



## EMPIRICAL RESEARCH

# Effects of Using Thinking Routines on the Academic Results of Business Students at a Chilean Tertiary Education Institution

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## ABSTRACT

The present study investigates the effects of using thinking routines to promote interactive learning environments on the academic results of tertiary education students enrolled in the Cost and Budgeting course at a Chilean higher education institution during 2016. Using the quasi-experimental methodologies Propensity Score Matching and Differences in Differences, student grade averages and exam grade averages were compared using information from both the year this initiative was implemented (2016) and the previous year (2015) to control for preexisting differences between the comparison groups. The results show that students taught using thinking routines obtain better academic results than their counterparts taught using traditional methods.

***Subject Areas: Academic Results, Impact Evaluation, Tertiary Education, and Thinking Routines.***

## INTRODUCTION

Tertiary education is facing new challenges, given that information is accessible to students either through written documents, the Internet, or YouTube tutorials. Undergraduate students find it difficult to concentrate during teacher-based lectures and when reviewing material in a convergent fashion when their brains are operating divergently (Allendoerfer, Wilson, Kim, & Burpee, 2014; Baer, 2014; Chermahini & Hommel, 2012; Runco & Acar, 2012). For example, when teaching economics, Brinia, Kalogri, & Stavrakouli (2016, 86) highlight that “teachers are often facing various problems related to how they can make their students understand basic economic phenomena, relevant terms and their application in everyday life.” The continued use of traditional teaching methods has caused a chasm between the way teachers teach and the way students process. This divide begins in

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early education and is seldom addressed before students enter tertiary education, leading to a lack of critical thinking skills. Even though educators worldwide agree that students need to be able to think critically, communicate effectively, innovate and solve problems (Lundquist, 1999; Scott, 2015), general pedagogy has not adapted to these challenges.

It is in this divide that our problem arises. At this national higher education institution's Business School, one of the basic courses—Cost and Budgeting—has a high failure and dropout rate. This class is traditionally taught by lectures and is evaluated using mixed-item tests. Since this class provides important basic knowledge, a change was necessary with respect to how it was taught to ensure that students learned. Redecker et al. (2011, 10) indicate that “with the new emergence of lifelong and life-wide learning as the central learning paradigm for the future, learning strategies and pedagogical approaches will undergo drastic changes.” Thus, these authors directly challenge universities to implement new formats and strategies for learning and teaching to offer relevant, effective, and high-quality learning experiences. In this context, the relevance of exploring new teaching practices to improve how concepts are learned and applied emerges as a relevant challenge.

Against this backdrop, the goal of this study is to investigate the effects of thinking routines on the academic results of business students in the Cost and Budgeting course. To this end, thinking routines pertaining to the Visible Thinking Project at the Harvard Graduate School of Education's Project Zero were implemented to foster high-quality learning, since these are powerful tools for underpinning understanding. This study is unique in that it was conducted in a tertiary education setting with students enrolled in a mandatory course, whose degree plans range from technical to bachelor's degrees.

## **BACKGROUND AND MOTIVATION FOR THE PRESENT STUDY**

Bernasconi (2017) indicates that if the future growth of tertiary education students in Chile is segmented, then posing the question of whether higher education institutions have adapted to the needs and characteristics of incoming students in terms of admission, diagnostic assessments, teaching methodologies, and academic support, among others, is valid. Bernasconi also goes further, suggesting that to maintain its value, formal tertiary education must offer something that goes beyond technological access, such as direct and frequent contact with professors and teaching methodologies.

Greater access to higher education, new generations, an uncertain and complex world, and an array of literature positing the need to teach 21st century skills all suggest that higher education institutions must offer relevant degrees using the appropriate teaching and learning practices. The 2015 National Review of Education for All (Chilean Ministry of Education, 2015)—a report on the progress of access to tertiary education in Chile since 2000—states that in the current Chilean educational environment, education itself is perceived as pivotal. When looking at dropout rates in Chile, SIES (2014) establishes that first-year student retention is mainly affected by vocation, funding, and academic achievement in its overview of higher education. By introducing new teaching strategies, this study aims to have

a positive impact on students' academic achievements in this first-year course to prevent them from dropping out.

Perkins and Reese (2014) suggest that, among the factors used to sustain change over time, the use of frameworks is key as they offer a vision for more effective teaching and learning. In this context, the framework chosen to be both explored and implemented is Visible Thinking (Ritchhart, Church, & Morrison, 2011). This framework is expected to reinforce and enhance how the Cost and Budgeting course is taught and learned as it is defined as an innovative teaching strategy capable of improving students' understanding of course contents.

## **PROJECT ZERO (PZ) AND VISIBLE THINKING**

Project Zero is a research group at the Harvard Graduate School of Education. It was established in 1967 to research how learning in and through the arts takes place; although over the years, the project has expanded its scope and lines of inquiry, becoming an important point of reference for 21st century education (retrieved from <http://www.pz.harvard.edu/>). Project Zero's different projects work mostly with k-12 schools and museums; therefore, there is a great opportunity to expand its work into tertiary education. Also, as reported by DeLusé, "little of its work has appeared in traditional, peer-reviewed academic channels that would foster deeper shared analysis by its researchers and other scholars" (DeLusé & Henry, 2009). Therefore, this article is also a contribution for other scholars and education-related agents who are interested in using some of the PZ ideas, one of which is Visible Thinking. Tishman and Palmer (2005, 1) define Visible Thinking as, "any kind of observable representation that documents and supports the development of an individual's or group's ongoing thoughts, questions, reasons, and reflections." One way of making thinking visible is through the use of thinking routines.

### **Thinking Routines**

Thinking routines are defined by Perkins as simple patterns of thinking that can be used repetitively and folded easily into learning in different subject areas (Perkins, 2003). As suggested by Ritchhart (2015, 9), "we must also establish learning and thinking routines in our classrooms that offer students known structures within which to operate and tools that they can take control of and use for their own learning. Ultimately, a routine can be thought of as a pattern of behavior and a manifestation of a group's way of operating." For the purpose of this study, five core thinking routines were chosen and implemented in the Cost and Budgeting course, and their effects on students' academic achievements were measured.

Taken directly from the Harvard Graduate School of Education's Project Zero, Table 1 below shows the thinking routines used in this research. See <http://www.visiblethinkingpz.org> for other thinking routines, which can be accessed and printed out for free.

## **METHODOLOGY**

Based on the previous discussion, we raised the following research question at the outset of this study: Does the use of thinking routines affect the academic results

**Table 1:** Thinking routines description.

Thinking Routine	Purpose
<i>What Makes You Say That?</i>	<i>Interpretation with Justification Routine:</i> This routine helps students describe what they see or know and asks them to build explanations.
<i>Think Pair Share</i>	<i>Active Reasoning and Explanation:</i> This routine encourages students to think about something, such as a problem, question, or topic, and then articulate their thoughts.
<i>See Think Wonder</i>	<i>Observation and Interpretation:</i> This routine encourages students to make careful observations and thoughtful interpretations. It helps stimulate curiosity and sets the stage for inquiry.
<i>Circle of Viewpoints</i>	<i>Exploring Diverse Perspectives:</i> This routine helps students consider different and diverse perspectives involved in and around a topic.
<i>Used to Think . . . , But Now I Think . . .</i>	<i>How and Why Our Thinking Has Changed:</i> Useful in consolidating new learning as students identify their new understandings, opinions, and beliefs.

of Universidad Tecnológica de Chile INACAP students in the Cost and Budgeting course?

Specifically, this effect was tested on Universidad Tecnológica de Chile INACAP students at the La Serena campus who were enrolled in the Cost and Budgeting course during the second semester of 2016.

## Participants

A total of 883 participants were included in the present study. All participants were first-year and second-semester students enrolled at Universidad Tecnológica de Chile INACAP, a higher education institution offering technical, professional and university degrees. The 833 students belonged to 32 different sections of the Cost and Budgeting course at the Business School and came from three different campuses. Information about the students' results during the second semester of 2015 and 2016 was considered.

This research aims to evaluate the impact of using thinking routines on the academic results of students enrolled in the Cost and Budgeting course at the La Serena campus. To this effect, both a treatment and a control group were defined.

Members of the treatment group were students enrolled in the Cost and Budgeting course at the La Serena campus during the second semester of 2016 and were taught using thinking routines ( $n = 152$  students).

In relation to the control group, this was chosen based on the characteristics of the institution's other campuses that were involved, where this same course was taught. Universidad Tecnológica de Chile INACAP has 26 campuses throughout the country offering similar study programs. Therefore, a control group was selected from students enrolled in the Cost and Budgeting course during the second semester of 2016 on campuses as similar as possible to the La Serena campus. In order to choose these campuses, the Nearest Neighbor methodology was used

(Thoemmes & Kim, 2011) considering the following variables: total number of students, number of students on the programs associated to the assessed course, student attendance levels, and number of sections of the assessed course.

Based on the results of the Nearest Neighbor methodology, the control group was made up of students enrolled in the Cost and Budgeting course during the second semester of 2016 at Universidad Tecnológica de Chile INACAP campuses in Valparaíso and Concepción-Talcahuano. These students were taught the course without the use of thinking routines and using a teacher-centered approach ( $n = 258$  students formed this group; 118 in Valparaíso and 140 in Concepción). The control group students were all taught using the same materials.

To carry out further analysis to control for preexisting differences between the treatment and control group students, this study also considered the academic results of students enrolled in the same course at these three campuses during the second semester of 2015. The latter involved 110 students in La Serena, 181 students in Valparaíso, and 132 students in Concepción.

A data set containing information about all these students ( $n = 883$ ) was created including students' sociodemographic and academic characteristics from Universidad Tecnológica de Chile INACAP's registration databases, information about student's secondary education obtained from the Chilean Ministry of Education's records, and information about students' participation in the evaluated initiative.

## Procedures

The researchers carried out intervention with the treatment group for 18 weeks, corresponding to the length of the semester in which the research was carried out. Throughout the semester, the instructor for the treatment group applied each of the following thinking routines at least three times: What Makes You Say That; Think Pair Share; See Think Wonder; Circle of Viewpoints; and I Used to Think . . . , But Now I Think.

These routines were used at different points in the class to underpin student understanding of the theoretical concepts of Costs and Budgeting, while at the same time fostering deeper thought about their application and implications for the discipline. The instructor used these thinking routines as a tool for understanding during classes. These routines did not take the form of specific activities, but rather they were implemented as a leading set of questions to solicit a specific type of response. For example, when using See Think Wonder, the instructor first presented the students with budgeting material such as a spreadsheet and then asked them to describe what they saw, without interpretation or judgment, with the aim of making them study it in greater detail. Then the instructor posed a follow-up question, asking the students to think about what they saw. After students shared their thoughts on this specific material, the instructor then prompted students to ask questions about the material.

By considering this as a segmented, step-by-step process whose routine is never explained or introduced as a whole (since full instructions about the entire process are never given), it is easier to avoid setting the brain to think in a particular way or getting students to think ahead. Participation in the thinking routines was documented with written answers on post-it notes and videos. The

control group was involved in a traditional, teacher-centered course with lecture-type class sessions and exercises and no exposure to thinking routines. In other words, the instructors presented the main concepts and gave explanations with no active student participation. All the course assessments at every campus matched those defined in the course's standard, official syllabus.

### **Variables**

To estimate the effects of thinking routines, two dependent or result variables were defined: a student's final grade average before the exam in Cost and Budgeting and his or her final exam grade for this same course. In both cases a 1 to 7 scale was used, which is the data's original scale and Chile's standard evaluation scale for formal education. In terms of the comparability of these indicators, it is important to highlight that the final exam was the same for all campuses and that, even though the components of the course average may vary slightly across campuses, they tend to be similar since they relate to the same course syllabus.

In terms of the independent variable, a dummy indicator that measured whether the student was taught using thinking routines or not was defined. Additionally, the following control variables regarding the students' socio-demographic and academic attributes were considered to estimate the effect of the evaluated initiative: gender, degree course, geographical zone, high school administration type (public, private, or subsidized-private), high school level of social vulnerability, high school zone (urban/rural), high school type (technical/scientific-humanist), and year of high school graduation.

### **Data Analysis**

To address the research question, quasi-experimental designs were applied. Specifically, two different methods were applied independently: Propensity Score Matching (PSM) and Differences in Differences (D-D) (Gertler, Martinez, Premand, Rawlings, & Vermeersch, 2016).

The PSM method was used to examine the effect of being taught using thinking routines, comparing the academic results of the treatment and control groups for those enrolled in 2016. Specifically, this method calculated the impact of this initiative by examining the academic results of both groups, considering the probability of each student being treated and based on some of the characteristics previously defined as control variables. In this study the following three PSM estimators were applied: Nearest Neighbor, Regression Adjustment, and Inverse Probability Weight.

When applying these three methods, the average treatment effect (ATE) was considered. This parameter estimates the effect of certain programs or actions by considering all the examined subjects as potential beneficiaries (Austin, 2011).

Regarding the second methodology, Differences in Differences estimates the effect of an initiative that controls for the differences existing prior to the implementation of a specific action between the treated and control group students. This method estimates the impact of an initiative as the average change over time in the outcome variable for the treatment group, minus the average change over time for the control group. In other words, the effect of an action is measured as the

**Table 2:** Thinking routines impact on exam grades using PSM methodology.

PSM	Coefficient	Standard Error	Z
NNMATCH	.936	.192	4.870 ***
IPW	1.264	.215	5.880 ***
RA	1.041	.158	6.580 ***

N: 294.

\*\*\* $p < .01$ .

difference between the treated and control group, minus the preexisting differences between these two groups in the period before an evaluated action is implemented.

Since there was no information available about students' results before and after the treatment, the D-D method was used considering repeated cross-sectional data. Specifically, the impact of the implemented initiative was estimated as the difference between treated and control students' results in the Cost and Budgeting course in 2016 minus the difference between students from the same campuses who formed both comparison groups in this same course in 2015.

## RESULTS

### Propensity Score Matching (PSM)

The first results of the quasi-experimental designs to be presented are those estimated using the PSM methodology. In this case, the academic results of students taught at the La Serena campus (the treatment group) were compared with the results of the students in the previously specified control groups. Regarding the results obtained, the three PSM estimations considered are presented in Table 2 using students' final exam grades from the Cost and Budgeting course as a result variable.

The first thing to note is that, regardless of which PSM algorithm is used, employing thinking routines has a positive and significant impact that is always estimated at the 1% level. All the estimations indicate that students who took the Cost and Budgeting course using thinking routines had significantly higher final exam grades than those who took the course that used traditional teaching methods.

When reviewing the magnitude of the effects, it can be seen, for example, that when the Inverse Probability Weight method is used, students taught using these innovative tools obtained on average 1.3 points more in their final exam grade (on a scale of 1 to 7) than students who were not part of this project, an effect that is significant at a 1% level.

A second measure of this initiative's impact involved estimating the effect on students' average final course grade before the course exam. In this specific case, the effect of thinking routines on students' final average grade for the Cost and Budgeting course before taking the final exam was estimated.

Table 3 indicates that the three algorithms considered have a positive impact on the initiative, being significant at the 1% level when considering the Nearest Neighbor and Adjusted Regression methods and at the 10% level when using the Inverse Probability Weight method.

**Table 3:** Thinking routines impact on final course average grades using PSM methodology.

PSM	Coefficient	Standard Error	Z
NNMATCH	.408	.160	2.540 ***
IPW	.368	.202	1.830 *
RA	.394	.150	2.620 ***

N: 361

\*\*\*  $p < .01$ , \*  $p < .1$ .**Table 4:** Thinking routines impact on exam grades using differences in differences methodology.

Groups		Exam Score	Standard Error	t
Before	Treatment	4.611	–	–
	Control	4.538	–	–
	Difference (T-C)	.073	.163	.44
After	Treatment	4.738	–	–
	Control	3.769	–	–
	Difference (T-C)	.969	.149	6.52 ***
Difference-in-difference		.896	.221	4.06 ***

N: 654.

\*\*\*  $p < .01$ .

Regarding the magnitude of these effects, these are lower than when students' exam grades are examined. For example, if we consider the Adjusted Regression PSM method, it can be seen that students taught using thinking routines obtained, on average, .39 more in their final course grade for the Cost and Budgeting course, higher than students on the same course at the Concepción-Talcahuano and Valparaíso campuses who were not involved in this initiative.

### Differences in Differences

The second methodology used to estimate the effect of thinking routines was Differences in Differences. By using this quasi-experimental method, the impact can be estimated while controlling for existing differences between the defined treatment and the control group prior to implementing the evaluated initiative. To do this, the differences between the academic results of students in the treatment group and the control group were estimated during 2016 minus the observed differences between students on the courses who comprised these groups during 2015.

In relation to this analysis, Table 4 shows that when considering students' final exam grades, thinking routines have a positive and significant impact of .896 points at the 1% level. This means that when controlling for preexisting differences among the examined students, the exam grades of students at the La Serena campus who were part of the evaluated initiative were, on average, .896 points higher than those of students at the Concepción-Talcahuano and Valparaíso campuses.



**Table 5:** Thinking routines impact on final course average grades using differences in differences methodology.

Groups		Presentation Score	Standard Error	<i>t</i>
Before	Treatment	4.228	–	–
	Control	4.216	–	–
	Difference (T-C)	.012	.143	.08
After	Treatment	4.507	–	–
	Control	4.100	–	–
	Difference (T-C)	.406	.132	3.08 <sup>***</sup>
Difference-in-difference		.394	.195	2.03 <sup>**</sup>

*N*: 833.

<sup>\*\*\*</sup>*p* < .01, <sup>\*\*</sup>*p* < .05.

The magnitude of this effect is obtained by subtracting the difference observed during 2016 (the initiative's year of implementation) from the difference between students on these same courses during 2015. If only the results obtained during 2016 are compared, Table 4 shows a difference that favors the treatment group by .969 points. However, given that in 2015 students from the campus that made up the treatment group (La Serena) had already performed better than those from the campuses that made up the control group (Concepción-Talcahuano and Valparaíso), the estimated effect of thinking routines considers the difference seen in 2016, minus what was observed the previous year (.969-.073 = .896).

Table 5 shows this same type of analysis, this time considering as the result variable students' final course average grades before the exam. A positive and significant impact of the evaluated initiative is observed at the 5% level. First it can be seen that in the year prior to this project's implementation there was a difference in La Serena campus students' final course average grades of .012 points; during 2016, this difference was .406 points. Therefore, it is estimated that the effect of the evaluated initiative is .394 points (.406-.012). In other words, it can be stated that students who are taught using these innovative teaching tools are expected to obtain, on average, final course grades in the Cost and Budgeting subject that are .394 points higher than students taught using traditional methods.

From this analysis, it can be seen that the implementation of thinking routines developed by Project Zero at Harvard University improved students' academic results overall in the Cost and Budgeting course at Universidad Tecnológica de Chile INACAP's La Serena campus. Although it was not possible to estimate the effect of this initiative on students from the same campus who either took part or were not involved in this project, both quasi-experimental methodologies used showed that the academic performance of those who were part of the evaluated project improved.

## DISCUSSION

The results obtained from the present study meant that the answer to the research question (Does the use of thinking routines affect the academic results of

Universidad Tecnológica de Chile INACAP students in the Cost and Budgeting course?) was a positive one.

Both quasi-experimental methods (PSM and D-D) used showed that students taught in the Cost and Budgeting course with the aid of thinking routines obtained higher average grades and exam results than students who were taught this same subject using traditional teacher-centered methods. Based on previous research at the Harvard Graduate School of Education (Krechevsky, Mardell, Rivard, & Wilson, 2013), these results were to be expected since it has been argued that the use of thinking routines has a positive effect on students' academic results. At this point, how thinking routines improve academic results emerges as a relevant question. Even though this research did not look at this issue in depth, certain hypotheses can be proposed.

As per recent literature on this issue, it can be hypothesized that the positive effect of thinking routines on students' standardized academic scores is mediated through the acquisition and development of thinking dispositions. It could be claimed that thinking routines seem to generate and foster ways of thinking that allow students to understand the contents of their courses better, which eventually leads them to improve their academic performance (Ritchhart et al., 2011; Ritchhart, 2015).

Based on what has been previously stated, it can be argued that the use of thinking routines had an impact on the academic results of students on the Cost and Budgeting course since they allowed students to develop different thinking dispositions. Therefore, it could be suggested that using thinking routines helps students to understand economic phenomena, which is a difficult task according to instructors, as mentioned in Brinia et al.'s research (2016). Being able to look for evidence, analyze, and search out different points of view enhances the learning process, having a direct effect on student results in this frequently failed course. Teaching and learning are complex processes that must be honored and nurtured through strong frameworks like Visible Thinking or others that promote more innovative teaching practices capable of engaging new and more challenging types of students (O'Flaherty & Phillips, 2015; Perez & Torelló, 2012).

Another important point is that the results obtained from the treatment group using thinking routines compared to the control group with lecture-type teaching suggest that the latter may have different effects on students' results that do not necessarily have an impact on academic results such as improving students' social skills. Using thinking routines, students can explore, discuss, document, and—most importantly—drive their thinking and learning of class material. Since the thinking routines were not used as activities but rather as routine tools throughout the semester, it can be hypothesized that these thinking dispositions became automated and used to approach class content and exams even when routines were not used. Therefore, a line of inquiry for further research is to determine what kinds of thinking dispositions are achieved through lecture-type teaching and what kind of thinking becomes routine in the teacher-centered classroom.

Other new opportunities for further research include the study of the effect of thinking routines on the Cost and Budgeting course considering a control and treatment group on the same campus. This was not possible for the current study as the campus decided to apply this innovative teaching practice to all students of

the Cost and Budgeting courses. Other business school courses could be included in the initiative in order to assess the overall performance of cohort-like groups. In addition, thinking routines are a cultural force present in the PZ project *Creating Cultures of Thinking*, which contains eight cultural forces to transform the classroom. Therefore, it is only fair to suggest that using thinking routines may promote the implementation of other cultural forces in the classroom. Which ones? How can these be documented? What impact do they have? All these questions could be researched further in the future.

Our study contributes to the ever-growing research on Visible Thinking and its effects on the learning process. Therefore, the field of economic science—as well as other disciplines in tertiary education—could benefit from further research that explores the value of nurturing deeper thought through the use of powerful 21st century educational frameworks, as suggested by Perkins and Reese (2014).

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