account the reflections, shown in Graph 5, are those who also decide not to do the action, as shown in Graph 8. In this case, the ratio between the total number of students who decide not to do the action and those who also take into account the reflections of the Ethics Workshop is 72%.

CONCLUSIONS

It can be said that the results show a much clearer and more evident relationship than was initially expected.

If we wanted to base any decision regarding the modification of the contents of the Ethics Workshop course, we consider that there is no element in the results obtained to support them.

Likewise, it should be pointed out that, although the relationship between the reflections of the subject and decision making is visible, the results of the questionnaire created reaffirm that there are certain bad or immoral actions, which the students themselves admit to deciding to do with certain frequency, in which the reflections of the Workshop are not having the desired impact.

Finally, the results obtained in the present research open the possibility of expanding the investigation about the impact of the Ethics Workshop on decision-making, both in later generations and among students from other countries.

careers taught in the Technological Institutes. Likewise, it is interesting to explore the way in which certain variables affect the results of a study such as the one that was carried out, such as the semester in which the subject was taken, among others.

There should be no doubt that the more information we have regarding the impact of the Ethics Workshop among students, the more relevant will be the decisions that TecNM will make regarding this subject, especially in light of the process of creating TecNM's own Educational Model.

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