First Year Statistics Units across Three Continents: Similarities and Differences

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Abstract

Statistical literacy is a key ability expected of citizens in information-laden societies and is a necessary component of adults' numeracy and literacy. Thus, from an educational perspective, it is crucial to enable students to interpret and critically evaluate statistical information, understand data-related arguments, build intuition about data, and make reasoned judgments and decisions. In order to accomplish this goal, many higher education degree programs have since included statistics courses in their curriculum to better prepare their graduates for the work environment, and enable them to deploy evidence based practices in their work.
Unfortunately, statistics is commonly viewed as a difficult and unpleasant topic. Students often perceive statistics courses as a burden and encounter difficulties. Because statistics is a compulsory course in many programs, students sometimes fail to pass the exams and these failing grades may cause students to abandon their academic and professional aspirations. Research focused on improving statistical education may be able to ameliorate all these problems.
To attain this goal it is essential to identify variables that attenuate or accentuate statistical learning and determine the nature of barriers faced by students. Among them, it is important to investigate the approach that students adopt in learning statistics, as well as reasons for students adopting different learning approaches. Culture background, individual characteristics, and course characteristics can be related to different learning approaches. Thus, to investigate these topics a substantive contribution could derive from the networking activity among different universities involved in enhancing statistical learning, and from sharing the same instrument to investigate the learning approaches.
In the present paper, the similarities and differences of first year statistics student cohorts (enrolled in different degree as engineer, psychology, economics, agriculture) from Europe, South-America, and Australia universities were investigated using a questionnaire-based survey. These represent a preliminary step to then investigate similarities and differences in students' learning approaches using different language versions of the Approaches and Study Skills Inventory for Students (ASSIST).

Keywords: Statistics education; Statistics learning approaches; cross-country survey; university students.

1. Introduction

In information-laden societies, in which the data available are growing exponentially and technologies are evolving to keep pace, there is an increasing need for people to think effectively with data. For this reason, statistical literacy is considered a key ability that helps people in making informed decisions on the basis of quantitative information in their professional and private lives. A physician, for example, should formulate diagnoses in uncertain situations, and choose a course of treatment with uncertain outcomes. The patient should have the skills necessary to understand and evaluate the decisions of the physician. Thus, statistical literacy should support both

the physician and the patient in making decisions, and would support their communication. More in general, statistical reasoning become essential for both experts and consumers to make good decisions about investments, weather, law, health, politics, and so on, and an inability to make optimal choices can be extremely costly, not only at the individual level, but also for society in general.

Thus, from an educational perspective, statistics has to be an expected outcome of schooling and a necessary component of adults' numeracy and literacy (Gal, 2002), i.e., it is crucial to develop students' statistical reasoning and provide them with tools for understanding data-related arguments, building intuition about data, and making reasoned judgments and decisions. For this reason, statistics has been incorporated into a wide range of university programs in many countries. Unfortunately, statistics is commonly viewed as a difficult and unpleasant topic. Students often perceive statistics courses as a burden, encounter difficulties, experience stress and anxiety. They often have low expectations regarding statistics classes and have negative attitudes towards statistics. Additionally because statistics is a compulsory course in many programs, students sometimes fail to pass the exams and these failing grades may cause students to abandon their academic and professional aspirations, contributing to the drop-out rate for these university programs.

Research focused on improving statistical education may be able to ameliorate all these problems and to ensure that students not only acquire the mechanics of statistical methods but also the concepts that underlie statistical reasoning (Garfield and Ben-Zvi, 2008). To attain this goal it is essential to identify variables that attenuate or accentuate statistical reasoning and determine the nature of barriers faced by students, especially those ones who do not major in statistics.

Learning approaches, one of the most widely used frameworks for understanding how students go about learning in higher education (Tight, 2003), turn to be an interesting issue that have not been investigated yet referring specifically to statistics. Learning approaches are defined as *deep*, *surface*, and *strategic*. A deep approach to learning is characterized by a personal commitment to learning and an interest in the subject. Students adopting this approach set out with the intention of understanding the material, they interact critically with the arguments put forward, relate them to their prior knowledge and experience, and evaluate the extent to which conclusions are justified by the evidence presented (Biggs, 2003; Ramsden, 2003). Consequently, deep learning is more likely to result in better retention, transfer, integration, and application of knowledge and lead to higher quality learning outcomes (e.g., Ramsden, 2003). In contrast, a surface approach is characterized by a lack of personal engagement in the learning process. As such, students focus on rote-learning the material in an unrelated manner and they are constrained by the specific task. This approach leads to the misunderstanding of important concepts and poor quality learning outcomes (Ramsden, 2003; Watkins, 2000). Students who adopt a strategic approach are primarily focused on achieving the highest possible grades. Their interest in content is driven by assessment demands and they use whatever learning strategy will maximize their chances of academic success (Watkins, 2000). These students have a competitive and vocational motivation and have been described as cue seekers, in that they pursue hints regarding the content of assessment from their teachers (Duff, 2004).

Students' approaches to learning are not intrinsic characteristics of students (Lucas & Mladenovic, 2004; Ramsden, 2003) but they are highly sensitive to the context in which the learning occurs, i.e., learning approaches are affected by students' perceptions of the learning situation (teaching, class sizes, curriculum, and assessment) and personal factors, such as general orientations to studying and prior educational experiences.

Starting from this premise, we aimed at conducting a comprehensive study of the learning approaches utilized by students in four countries, Argentina, Italy, Australia, and Turkey in order to gain a better understanding of the influence of contextual and personal variables on students' learning approaches and achievement. In detail, the

aim of the paper is two-fold. First, to describe and compare the unit and the assessment characteristics of first year introductive statistics units (courses) offered in Argentina to Agricultural Engineering and Environmental Sciences students, in Italy to Psychology students, in Australia and in Turkey to mainly Business students, i.e., all students were progressing towards a degree other than statistics. Second, to describe the main features of the employed tools since in all these educational contexts learning approaches were measured administering the Approaches and Study Skills Inventory for Students (ASSIST) and a demographic survey was developed to gather information regarding students.

2. Unit and Assessment Characteristics

The sample chosen in Argentina was for the course 'Estadistica General' which is compulsory for students studying toward an Agricultural Engineering and Environmental Sciences Degree. The teaching team of four academics was headed by a senior lecturer with more than ten years' experience. There were 450 students in the course in 2011. The course ran for 16 weeks, and consisted of one 2 hour lecture, and one 3 hour tutorial (with up to 36 students per group) per week, and 2 practicals a term. The largest lecture class size within this course consisted of 116 students.

The course of interest in Italy was an introductory statistics course (called 'Psicometria') for psychology students of the University of Florence. This course is compulsory for first year students. There were about 400 students in the course in 2011. The teaching team consisted of only two academics who run the lectures and tutorials. The course runs for ten weeks, and consists of four hour lecture and two hour tutorial (with students working in groups) per week. The largest lecture class size within this course consisted of 200 students. Consultation hours were also offered to students for one on one help with exercises. Classes were based around the discussion of theoretical issues, followed by practical examples and exercises undertaken with pen and paper rather than in computer packages in tutorials.

In Australia, the focus of the research was an introductory statistics unit within Macquarie University. Although not compulsory for all students, many courses in the University have this unit as a prerequisite for further study, including Bachelor of Applied Finance, Bachelor of Business Administration, Bachelor of Economics, Bachelor of Marketing and Media, Bachelor of Biodiversity and Conservation, Bachelor of Marine Science, and Bachelor of Medical Sciences. The unit teaching team for 2011 consisted of three academic staff members, all with more than ten years experiences, from the Department of Statistics. The teaching team was headed by a Senior Lecturer. There were more than 900 student enrolments which necessitated four lecture streams each two hours a week for 13 weeks. One of them was taken by the lecturer in charge, two of them by one academic staff and the final one by another academic staff. The largest lecture class size within this course consisted of 334 students. As well as attending a two hour lecture each week, students were required to attend one hour tutorial and a one hour practical (both with up to 50 students per group) each week. Tutorials involved guided problem solving using a pen and paper and manual calculations, and practicals helped students in how to solve these problems using a statistics package. Both tutorials and practicals started in second week and continued until the last week. In second semester 2011, there were nine tutors (higher degree students) and seven practical demonstrators running 23 practical classes.

The course of interest in Turkey was an introductory statistics course for mainly Business students of the University of Bahcesehir. This course is compulsory for first year students. There were about 780 students in the course in 2011. The teaching team consisted of only two academics who run the lectures and tutorials. The course runs for twelve weeks, and consists of three hour lecture and one hour tutorial per week. The largest lecture class size within this course consisted of 120 students.

All these information are summed up in Table 1. Focusing on the total face to face contact hours during the semester for four learning environments, while Australian students had 50 hours total face-to-face contact with academics, half of these were with junior academics (i.e. current higher degree students), and all contact hours in Italy (60 hours per semester), in Argentina (80 hours per semester), and in Turkey (57 hours per semester) were with senior academic staff members.

Table 1. Face-to-face hours per semester in Argentina, Italy, Australia, and Turkey

Country	*Number of Students*	*Maximum lecture class sizes*	*Teaching Team Lecturer + Tutor + Demonstrator*	*Total face-to-face lecture hours per semester*	*Maximum number of students per tutorial*	*Total face-to-face tutorial hours per semester*	*Maximum number of students per practical*	*Total face-to-face practicals hours per semester*	*Total face-to-face hours per semester*
Argentina	450	116	4+8	32	36	42	36	6	80
Italy	400	200	2	40	120	20	-	-	60
Australia	970	334	4 + 9 + 7	26	50	22	80	12	50
Turkey	780	120	2	36	90	16	50	5	57

Concerning assessment (see Table 2), in Argentina, the performance of the students was assessed through continuous evaluation (with assignments that are submitted in every class) and two midterm tests (four or five problem-solving exercises). If the students gained 70% or above in the midterm tests, then they passed the course, they did not need to sit a separate final exam. If their performance during the semester fell below 40% then they failed the unit and they were not allowed to sit the final exam. Students with intermediate performances (i.e., achievement between 40% - 70%) were required to sit a final, integrated examination, which consisted of multiple choice questions. These students were given four attempts to sit the final examination.

In Italy, the assessment consisted of a group report (10%), an ungraded assignment for providing students with formative feedback, a written (70%) and oral (20%) final examinations. The tasks in these examinations consisted of solving problems and open-ended questions in which students had to apply and explain concepts acquired during the course. Similarly to Argentina, students were allowed to sit the examination up to five times in the year.

In Australia assessments for the unit included online quizzes (15%), three group-based assignments each worth 5%, a class test (multiple choice questions) run under exam conditions organized during tutorials just before the mid semester break (15%), and a final examination worth 55%. Final examination covered all the contend of the unit and it required students to write short answers for some questions and worked out solutions for the others. Students were provided with a formulae sheet and they were allowed to bring one A4 hand-written paper to final exam room. Unless students were able to prove that a serious event or set of circumstances (i.e. illness) prevented them being able to sit the final exam on allocated date and time, students were not given an opportunity to attempt to pass the examination more than one time.

In Turkey, the assessment consisted of two assignments during the course (10%) and a written final examinations (90%). Differently from Argentina and Italy, but similarly to Australia, students were not given an opportunity to attempt to pass the examination more than one time.

Table 2. Assessment Characteristics in Argentina, Italy, Australia, and Turkey.

Country	*Online Quizzes Number*	*Assignments or quizzes Number*	*Written exam Number*	*Oral Exam Number*	*Attempts allowed for exams*
Argentina	-	2-12 (10%)	2 (90%)	-	4
Italy	-	1 (10%)	1 (70%)	1 (20%)	5
Australia	9 (15%)	3 (15%)	2 (70%)	-	1
Turkey	-	2 (10%)	2 (90%)	-	1

3. Survey Tools

While the first research concerning students' approaches to learning was mainly qualitative and involved interviewing students (Marton & Saljo, 1976a and b), subsequent researchers developed inventories for use with large samples. The *Approaches to Study Inventory* (ASI) devised by Entwistle and his colleagues in the U.K. is probably the most widely used instrument on student learning in higher education. Over the years, a number of revisions were made to the original instrument; however, it was felt that these amendments somewhat sacrificed its conceptual integrity and also affected its validity and reliability. Thus, in the late 1990s, following extensive trialing, it was substantially revised and was titled the *Approaches and Study Skills Inventory for Students* (ASSIST; Tait, Entwistle, & McCune, 1998). The validity and reliability of this latest version has been confirmed by other studies in different countries and within different disciplines (Byrne, Flood, & Willis, 2004; Diseth, 2001; Entwistle, Tait, & McCune, 2000; Kreber, 2003; Reid, Duvall, & Evans, 2005).

The ASSIST measures students' approaches to learning on three main scales: *Deep, Strategic,* and *Surface*. It contains 52 statements and respondents indicate their agreement with each statement using a five-point Likert scale where 1 = disagree and 5 = agree. The statements are combined into 13 subscales of four statements each, which are then further grouped into the three main scales (*Deep*: Seeking meaning, Relating ideas, Use of evidence, Interest in ideas; *Strategic:* Organized studying; Time management; Alertness to assessment demands, Achieving , Monitoring effectiveness; *Surface:* Lack of purpose, Unrelated memorizing, Syllabus-boundness; Fear of failure). This survey tool is publicly available (Centre for Research on Learning and Instruction 1997), although it can only be used where the educational language is English. Therefore the ASSIST has been translated into Italian, Spanish and Turkish for this study to be used in Italy, Argentina, and Turkey respectively.

A demographic survey was also developed to gather information regarding the demographics of students (e.g. gender, age, language spoken at home, their parent's educational background), their educational background (e.g. where they completed high school, what kind of high school they attended), their current circumstances (e.g. where they live, whether they work), their future educational plans (e.g. whether they intend to enroll a higher degree) and finally after providing a brief description of three learning approaches (deep, surface and strategic), we asked students to identify their learning approach for the statistics unit they were studying and write a few sentences why they use this specific approach in this statistics unit. In each country, minor modifications were made to the demographic survey to address the differences in high school and tertiary education systems.

In all countries, we surveyed students towards the end of their study period so that they were exposed almost all the concepts to be covered in the semester, they would have been assessed in some aspects of their learning, and they would have been given feedback on their assessment tasks.

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