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Student Motivation in Teaching Process during the COVID-19, a Significant Experience of International Exchange for Control Charts Learning

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ABSTRACT

The objective of this study was to analyze student motivation in the teaching process during COVID-19, as a significant experience of the international exchange for learning control charts trough open educational practices. An instrument was applied to students in international exchange based on the expectation value model. Statistical analysis was based on hypothesis test of two dependent samples. Using the paired samples t-test and sensitivity analysis, significant progress is identified in achievement, utility, and expectation values. The results showed that student motivation increased significantly.

Keywords: Motivation, Teaching process, Expectation value, Control charts, Paired samples t-test

INTRODUCTION

COVID-19 has generated changes in education systems that impact the main authors of the system: teachers and students. As an alternative, most of the university courses have been taught remotely (Giannini, 2020). Using the contribution of industrial engineering teachers from the universities involved, opportunities are evident to strengthen the teaching-learning processes that were incorporated in the design of the process, since the academic motivation of the students depends to a large extent on the perceptions in relation to their experiences in class (Jones, 2015).

There is diverse research in the involve the expectations value model to motivation in transition for college engineering (Jones and Hite, 2020), to describe factors that influence computer science enrollments and careers for Korean School Students (Robinson et al., 2019), to explore aspects of motivation and engagement in inquiry-based learning in primary mathematics

(Fielding-Wells et al., 2017), or to designing undergraduate design experiences (Panchal et al., 2012). Then, the objective of the research was using the "Expectations Value Model" (Wigfield and Eccles, 2000), to analyze the motivational beliefs of the students in the teaching process during the Covid-19, at the level of the control graph domain.

On the other hand, there are multiple learning options in open pedagogical practices (Paviotti et al., 2020), and in open educational practices (Ehlers, 2020; Axe et al., 2020; Marchisio et al., 2020), which corresponds to innovative and attractive pedagogies that incorporate open evaluation, open collaboration, and in itself open teaching processes. Considering these concepts of open education, added to the international exchange policies of the universities: Universidad Austral de Chile and Universidad Tecnológica de Pereira, an international exchange is planned for control graphics students, incorporating pedagogical strategies with a pragmatic approach in the solution of international cases of control charts and where collaborative work between academic peers complement the academic experience.

The current study is an inferential statistical investigation on academic motivation in students of statistical process control, in remote exchange learning. In this area (Symes and Putwain, 2016), postulates that individual evaluations in an activity are elements to predict values that are part of motivational constructs. Therefore, the purpose of the research is to determine if there are statistically significant differences in the beliefs of the students of the statistical control analyzed at the beginning and at the end of the academic exchange of the 2021 semester.

DEVELOPMENT

Methods

The population approached was 27 students during control graphics in academic exchange between the Austral University of Chile and the Technological University of Pereira. Although the study subjects are enrolled in courses directed by the researchers, elements indicated by (Sil et al., 2017) were taken, research with voluntary participation was programmed, based on the principle of voluntary participation that requires that people not be coerced to participate in the investigation.

The validated instruments for experts, took aspects of studies prepared by Kosovich et al. (2015) and Østerlie et al. (2019). The procedural aspect of data collection consisted of applying two instruments at the beginning of the international exchange in the 2021.1 semester and at the end of it. The instruments have fifteen categories of constructs in relation to the items, sentences, or specific questions of the applied instruments and which are synthesized in the following content of the expectations value model (Figure 1).

Taking into consideration some general lines for the number of options on the Likert scale according to (Simms et al., 2019), a level of five options was taken, then, all items of the instruments used a five-level Likert scale according to: strongly disagree, disagree, neither agree nor disagree, agree, and totally agree; with whole quantitative evaluations from 1 to 5, respectively.
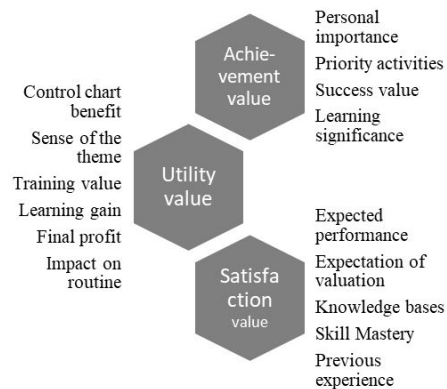
Figure 1: Content of expectations value in instruments.

The longitudinal study is established in two moments: the one prior to the academic exchange and the subsequent one, in which pragmatic approaches are incorporated into statistical control applications, taking advantage of internationalization scenarios. For this reason, it is decided to use the two-sample hypothesis test for dependent samples suggested by Lind et al. (2019) and Anderson e al. (2020), an initial hypothesis is defined: the mean assessment of motivation after the international exchange must be higher than the initial assessment of the control chart students. Where the term motivation can be adjusted to the constructs and/or categories in constructs.

According to Lind et al. (2019) and Anderson e al. (2020), a significance level of 0.05 is selected, identifying the student's t distribution as the test statistic in which the decision rule is: If $p < 0.05$, the proposed hypothesis is rejected. This process is developed through the Jamovi software.

Results and Discussion

The participation of the students was voluntary, that is, the students could decide between participating and not participating in the evaluation moments through the instruments sent by email using Google forms for their respective completion.

From the data analysis, it was found that of the twenty-seven students who made up the international exchange group, 25 participated in the initial assessment (before moment) and ten participated in the final assessment (after moment), therefore discarding the students who participated only in one of the evaluation moments, the final viable sample for the analyzed data corresponds to a total of eight students.

The voluntary participants were three female and five males, all enrolled in the control charts at the industrial engineering program of the Austral University of Chile.

Figure 2 identifies the statistical results of the paired t-test for the achievement value construct, which according to Jones and Hite (2020) and Wigfield and Cambria (2010) establishes a global measure of the level of identification in learning.

A B Student's t	statistic	P
Personal importance	1.530	0.085
Priority activities	2.380	0.049
Success value	1.320	0.114
Learning significance	0.798	0.226

Achievement Value (label to the left of the table)

A: After, B: Before. Ho: Measure A > Measure B

Figure 2: Paired t-test for achievement value.

A B Student's t	statistic	P
Control chart	1.000	0.175
Sense of the theme	0.552	0.299
Training value	0.957	0.099
Learning gain	0.424	0.342
Final profit	1.000	0.175
Impact on routine	0.798	0.226

Utility value (label to the left of the table)

A: After, B: Before. Ho: Measure A > Measure B

Figure 3: Paired t-test for utility value.

In this case, only the item associated with the priority activities whose phrase in the instrument: "Performing well the activities of the control chart to measure variables is very important to me" should reject the initial hypothesis, because $p < 0.05$, that is, the average evaluation of motivation in the specific item associated with the priority activities, after the international exchange, is not higher than the initial evaluation of the control graph students. For all the other elements of Figure 2: personal importance, value of success and meaning of learning, the hypothesis is accepted. For example, regarding the significance of learning, the question in the instrument "I care how well I do in the control graphs of learning", leads to affirm that the mean assessment of motivation in the significance of learning, after the international exchange, is higher, to the initial evaluation of the students, therefore, the students, after the international exchange, care more significantly how well they do in learning the control charts.

According to Rosenzweig et al. (2020), the utility value construct generates connections between the material they are studying in a course and their own life, that is, its practical utility. The statistical results of the paired t-test for the utility value construct are shown in Figure 3. Then, the initial hypothesis must be accepted, since for each category of utility value, $p > 0.05$, that is, the average evaluation of motivation in each specific utility item, after the international exchange, is higher than the initial evaluation of the students of control charts. For example, since the hypothesis is valid for the specific category "learning gain" associated with the instrument item: "I have a lot to gain from learning control charts," then the mean evaluation of learning gain after the international exchange is greater than the initial one.

DomÃ©nech-Betoret et al. (2017), indicate that the value of student satisfaction is one of the most important learning outcomes in education, being considered a key indicator of the quality of education.

The statistical results of the paired t-test for the satisfaction value construct are shown in Figure 4. For the total of the five categories: expected

	A B Student's t	statistic	P
Satisfaction Value	**Expected performance**	0.261	0.401
	Expectation of evaluation	0.424	0.342
	Knowledge bases	0.600	0.284
	Skill Mastery	0.683	0.258
	Previous experience	0.475	0.325

A: After, B: Before. Ho: Measure A > Measure B

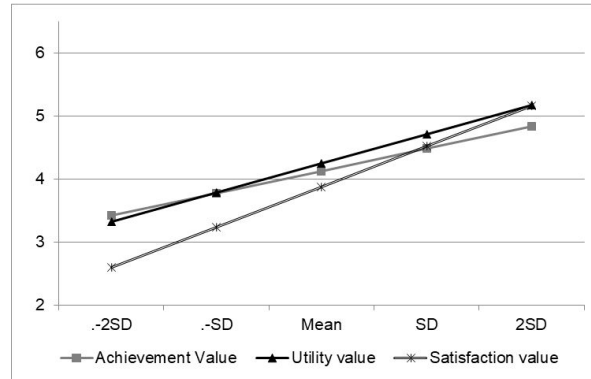**Figure 4**: Paired t-test for satisfaction value.

Figure 5: Average evaluation at the previous time.

performance, the expectation of evaluation, knowledge bases, skill mastery, and previous experience the initial hypothesis is accepted, since in each one, p> 0.05, that is, the Average evaluation of motivation in each specific satisfaction item, after the international exchange, is higher than the initial evaluation of control charts students. To exemplify, evaluation expectation, associated with the instrument item: "I think I will do well in the evaluation of control charts", having ultimately the mean evaluation of the learning gain after the international exchange is greater than the initial one.

For a better understanding (Morris et al., 2019), they mention about the sensitivity analysis establishing gaps between the evaluation obtained and the maximum score. Figures 5 and 6 show the average evaluation calculated for each construct of the expectations value model at the previous time and at the later time, respectively, the academic exchange. In this sense, having as the maximum possible score on the Likert scale the value of 5, the gaps for the constructs in the previous moment are: 0.87 in achievement value, 0.75 in utility value and 1.12 in satisfaction value; while for the later moment they are: 0.5 87 in achievement value, 0.37 in utility value and 0.87 in satisfaction value.

Figures 5 and 6 also give us the possibility to review the extrapolation of data (Armstrong, 2001) in the possible variation of the results. For example, in the average evaluation at the previous time an error of one standard deviation it could give a coincidence between the achievement value and the satisfaction value and in two standard deviations it could give a coincidence between the utility value and the satisfaction value.
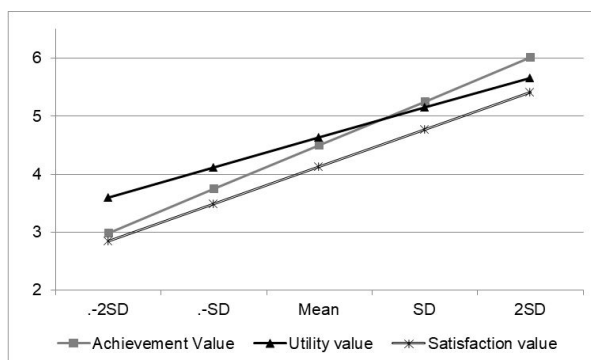
Figure 6: Average evaluation at the later time.

A B Student's t	statistic	P
Expectations **Value** Achievement Value	1.160	0.142
Utility value	1.430	0.099
Satisfaction value	0.683	0.258

A: After, B: Before. Ho: Measure A > Measure B

Figure 7: Paired t-test for expectations value.

Performing an analysis of the calculated gap values, we have that the academic motivation factors with the best evaluation both before the academic exchange and after it, in hierarchical order are: utility value, followed by achievement value, closing with value satisfaction, that is, utility is the best valued, followed by achievement and satisfaction value is third. From the perspective of academic exchange, it is observed that all the constructs of the value expectation model improved: the utility value went from 4.25 to 4.63, the achievement value went from 4.13 to 4.5 and the satisfaction value went from 3.88 to 4.13.

In Figure 7, identify the statistical results of the paired t-test for the set of constructs: achievement value, utility value, and satisfaction value. The incorporated data were obtained by taking the average of the mean evaluations of the categories of each construct. This leads to affirming that the average evaluation of motivation in all the constructs of the expectations value model, after the international exchange for learning, is higher than the initial evaluation of the students, therefore:

- The average assessment of motivation in the achievement construct, after the international exchange, is higher than the initial evaluation of the students.
- The average assessment of motivation in the construct of utility, after the international exchange, is higher than the initial assessment of the students.
- The average evaluation of motivation in the satisfaction construct, after the international exchange, is higher than the initial evaluation of the students.

It is recommended to maintain the international exchange strategies used, to favor the categories that were better valued with the highest probability of acceptance (p> 0.2), these are:

- In the value of achievement: learning significance.
- In the value of utility: the learning gain, sense of the theme and impact on routine.
- In the satisfaction value: expected performance, expectation of evaluation, previous experience, knowledge bases and skill mastery.
- It is recommended to complement the international change strategies used, to advance in favoring the categories that were well valued with probability of acceptance (p> 0.05) but (p≤ 0.20), these are:
- In the value of achievement: success value and personal importance.
- In the value of utility: control chart, final profit and training value.
- Finally, it is recommended to design new pedagogical strategies, to advance in favoring the category that was poorly valued with probability of acceptance (p≤ 0.05), that is:
- In the value of achievement: priority activities.

CONCLUSION

The results of the statistical analysis carried out confirm the initial general hypothesis in which it is verified that the change in the didactic strategy in international exchange after COVID-19 has a significant influence on the motivational beliefs of the students, where the factors of the academic motivation with better evolution after the academic exchange are in hierarchical order: utility value, followed by achievement value, closing with satisfaction value.

Through the process of association of variables of the expectation value model, it is possible to establish that the levels of relationship between the expectation of success, the value of achievement and the value of utility that the students perceived from the academic exchange process were positive. Therefore, the design and facilitation of the course generated benefits in the observed motivational aspect, so that the work of teachers in remote learning situations in circumstances such as COVID-19, find in the design of international exchanges, significant experiences that can positively impact the motivation of students that it represents to a great extent, which moves them to scenarios with specific behaviors more favorable for learning.

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