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Effectiveness of concept maps in economics: Evidence from Australia and USA

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Abstract

This paper evaluates the effectiveness of concept maps as a teaching and learning tool in university level Principles of Microeconomics courses in Australia and USA. Concept mapping was incorporated in the teaching material in both courses at different countries and, at the end of the semester, the students completed a survey regarding the use, effectiveness, and accessibility of concept maps. It was revealed that USA students valued concept maps relatively less than Australian students. We provide two explanations: First, there may be differences in prior training in economic and/or concept mapping between Australian and USA students. Second, there were significant differences in class structure, which caused the link between collaborative study-groups and the construction of concept maps to not be maintained in the case of USA students.

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As early as 1965, a concern was developing within the economics profession that instructors were not “getting through” to most students studying economics in universities. Economics students often had trouble applying the strictly analytical material to real world applications (Herrnstadt, Fusfeld, & Fels, 1965). Methods used in economics instruction have been surprisingly resistant to change since Herrnstadt et al. (1965) noted the problem. In universities, economics instructors predominantly use the lecture, with the support of blackboards/whiteboards and/or overheads, textbooks, and classroom discussion. The standard approach in universities to teaching principles of microeconomics has been composed of two one-hour lectures and a one-hour tutorial session (a.k.a. ‘recitation’ in USA). The tutorials are often organized as ‘mini-lectures’ and are presented by a graduate teaching assistant. Becker and Watts (1996) found evidence that economics instructors rarely deviate from this approach, relying on it over 80% of the time. This approach has been under increasing scrutiny, as it has resulted in a stagnation of positive learning outcomes (Marangos, 2000).

Carlson and Skaggs (2000) argued that active learning strategies encourage students to engage in critical thinking, resulting in better understanding of concepts. Active learning strategies include any classroom activities that require students to actively engage the material. Copying notes while an instructor lectures is the quintessential passive strategy. Active learning strategies in economics courses might include group activities or games where the student takes part in a simulated market transaction. While there are many active learning techniques that would probably improve the teaching of microeconomics, we focused on concept maps because of the extensive literature, which

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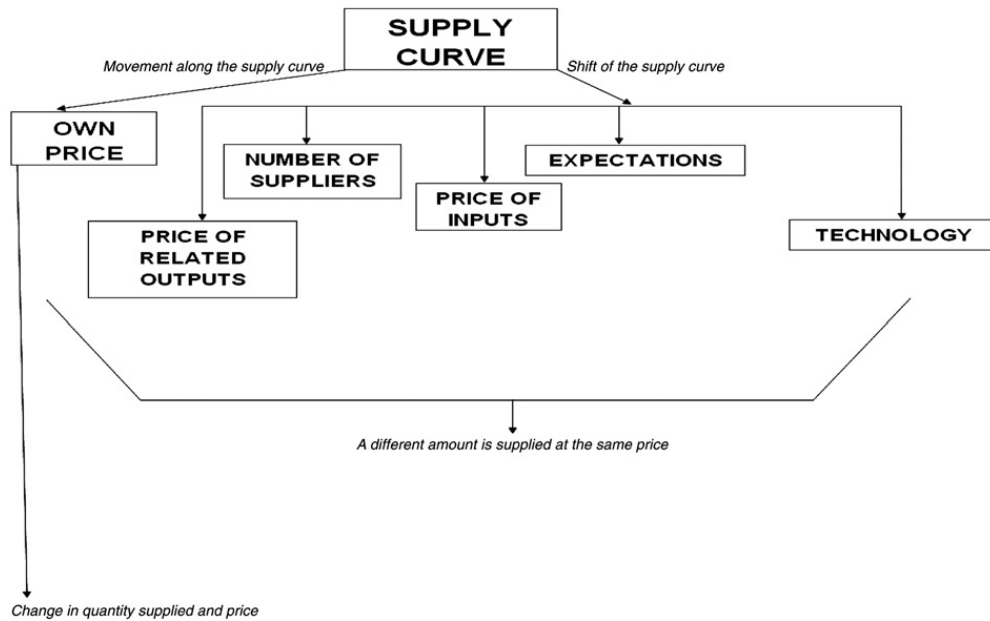


Fig. 1.

documents their success in other fields of study and the success experienced by the principal investigator in introducing them to Australian students (Marangos, 2003).

A concept map is a special form of a web diagram for exploring knowledge and gathering and sharing information. Concept mapping is the strategy employed to develop a concept map. A concept map consists of nodes or cells that contain a concept, item, or question, and links. The links are labeled and denote direction with an arrow symbol. The labeled links explain the relationship between the nodes. The arrow describes the direction of the relationship and reads like a sentence. In the following, two examples of concept mapping are provided. The first concept map links the

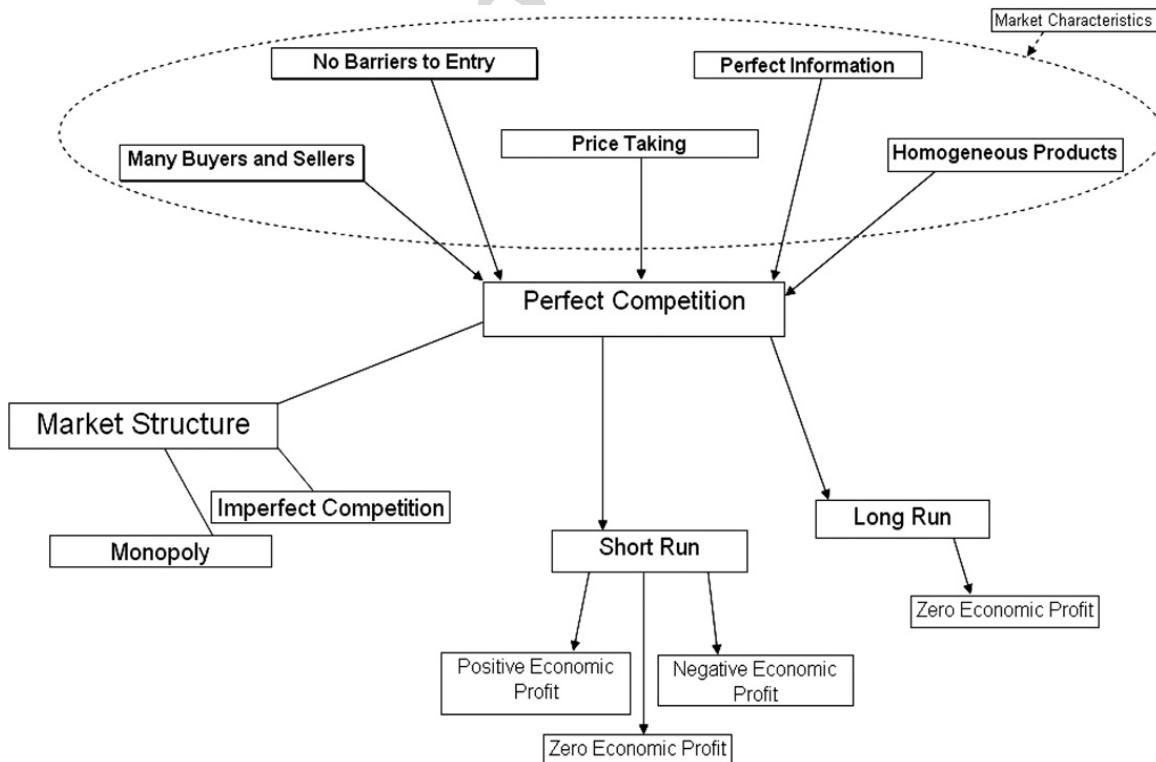


Fig. 2.

factors that influence the supply curve, while the second concept map links the concepts associated with perfect competition as a market structure. While the construction of a concept map involves labeling the links to explain the relationship between the nodes, the examples provided do not include the links, as it was the responsibility of the students to articulate the links during their presentations (Figs. 1 and 2).

Concept mapping has distinct advantages over traditional teaching methods. Concept mapping facilitates meaningful learning and, as a result, higher scores have been recorded in student tests when concept maps were used in the classroom (Fraser & Edwards, 1985; Novak, Gowin, & Johansen, 1983). Concept maps also perform a social function. That is, the construction of a concept map brings people together if the instructor structures concept mapping as a cooperative group activity (Marangos, 2000; Roth & Roychoudhury, 1992). The literature regarding the use of concept mapping for educational purposes has generally been positive. Unfortunately though, the majority of this research has been restricted to introducing concept maps in science courses, with the exception of Marangos (2003) who introduced concept maps in economics teaching. Marangos (2003) studied the use of concept maps for introductory microeconomics instruction in Australia and found that students responded positively to the use of concept maps during lectures and tutorials. Only a few students, however, used concept maps to help study for exams or in other subjects. This paper extends the results of the Marangos (2003) paper.

It should be highlighted that the project was experimental in nature in the context that the comparative approach adopted was ad hoc and unplanned. The principal investigator was teaching at Monash University in Melbourne, Australia, and then unexpectedly relocated to Colorado State University in Fort Collins, Colorado. The unplanned implementation of the project in the USA reduced the possible controls available; however, an attempt was made to simulate as much as possible the teaching conditions in Australia, so results could be meaningfully compared, at least qualitatively. We are de-emphasizing the comparison between the two groups of students and prefer to emphasize the uniqueness of each case. We believe that the experiment is interesting, as it provides an indication of the effectiveness of the new teaching concept mapping methodology in economics not applied before by incorporating survey results of two different countries – Australia and USA – and the conclusions invite further research.

To our knowledge, there have been no studies investigating the effectiveness of concept maps in economics among students from different backgrounds and locations. This paper reports on the impact of concept mapping on Principles of Microeconomics university students in two different countries, Australia and USA, to determine their effectiveness as a teaching and learning tool. It should be noted that concept mapping can be used to enhance students' understanding of a subject and as an assessment tool for instructors to test student mastery of the material. In our experiment, we focused on both uses explicitly. The learning outcomes sought in our study of introducing concept maps in economics classes are for students to: 1) think abstractly about the material and be able to apply theoretical concepts to their everyday lives, 2) retain economic concepts long term, and 3) experience improved attitudes about the usefulness and accessibility of economics. These course-related goals are consistent with the generic learning outcomes (also called graduate attributes) of knowledge and understanding, skills, attitudes and values, enjoyment, inspiration and creativity, action, behavior and progression.

1. Introducing concept maps in Principles of Microeconomics.

The principal investigator was teaching at Monash University in Melbourne, Australia, and then relocated to Colorado State University in Fort Collins, Colorado. At Monash University, the principal investigator initiated a project aimed to introduce concept maps in the Principles of Microeconomics lectures and tutorials in the second semester, 2001. The introduction of concept maps into tutorials was combined with the already established collaborative problem-solving tutorial sessions. One hundred and twenty students participated in the project and responded to the survey. After the relocation of the principal investigator to Colorado State University, the same project was initiated in Spring 2004 and 101 students responded to the survey.

Students were introduced to concepts maps in the first lecture. The lecturer explained what a concept map is, the usefulness of a concept map and how to construct a concept map. Students were also directed to the hard copy of the syllabus where the conduct of the tutorial was explained, followed by a thorough account of concept mapping. In the first tutorial, the teaching assistant also emphasized the usefulness of concept maps and the incorporation of concept mapping in the tutorial exercises. A set of homework questions was provided in the syllabus. Most importantly, the first question of the weekly homework questions involved the construction of a concept map. The student would construct their concept map from the concepts provided by the question before the class in a presentation and their fellow

Table 1
Student reaction to concept maps (in percentage)

	Always true								Never true	
	A		B		C		D		E	
	Monash	CSU	Monash	CSU	Monash	CSU	Monash	CSU	Monash	CSU
1. Concept maps were great	20	4	35	40	35	39	8	10	2	8
2. Concept maps were easy to construct	5	7	42	32	30	43	19	12	4	7
3. Concept maps were easy to understand	20	18	47	36	24	32	9	11	0	8
4. Concept maps were time consuming to construct	13	11	35	29	35	32	15	29	2	4
5. When I tried to justify my ideas during concept mapping, I found that I didn't understand a concept completely	10	8	25	39	39	36	21	15	5	3
6. By concept mapping, I can express complicated ideas in a simple way	19	10	40	36	29	33	9	17	3	5
7. Constructing concept maps works best in a group	26	19	34	31	28	36	9	9	3	6
	True		False		Not applicable					
	Monash	CSU	Monash	CSU	Monash	CSU	Monash	CSU	Monash	CSU
8. Concept maps helped me learn or remember concepts.			75	60	22	35	3			6
9. You really need to understand the work in order to construct a concept map.			83	72	17	28	0			0
10. Concept maps made me think of links that I never thought existed.			61	49	36	45	3			7
11. I used concept maps to clarify ideas that were complicated and confusing			50	32	45	56	5			13
12. I only constructed concept maps when it was required as "Homework" to do so.			69	72	28	24	3			6
13. I used concept maps to help with my mid semester exam preparation			38	45	57	52	5			4
14. I will be using concept maps to help me study for the final exam.			65	52	30	46	5			3
15. I have found myself using concept maps in my other subjects			29	8	66	83	5			10
16. I believe concept maps did aid in my learning.			71	58	25	35	4			8
17. I will use concept maps in future economic classes			62	23	26	60	2			18

students would comment, agree or disagree with the linkages, or provide their own alternative concept map. Through this process, the class constructed a concept map, making the process of learning and understanding a productive and interesting exercise as a result of discussing the links between concepts and finalizing the construction of a "class" concept map.

In the study presented in this paper, we combine both the teacher and student constructed concept maps. Our method began with the instructor introducing the concept map into the microeconomics lecture. Then, during the tutorials, students collaboratively constructed concept maps as part of the set exercises. At the end of the semester, students were surveyed regarding the use, effectiveness and accessibility of concept maps.

2. Empirical results

Students studying Principles of Microeconomics in the Department of Economics at Monash University at the Clayton campus were asked to complete a questionnaire in the last week of lectures. We received 120 valid student responses. The responses indicated that 57% were male and international students were 42% of the sample population. Students from an English speaking background and non-English speaking background were equally distributed. The subject was compulsory for 75% of the students and for 25% it was an elective. The results are demonstrated in the following table (Table 1).

For the first seven questions, students could respond by choosing between the options A (always true), B, C, D and E (never true). The remaining ten questions were true/false questions. Overall, students' responses were very positive at Monash University. It would be useful to first establish the effectiveness of concept maps using quantitative evidence before turning to comparative issues. Question 8 (Concept maps helped me remember concepts) with a true response 75%, question 10 (Concept maps made me think of links that I never thought existed) with a true response 61% and question 16 (I believe concept maps did aid in my learning) with a true response 71% are used to address the effectiveness of concept maps for Australian students.

In the first question "Concept maps were great" the positive response (A+B) received 55% and in the second question, "concept maps were easy to construct", 47 percent answered positively. In the question, "Concept maps were

easy to understand”, 67% agreed with this statement, while 17% answered negatively to the question that “concept maps were time consuming to construct”. Thirty-five percent of the students found that, during concept mapping, they did not understand the concept completely, and 59% of the respondents found that through concept mapping they could express their ideas in a simple way. Sixty percent of the students reaffirmed the argument that constructing concept maps is more effective in groups.

In the true/false questions, students’ responses registered as true (50% or over) in nearly all the questions. Question 9, “You really need to understand the work in order to construct a concept map”, received 83% as a true answer, which was the most common true response. Question 13, “I used concept maps to help with my mid-semester exam preparation” received only 38% and Question 15 “I have found myself using concept maps in my other subjects” received only 29% agreement. Questions 13 and 15 were the only questions that received less than 50% true answer. In sum, the average positive response for questions 1–7 was 53%, and for questions 8–17 the average true response was 60.3%.

Students studying Principles Microeconomics in the Department of Economics at Colorado State University were asked to complete a questionnaire in the last week of lectures. We received 101 valid student responses. Due to privacy restrictions, we were unable to collect demographic data on our sample. The results are demonstrated in the aforementioned table. Overall, students’ responses were somewhat positive. Questions 8 (Concept maps helped me remember concepts) with a true response 60%, question 10 (Concept maps made me think of links that I never thought existed) with a true response 49% and question 16 (I believe concept maps did aid in my learning) with a true response 58% are used to address the effectiveness of concept maps for USA students.

In the first question, “Concept maps were great”, the positive response (A + B) received 44%. On the second question, “concept maps were easy to construct”, 39 percent answered positively. In the question, “Concept maps were easy to understand”, 54% agreed, while 33% answered negatively to the question that “concept maps were time consuming to construct”. Forty-seven percent of the students found that, during concept mapping, they did not understand the concept completely; 46% of the respondents found that through concept mapping they could express their ideas in a simple way. Half of the students reaffirmed the argument that constructing concept maps is more effective in groups.

In the true or false questions, CSU students’ responses registered as true, on average, on 5 out of the 10 questions. Question 9, “You really need to understand the work in order to construct a concept map” and Question 12 “I only constructed concept maps when it was required as “Homework” to do so”, both received 72 percent as a true answer. Question 13, “I used concept maps to help with my mid semester exam preparation” received 45% true. Question 15, “I have found myself using concept maps in my other subjects”, received only 8% as a true answer. Questions 10, 11, 13, 15 and 17 were the questions that were marked true less than half the time. In sum, the average positive response for questions 1–7 was 45% and for questions 8–17 the average true response was 47%.

Comparing the results, Australian students found that concept maps were more effective than the USA students did. In question 16 (I believe concept maps did aid my learning) 71% of the Australian students versus 58% of US students responded positively. In question 17 (I will use concept maps in future economic classes) 68% of the Australian students versus only 23% of US students responded positively. These two questions provide a springboard into the comparative differences which provide the motivation for looking at differences in the remaining questions and for raising some of the structural issues that differ between the two classes.

Australian students reported a higher positive result for each question on part one, question 1–7. Regarding the true and false questions 8–17, CSU students had a larger true response only for questions: 12. “I only constructed concept maps when it was required as “Homework” to do so”, and 13. “I used concept maps to help with my mid semester exam preparation.” How can we explain this discrepancy? Why did more Monash students than Colorado State students agree that concept maps helped their learning? Two possibilities came to mind. First, there may be differences in prior training between Australian and USA students. Our literature review shows that prior training in economics or exposure to concept maps by one group would result in better learning outcomes. Perhaps first year college students in Australia have more preparatory training in economics or concept maps. Second, there were significant differences in class structure. At Monash University, the tutorial class had a maximum capacity of 20 students. The first tutorial was designed to allocate students into their groups. The students were then to work with their group throughout the semester and complete designated homework tasks, such as tutorial group presentations of homework and group class tasks. A set of homework questions, which were to be presented by each student group to the tutorial class as their turn arose, was provided by the syllabus. As such, student groups had to meet and prepare their presentation before the class. Most importantly, the first question of the weekly homework questions involved the construction of a concept map. The student group presenting their answers which was part of the assessment procedure would construct their concept map

as a result of group activity. This arrangement of tutorial work was not possible at CSU. Each tutorial class was enrolled at a capacity of 60 students. Students were asked to voluntarily form groups and prepare the homework question and, within those questions, the concept map of the week. Constructing the class concept map with 60 students in the class is not as productive as having 20 students in the class (as with Monash). To “ensure” that students were encouraged at CSU to form groups and study together, an exercise including constructing a concept map was part of the test questions. These maps were included in the class tests (5 tests in total), and students were forewarned that this material would be represented on the test. This explains the high true answer for CSU students at question 13. “I used concept maps to help with my mid semester exam preparation”. From the other responses, it is obvious that the voluntary study groups were not formed and, as such, the link between collaborative group work and the construction of concept maps was broken. This explains the lower effectiveness of concept maps for CSU students. Even the students recognised this, as in the question 7. “Constructing concept maps works best in a group,” 50% of the students replied positively. However, no structural process in forming and maintaining study-groups was provided. A very interesting response of CSU students comes from question 17. “I will use concept maps in future economic classes”, which had only a 23% true response (in comparison to 62 percent by Monash students); Australian true response 2.6 times larger, in percentage terms.

Hence, the Australian students probably spent more time creating the individual maps and spent more time in the tutorial constructing a group concept map, which illustrated a shared understanding of the content by the tutorial group. By spending more time using the maps, the students may have come to appreciate the learning advantages of the maps. In contrast, the USA students only had voluntary study groups and the link between collaborative group work and construction of the concept map was broken. It is difficult to compare the two groups when this task was changed.

There were a number of controls: students from both universities were taught by the same instructor, using the same teaching material (notes, textbook, exercises, tests and final exam) and the same teaching philosophy based on concept maps. It should be pointed out that the teaching assistants who conducted the recitation classes were different. This was offset as much as was feasible: the same instructor and principal investigator provided to both teaching assistants the same training in the concept map technique and the teaching philosophy of the course based on concept mapping.

In sum, there were enough differences between the courses that we were uncomfortable making hard quantitative comparisons of the results, but we felt that the classes were sufficiently similar to support anecdotal discussion of the results and to expose large differences in student attitudes that do not require statistical analysis to observe. At the end, we are de-emphasizing the comparison between the two groups of students and prefer to emphasize the uniqueness of each case. The experiment should be treated as useful pilot project. The data are only self-reports, there were insufficient controls for rigorous analysis and there were differences between the way the courses were taught. The information accumulated from the pilot provides the basis for a better-controlled study.

3. Conclusion

The students studying Principles of Microeconomics in the Department of Economics at Monash University in second semester 2001, responded quite positively to the introduction of concept maps in lectures and tutorials. It appears, though, that only a small percentage of Monash students used concepts maps as a tool for exam preparation, and an even smaller percentage used concept mapping in other subjects. Thus, while Monash students found concept mapping as a tool for understanding concepts in economics, they did not extend the effectiveness of this tool in exam preparation and in other subjects. Strangely enough, the applicability of concept maps to other subjects was questioned by the Monash students studying economics.

The students studying Principles of Microeconomics in the Department of Economics at Colorado State University in spring semester 2004, also responded positively to the introduction of concept maps in lectures and tutorials. However, the CSU students valued the concept maps relatively less, compared with the Monash students. We posited two possible explanations for this, and feel that both are plausible. We are particularly intrigued with the second explanation, which was that the link between collaborative student study-groups and the construction of concept maps was broken for the CSU students because of class size. This would explain the differences for the student perception of the effectiveness of concept maps. More study is needed, using USA students in smaller classes to test this hypothesis.

This could have substantial consequences for the development of new teaching methodologies in economics. As shown in the literature, recent advances in teaching methodology revolve primarily around deep learning, active learning, and collaborative study. A major concern for the implementation of new teaching methodologies is the size of classes, as large classes do not allow a large degree of freedom. However, in an environment of strict budget constraint

for higher education in Australia and the USA, the reduction of class size is not foreseeable in the near future. This is very likely to create obstacles in the implementation of new teaching methodologies that are not “cost efficient”, but have a high in return for student learning and performance.

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