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The Concept-Mapping Method as a Meaningful Learning Strategy for International Students in an Introductory Economics Course

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ABSTRACT

International students' low academic achievement is a concern, as language and cultural differences contribute to poor achievement and declining retention. The concept-mapping method, a note-taking strategy, may promote meaningful learning for these students. Using a mixed-methods comparative design, this study examined the effects of concept mapping on international students' learning in economics and their perceptions. One class of international students (n = 26) used concept mapping; a comparison class of English-speaking students (n = 25) did not. Achievement was measured through quizzes, midterms, and concept-map rubric scores; motivation was measured with a modified MUSIC inventory; and 15 intervention students were interviewed. Both groups showed a positive trend in quiz and midterm scores; the intervention group rated the course significantly more interesting (d = .58); the groups did not differ significantly in classroom participation; and concept-map scores correlated moderately with final grade (r = .65, p < .05). Six interview themes emerged, including students' prior knowledge, perceived advantages, ambivalence, and willingness to use the strategy in the future. The study suggests that instructors teach concept mapping as an effective note-taking method and consider it as an alternative assessment for international students.

Keywords: academic performance; assimilation theory; concept mapping; economics education; international students; meaningful learning; mixed methods; note-taking strategy

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INTRODUCTION

International students—those who travel to a country other than their own to pursue higher education, typically on a temporary student visa—are a growing presence in U.S. colleges and universities: in the 2015–16 academic year, their numbers surpassed one million for the first time (Redden, 2016). Yet as their numbers grow, retention remains a concern: many international students struggle academically and return home without completing their degrees (Fischer, 2014; Meikrantz Sharp et al., 2026; Wecker, 2017). Meikrantz Sharp et al. (2026) suggested that international students in the U.S. earned lower grade point averages and were retained at lower rates than domestic peers, with belonging and self-efficacy significant predictors of achievement. Research traces these academic struggles to three main learning challenges—limited English proficiency, cultural differences that affect academic performance, and a lack of effective learning strategies (Ching et al., 2017; Huang, 2012; Kuo, 2011; Valdez, 2015; Wu et al., 2026).

The first two challenges—limited English proficiency and cultural differences—are well documented. Standardized tests such as the TOEFL do not capture the academic English students need once they arrive, and many test-preparation programs build test-taking skills rather than academic language (Kuo, 2011), so students with high proficiency scores still face substantial academic difficulty. Cultural differences compound the problem: many international students from Asian countries consider asking questions or interacting with professors during lectures impolite or disrespectful, making them less likely to participate in class and potentially affecting their learning (Kuo, 2011).

The third challenge—a lack of effective learning strategies—is the focus of this study. Note-taking is a common study strategy: in a survey of 577 college students, nearly all reported taking notes and most considered note-taking important to their success, yet a majority wished they had better note-taking skills (Morehead et al., 2019). Most students rely on rereading and on bulleted lists or outlines, strategies that do not elaborate the relationships among ideas or integrate new information with prior knowledge and therefore do not promote meaningful learning (Novak & Gowin, 1984). For international students, these ineffective strategies contribute to low academic achievement, which raises concerns about their retention and graduation rates in the United States (Fass-Holmes, 2016; Rust & Singh, 2021). These challenges underscore the need to identify effective strategies to support international students' academic performance.

Note-taking strategies such as the concept-mapping method may enhance international students' knowledge acquisition by providing a learning tool that promotes meaningful learning (Novak, 2002). A concept map is a graphical tool that organizes and represents knowledge visually, displaying the relationships among facts, concepts, and ideas rather than presenting them as written sentences. Empirical studies suggest that using concept maps as an intervention can improve academic performance and classroom participation (Benni et al., 2025; Casteleyn et al., 2013; Evans & Jeong, 2023; Evrekli et al., 2009). Much of this research, however, has been conducted in nursing, second-language, and science settings; only a limited number of studies have examined undergraduate international students, especially in Business and Management, or in economics specifically (Burdina, 2015; Marangos, 2003; Marangos & Alley, 2007). Using a mixed-method comparative design, this study examined whether international students could benefit from the concept-mapping strategy to support their academic performance in an introductory economics course, as well as their perceptions of using the strategy.

LITERATURE REVIEW

Assimilation Theory and Concept-Mapping Theory

The study was guided by two theories: Ausubel's (1963) assimilation theory and Novak's concept-mapping theory, first developed in 1972 (Novak & Musonda, 1991). Ausubel distinguished meaningful learning from rote learning. In meaningful learning, individuals connect new information to prior knowledge stored as schemata in long-term memory; in rote learning, information is merely memorized without being linked to existing knowledge (Ausubel, 1963). Ausubel described four assimilation modes—

subsumption, superordinate learning, progressive differentiation, and integrative reconciliation—and held that meaningful learning requires three conditions: relevant prior knowledge, meaningful learning material, and the learner's own decision to relate the new material to what he or she already knows. To bridge new material and prior knowledge, Ausubel proposed advance organizers, and the concept-mapping strategy is one such advance organizer.

Novak built on Piaget's constructivism and Ausubel's assimilation theory to develop concept-mapping theory in 1972 (Novak & Musonda, 1991; Novak, 2002), with meaningful learning as its central aim. A concept map externalizes a learner's cognitive construction, allowing both learner and instructor to recognize what has been learned, and it can therefore serve as an evaluation tool that reveals misconceptions (Novak & Cañas, 2006; Novak & Gowin, 1984). Novak (2002) identified four central elements of a concept map: concepts, propositions, cross-links, and a hierarchical structure. Taken together, the two theories frame the present study: assimilation theory specifies that meaningful learning requires relevant prior knowledge but does not, by itself, provide a way to evaluate or correct the accuracy of that prior knowledge, whereas the concept-mapping strategy may help address this gap by making a learner's knowledge visible and open to correction (Cañas et al., 2003).

Learning Challenges of International Students

International students' retention is shaped by several factors, but their academic struggles are central, and those struggles trace to limited English proficiency, cultural differences, and a lack of effective learning strategies (Ching et al., 2017; Kuo, 2011; Valdez, 2015). English proficiency involves more than a test score: international students who received teacher-centered, grammar-focused instruction often have more difficulty with speaking because active production was neglected in their prior learning (Cheng & Erben, 2012; Heng, 2016; Wolf & Phung, 2019). They may also find the volume of reading demanding and need more time than native-speaking peers to process complex texts (Huang, 2012; Jiang et al., 2017). Because academic reading may draw on language-processing strategies that these students have had fewer opportunities to develop (Birch & Fulop, 2021), effective learning strategies aligned with meaningful learning may be especially valuable for them (Ching et al., 2017; Kuo, 2011). Recent research suggests that these challenges persist: studying Chinese international students at universities in the United States, the United Kingdom, Australia, and Canada, Wu et al. (2026) found that limited foreign-language competence and culturally shaped learning habits—including a reluctance to ask questions or express disagreement rooted in values such as mianzi (face), modesty, and the teacher's authoritative role—continued to hinder their learning and their transition from teacher-centered to student-centered classrooms. A content analysis of 470 dissertations on international students (2022–2024) showed language barriers and academic adaptation to be persistent challenges (Bista et al., 2026).

Benefits of Concept Mapping and Its Use as an Evaluation Tool

Across disciplines, the concept-mapping strategy has been found to promote meaningful learning, reading comprehension, critical thinking, and classroom participation (Akinoglu & Yasar, 2007; Cardellini, 2004; Kern et al., 2006; Mueller et al., 2002). Two strands of this evidence are especially relevant to international students. First, studies of English-as-a-foreign-language and English-as-a-second-language learners have shown that concept mapping improves reading comprehension more than traditional reading strategies, with the largest gains for lower-proficiency learners (Liu et al., 2010; Rassaei, 2019; Soleimani & Nabizadeh, 2012). A recent experiment reports this comprehension gain persisted two weeks after the activity (Khudhur et al., 2026). Second, concept mapping has been linked to gains in critical thinking and meaningful learning, including in nursing education (Bilik et al., 2020; Lee et al., 2013; Wong, 2018).

Concept maps also serve as an evaluation tool. Because conventional achievement tests reward accurate reproduction of information and can encourage surface learning, instructors are advised to use assessments—such as concept maps—that reveal students' understanding and cognitive structure (Entwistle, 2000; Novak & Gowin, 1984). A student's map exposes how knowledge has been organized

and where links are missing or faulty, a higher-order activity in Bloom's (1956) terms. Several systems have been developed to score maps, ranging from traditional approaches that count valid concepts and links to holistic approaches that judge a map's overall breadth, organization, and correctness (Bartels, 1995; Cronin et al., 1982; McMurray, 2014; Novak & Gowin, 1984). The present study used McMurray's (2014) holistic rubric, which has also been applied to evaluate students' maps in other fields (Abd El-Hay et al., 2018; Farrag, 2017).

Recent research reinforces both functions—concept mapping as a tool for meaningful learning and as a means of assessing understanding. In a university mathematics course, Evans and Jeong (2023) found that the concept-mapping performance of 219 undergraduates explained a statistically significant share of the variance in their final-exam scores—and in their assessment self-efficacy—beyond what conventional coursework predicted, suggesting that concept maps capture aspects of conceptual understanding that traditional assessments do not detect. In a randomized controlled trial, Disch et al. (2024) showed that presenting a concept map alongside a complex scientific text produced significantly greater basic-level knowledge construction than the text alone, consistent with the assimilation account in which learners integrate new information into their existing knowledge. A 2025 systematic review of concept mapping in undergraduate pharmacology education reached a convergent conclusion, reporting consistent gains in deep learning, academic performance, and student perceptions across the studies reviewed (Benni et al., 2025).

Concept Mapping in Economics

Within economics, a small body of research has examined concept mapping in introductory courses. For example, Marangos (2003) surveyed 120 students in a first-year microeconomics course in Australia—42% of them international—and found that most regarded concept maps as an effective, practical aid for comprehension and collaborative learning; Marangos and Alley (2007) reported similar perceptions among 101 students in a U.S. microeconomics course. Burdina (2015) introduced a Conceptual Chapter Map—a variant of the traditional concept map that highlights the links among concepts—in an introductory economics course enrolling a large proportion of international students, and recommended further research on the relationship between concept-map effectiveness and learning outcomes. Concept mapping in economics has attracted little empirical attention since, and few of the existing studies have examined international students; the present study extends this line of research by examining international students' use of concept mapping, their perceptions of it, and the relationship between concept-map quality and course performance in an introductory economics course.

Research Questions

This study addressed seven research questions. The first six drew on quantitative data; the seventh drew on qualitative interview data to explore students' perceptions of using the concept-mapping strategy.

1. To what extent is there a difference in the trend of quiz scores of weeks 1, 4, 8, and 12 between students who were in the intervention group and those who were in the comparison group?
2. To what extent is there a difference in the trend of two midterm grades between students who were in the intervention group and those who were in the comparison group?
3. To what extent is there a difference of classroom participation between students who were in the intervention group and those who were in the comparison group?
4. To what extent is there a difference between the comparison group and the intervention group in terms of the students' rating of their success, interest, and usefulness in learning?
5. To what extent is there a difference in the rubric scores for the concept-mapping assignments of weeks 4, 8, and 12 in the intervention group?
6. To what extent is there a relationship between the concept-mapping total scores with final grade?

7. What are the perceptions of international students regarding the use of concept mapping in their course?

RESEARCH METHOD

Research Design

The study used a mixed-method, comparative design with a non-equivalent comparison group. Quantitative measures addressed the relationship between the technique and performance and perceptions; qualitative interviews addressed students' use and experience and enriched the quantitative findings. The independent variable was the concept-mapping intervention; the dependent measures were quiz, midterm, and final grades, concept-map rubric scores, and MUSIC Inventory scores. The quantitative and qualitative strands were collected over the same semester and integrated during interpretation, a convergent mixed-methods design.

Setting and Participants

The site was a private university on the West Coast with about 10,600 students, roughly 14% of them international, from 102 countries. Two online sections of Principles of Microeconomics ran in Fall 2020 with the same instructor. The intervention section enrolled international students living in their home countries; the comparison section enrolled domestic students. After accounting for consent, withdrawals, and missing records, 26 intervention students and 25 comparison students participated. The intervention group was 100% international, predominantly of Chinese family origin and Mandarin first language, and 96% business majors; the comparison group was predominantly domestic and English-speaking, and 88% business majors. Table 1 summarizes the groups.

Table 1
Participant Characteristics by Group

Characteristic	Intervention (*n* = 26)	Comparison (*n* = 25)
International status	100%	20%
Predominant ethnicity	Asian (92%)	White / mixed
Predominant family origin	China (65%)	United States (20%) / mixed
First language	Mandarin (65%)	English (52%) / mixed
Business majors	96%	88%
Age range	18–24	18–24

Course Description

The course was Principles of Microeconomics, a four-unit introduction covering the laws of supply and demand, elasticity, the production-possibilities frontier, market structures, and opportunity cost. Because of the pandemic, both sections met synchronously on Zoom for 75 minutes twice weekly; the section for international students was scheduled at a time that accommodated the different time zones of students attending from their home countries.

Both sections took the same six attendance quizzes (scored as proportion correct because the number of items varied), two midterms (100 points each), and a final project; both received the same study guides. Because the university canceled final exams during the pandemic, a market-analysis final project served as an alternative assessment: students built a concept map for the market structure (competitive, monopoly, monopolistic competition, or oligopoly) relevant to a firm of their choice. The concept-map activities were a required component for the intervention group and counted for up to four percent of the final course grade.

Measures

Student maps were scored with a rubric adapted from McMurray (2014) on four criteria—breadth, interconnectivity, efficiency of the links, and layout—each rated from Unacceptable to Excellent for a maximum of 20 points (Table 2). Two raters independently scored the maps after a one-hour calibration session and practice-rating activities. Across the 282 maps scored by both raters, inter-rater reliability was moderate to good: the intraclass correlation coefficient (ICC[2,1], absolute agreement) was .68, the quadratic-weighted kappa was .68, and the two raters' scores correlated .77. Raters agreed within two points on 65% of maps and within one rubric band on 96%, with no systematic difference between raters. Each map's final score was the mean of the two raters' ratings.

Table 2
Concept-Map Scoring Rubric and Criterion Definitions

Element	Excellent (5)	Good (4)	Acceptable (3)	Unacceptable (0–2)
Breadth of net	Important concepts included; domain described on multiple levels.	Most important concepts included; domain on a limited number of levels.	Some important concepts missing, or domain on only one level.	Minimal concepts; many important ones missing.
Interconnectedness	All concepts interlinked with several others.	Most concepts interlinked with others.	Several concepts linked to others.	Few concepts related to others.
Efficient links	Link types distinct, clearly describe the relationship, used consistently.	Most links distinct and present varied relationships; fairly consistent.	Several links synonymous, weakly discriminate concepts; inconsistent.	Links synonymous or vague; not distinct from other associations.
Layout	Single page; multiple clear hierarchies; well laid out; relevant linked examples.	Single page; several clear hierarchies; reasonably laid out.	Not on a single page; unclear hierarchies; poorly laid out.	Not on a single page; confusing; no hierarchical organization.

Note. Adapted from McMurray (2014). Each of the four criteria is rated from 0 to 5 (Unacceptable to Excellent), for a maximum of 20 points.

Students' perceptions were measured with a modified MUSIC Inventory of Academic Motivation (Jones, 2009, 2017), using 15 of the original items on a six-point Likert scale (1 = strongly disagree to 6 = strongly agree) and capturing three components: usefulness (the coursework is useful to the student's future), success (the student can succeed at the coursework), and interest (the instructional methods and coursework are interesting). Mandarin and English versions were available, the translation verified by a native Mandarin graduate student. In prior validation, the three subscales showed strong internal consistency: for the Mandarin version, Cronbach's α = .89 (usefulness), .87 (success), and .93 (interest) (Jones, Li, & Cruz, 2017); for the English version, α = .96 (usefulness), .93 (success), and .95 (interest) (Jones & Skaggs, 2016). In the present sample, the three subscales again showed high internal consistency (intervention n = 26: usefulness α = .91, success α = .89, interest α = .91; comparison n = 24: usefulness α = .90, success α = .92, interest α = .92).

Procedures

The university's institutional review board approved the study, and the department chair and instructor consented before any contact with students; participation was voluntary and confidential. Before the semester, the researcher delivered a one-hour concept-mapping training to the instructor over Zoom, using a PowerPoint that covered what concept mapping is, its advantages for academic learning, the types of concept maps, and how to construct one; the session was recorded. In Week 1, the instructor introduced the method to the intervention section and shared the recorded training video with students. The researcher then conducted a concept-mapping training during class and led a concept-mapping activity to ensure that students understood how to develop a concept map. Students reviewed the video on their own and practiced the technique over the following weeks. Across the term, students completed six concept-mapping assignments tied to specific chapters, embedded in the regular problem-solving homework rather than assigned as a separate exercise; a representative prompt asked students to produce a concept map for each of two chapters (e.g., The Market Forces of Supply and Demand and Elasticity) and to vary the style—colors, shapes, and structure—from a previous map. Both groups completed the MUSIC Inventory at the end of the term, and 15 intervention students who consented completed a 20-minute semi-structured interview.

Data Analysis and Trustworthiness

Interviews were transcribed and analyzed thematically (Creswell & Creswell, 2018) in NVivo 12, a software program for organizing and coding qualitative data. The author coded transcripts iteratively, grouped codes into themes and subthemes, and developed a codebook with code definitions and exemplars. Following Yeh and Inman (2007) and Carspecken (1996), four procedures strengthened trustworthiness. Methods triangulation combined the quantitative and qualitative findings so that each could inform the other. Peer debriefing was provided by a graduate-level teaching assistant, a Chinese international student, who reviewed the transcripts and discussed the analysis with the author. For member checking, three participants reviewed the transcripts and the emerging themes and agreed that they reflected their concept-mapping experience. Finally, to check the coding, a second coder—a doctoral student—independently coded three randomly selected interviews; using the Miles and Huberman (1994) agreement formula, intercoder consistency was 98%. The author's background in language education and experience teaching international students aided rapport and data interpretation but also posed a potential bias that the trustworthiness procedures were intended to manage.

RESULTS

Academic Performance

A repeated-measures analysis of variance (tests of within-subject contrasts) examined the trend of quiz scores across weeks 1, 4, 8, and 12; quizzes were scored as percentages because the number of items varied, and the first quiz served as a baseline. Complete quiz data were available for 16 intervention and 14 comparison students ($n = 30$). Box's M test was not statistically significant, and homogeneity of variances was not violated (Levene's test). There was a statistically significant linear time-by-group interaction, $F(1, 28) = 4.56$, $p < .05$, $\eta p^2 = .14$, and no significant linear main effect of time, $F(1, 28) = 1.34$, $p > .05$. The intervention group had better quiz performance than the comparison group across the four quizzes: the between-group gap was 34% at week 1, 9% at week 4, 15% at week 8, and 10% at week 12, all favoring the intervention group. The intervention group's scores changed little from week to week, whereas the comparison group's fluctuated, and both groups showed a positive trend across the four quizzes.

A repeated-measures analysis of variance examined the trend of the two midterm scores (100 points each), completed by all 26 intervention and 25 comparison students ($n = 51$). Box's M test was not statistically significant. There was a statistically significant linear trend for time, $F(1, 49) = 10.41$, $p < .05$,

$\eta p^2 = .17$, a large effect accounting for 17% of the variance; the linear time-by-group interaction was not significant, $F(1, 49) = 0.18$, $p > .05$. The comparison group scored higher than the intervention group on both midterms, a 3-point difference on the first ($M = 77.80$ vs. 74.96) and a 4-point difference on the second ($M = 83.16$ vs. 79.07), both favoring the comparison group, and both groups' scores increased consistently toward the second midterm. Between-group tests found no significant difference on either midterm (Midterm 1: $t(49) = 0.66$, $p = .51$, $d = 0.19$; Midterm 2: $t(49) = 1.02$, $p = .31$, $d = 0.28$).

Classroom Participation

An independent-samples *t* test compared classroom participation scores, which came from discussion questions (via Zoom chat or verbal prompt) that counted toward participation credit. After removing outliers (three from the comparison group, two from the intervention group), 22 comparison and 24 intervention students remained; the test is robust to the equal-variances assumption because the sample sizes are nearly equal. There was a 6-point difference favoring the comparison group ($M = 42.09$, $SD = 7.15$) over the intervention group ($M = 35.88$, $SD = 15.80$), but the difference was not statistically significant, $tp > .05$, and Cohen's *d*

Perceptions of Usefulness, Success, and Interest

Three independent-samples *t* tests compared the groups on the three MUSIC subscales (Table 3), robust to the equal-variances assumption because the sample sizes were nearly equal. For usefulness, there was little or no difference between the means, $t(49) = 0.58$, $p > .05$, $d = 0.16$ (a very small effect); both groups agreed the coursework was useful for their future learning. For success, there was no significant difference, $t(48) = 0.25$, $p > .05$, $d = 0.12$. For interest, the difference was statistically significant, $t(49) = 1.99$, $p < .05$, $d = 0.58$ (a medium effect): the comparison group's mean fell between somewhat agree and agree ($M = 4.51$), whereas the intervention group's mean was above agree ($M = 5.10$).

Table 3
MUSIC Subscale Comparisons (Six-Point Scale) and Participation

Measure	Comp. *M*	Int. *M*	*t*	*d*
Usefulness	5.11	5.25	0.58	.16
Success	4.90	5.00	0.25	.12
Interest	4.51	5.10	1.99*	.58
Participation (0–50)	42.09	35.88		

Note. $df = 49$ for usefulness and interest, 48 for success, and 44 for participation. The asterisk indicates $p < .05$.

Concept-Map Quality and Final Grade

Map scores were the two raters' mean ratings on the four-criterion rubric (maximum 20 points). Paired-samples *t* tests examined whether rubric scores differed across weeks 4, 8, and 12. Mean scores ranged from 13.51 to 14.51, and the differences between measurements were small—0.79 points between weeks 4 and 8, 0.67 between weeks 4 and 12, and 0.22 between weeks 8 and 12—none statistically significant (week 4 vs. 8: $t(20) = 1.66$, $d = 0.28$; week 4 vs. 12: $t(21) = 1.11$, $d = 0.23$; week 8 vs. 12: $t(22) = 0.44$, $d = 0.07$; all $p > .05$).

A Pearson product-moment correlation examined the relationship between students' total concept-map score and their final grade within the intervention group. The correlation was moderate, positive, and statistically significant, $r = .65$, $p < .05$ (two-tailed); the linear relationship accounted for 42% of the variation in final grade.

How Students Used and Experienced Concept Mapping

Thematic analysis of the 15 interviews produced six themes (Table 4). Perceived advantages dominated, accounting for 76% of coded responses.

Table 4
Themes From Interviews With Intervention Students (n = 15)

Theme	Representative content
1. Prior knowledge and use of the concept-mapping strategies (6%)	93% had learned concept mapping in junior/senior high (English, biology, mathematics).
2. Resource for Concept-map developing (5%)	Textbook (most common), teacher notes, personal notes, lectures, online material.
3. Participant-identified advantages of applying the concept-mapping strategies (76%)	Usefulness (67%), success (19%), interest (14%): previewing lectures, answering the professor's questions, clarifying vague concepts.
4. Reasons for ambivalence about using the concept-mapping strategies (6%)	Concept map presents limited information; course requirement; time-consuming.
5. Additional note-taking strategies used for economics learning (4%)	Bullet-point notes (most common), annotation, highlighting, illustration.
6. Participant-identified willing to use the concept-mapping strategies in the future (4%)	14 of 15 intended to keep using concept mapping in future courses.

Students described using the maps after class to prepare for the next session. Student 7 said:

> "Because it gives me an overall view, it helps me understand the lecture. After class, I create my concept map, and the next time I go back to the course, I can quickly answer the professor's question."

Student 12 said: "Whenever our professor asked some questions, I can find the answer when I draw on the concept maps." Student 2 said:

> "I use this method to take notes every time I finish the class. Then you will be more aware of things that you did not understand or that you still need to ask the teacher. … I have more opportunities to talk to the teacher."

Student 20, describing a rote learning background, said the map let her "catch up on the lecture quickly" when she did not fully follow the content in class. Most students built maps from the textbook first, then from notes.

Students recalled learning the technique in high-school English, biology, and mathematics. Student 21 used maps as a writing outline: "If I don't draw a concept map as my writing outline, I don't know how to start." Student 18 had used maps to find main and supporting ideas in English reading; Student 11 to preview mathematics units; and Student 26 recalled a biology teacher who "created the concept maps to present the content from the textbook," so that "students know what teachers are going to teach immediately once they see the concept maps."

Students differed in where they began. Student 13 built maps from his own notes—"I have my headings and my subheadings, and everything is written. After that, I start to develop my concept map based on my notes"—while Student 20 drew "a big circle first" and then extended it.

Students' perceptions were not uniformly positive. They named three drawbacks: the concept map presented limited information, it was a course requirement, and it was time-consuming. Student 21 said: "I feel a sense of accomplishment after finishing. I think the concept map helps my learning a lot. Now, when I look back, I don't mind if it cost me much time to develop a concept map." Fourteen of the 15 interviewees intended to keep using the technique.

DISCUSSION AND CONCLUSIONS

The quiz results are consistent with prior research that concept mapping supports ESL and EFL learners' performance (Liu et al., 2010; Rassaei, 2019). They diverge in one respect: Liu et al.'s (2010) concept-mapping group did not surpass the comparison group until the strategy had been used for about ten weeks, whereas the present intervention group led from the very first quiz—a difference that may reflect prior experience: 14 of the 15 interviewees had already learned concept mapping in their home countries and brought prior knowledge of economics, giving them longer effective exposure than the participants in that study.

Only a limited number of concept-mapping studies have examined the effectiveness of the strategy on academic achievement tests, and most comes from nursing education. Farrag (2017) demonstrated that a concept-mapping group outperformed the comparison group on the midterm and final exams, and Abd El-Hay et al. (2018) reported a statistically significant improvement in students' knowledge and problem-solving. The intervention group also improved significantly from the first midterm to the second, but the two groups did not differ significantly. The midterms covered multiple chapters under stricter, closed-book conditions in which English proficiency weighed heavily, a traditional assessment format that can disadvantage ESL and EFL students. Even so, the international students performed similarly to their domestic peers, a meaningful and practical finding with real-world implications.

Earlier economics studies inferred a participation benefit from self-report (Burdina, 2015; Marangos, 2003; Marangos & Alley, 2007); the present study tested it directly and found no significant difference between groups, suggesting concept mapping may help international students overcome the language barrier and participate at a level similar to domestic students. Because belonging and academic integration predict international students' persistence (Kaul & Renzulli, 2022), reaching parity on participation may bear on retention and not only on immediate performance. Interviewees from teacher-centered backgrounds described using their maps to find answers and to approach the instructor about unclear concepts, adjusting from passive toward active learning.

Students' perceptions echoed Marangos (2003) and Marangos and Alley (2007): the groups did not differ on usefulness or success, but the intervention group rated the course significantly more interesting and expressed greater learning enthusiasm. In the interviews, all participants identified advantages of the strategy (76% of coded responses), most often its usefulness for comprehension, and 93% said they would use concept mapping in future courses. This willingness exceeded that in the earlier economics studies—62% in Marangos (2003) and 23% in Marangos and Alley (2007)—which may reflect this study's small-group format rather than those studies' large tutorial classes. Some students were also ambivalent, noting that the concept map presented limited information, that it was a course requirement, and that it was time-consuming; these concerns matched what those studies reported and help explain why some still preferred traditional note-taking such as bullet-point notes.

In Farrag (2017) and Abd El-Hay et al. (2018), participants' map scores improved over time; in the present study, however, the intervention group's rubric scores did not change significantly across weeks 4, 8, and 12, remaining in the "good" tier throughout, consistent with 93% having learned concept mapping before college. Finally, concept-map quality correlated moderately and positively with final grade, indicating that the two are related measures of economics learning outcomes; given the small sample, further research is needed to test whether map quality can predict achievement.

IMPLICATIONS

International students who arrive with limited English proficiency and are then left to "sink or swim" are denied the equal educational opportunity affirmed in Lau v. Nichols (1974). As their enrollment grows and retention remains a concern, concept mapping offers a low-cost, transferable way to support

them—not a cure, but one means of providing the equitable learning and assessment resources that educational justice requires. Several practices follow from this study:

- Teach note-taking explicitly. Because ineffective note-taking contributes to international students' academic difficulty (Morehead et al., 2019), instructors and teaching assistants can teach concept mapping as an effective note-taking method. Because some students found that a concept map conveys limited information, they can also point students to software such as CmapTools (Novak & Cañas, 2006), which lets them embed images, graphs, and tables—placing the supply-and-demand model within the map, for instance—so that graphical economics content is not left out.
- Offer concept mapping as an alternative assessment. Differences in prior learning and language ability create assessment challenges when domestic and international students are taught together. Letting students demonstrate their grasp of a conceptual framework through a concept map, rather than only through writing, reduces the language barrier for ESL and EFL students while still showing how they construct knowledge (Novak & Cañas, 2006).
- Carry the strategy across courses. For first-year international students, concept mapping is most useful when sustained across courses; interviewees described using it to preview lectures, organize meaning, and prepare questions in a course taught in their second language.
- Train faculty and build brief mapping into class. Because instructors are often not trained in ESL methods, institutions can provide concept-mapping training for faculty and reserve five to ten minutes at the end of a session for students to map the lecture—recalling key points, reflecting on the learning goals, and surfacing unclear concepts.

A glance at international students' retention rates shows there is still room to improve educational justice in U.S. higher education; nurturing these students' goals by providing equal opportunity is a shared responsibility of students, instructors, and instittions.

Limitations and Future Research

Several limitations of this study suggest directions for future research. Although all intervention-group students were first-year international students, their English proficiency varied, and some had studied economics in China; future studies should assess students' English proficiency and prior economics knowledge before the study begins and treat prior knowledge as a factor in the analysis. Because the concept-mapping assignments were mandatory, future research should include students' willingness to use the strategy as a design factor. It could have students keep a logbook of their learning activities and fatigue to examine whether fatigue affects learning. The study was conducted in two online economics courses during the pandemic. Fully online delivery may have supported the use of concept mapping; however, the benefits could differ when the course is taught in person. Therefore, a replication beyond emergency-remote instruction is needed. All participants were predominantly Chinese students; consequently, participant diversity should be considered. Next, the sample size was small (26 intervention and 25 comparison students), so larger samples are needed to obtain more robust conclusions. Additionally, conducting questionnaire-based studies at a range of institutions and within various economics programs would clarify the extent to which these findings are generalizable. Future research could also examine whether students transfer concept mapping to other subjects, whether faculty-generated concept maps facilitate learning, and whether concept mapping works in courses beyond economics.

Conclusions

This study examined how the concept-mapping strategy affected international students' learning and perceptions in an introductory economics course. Drawing on both the quantitative and qualitative results, three conclusions emerge about the strategy's effectiveness. First, concept maps served as a vehicle to enhance reading comprehension and meaningful learning: as students outlined and defined concepts, the process helped them reflect on and synthesize the material (Novak & Cañas, 2006). Second, concept maps

facilitated classroom participation: by providing a holistic view of the key concepts and subconcepts, they gave students a handy resource for responding to questions during the lecture. Third, the strategy served as an aid to learning motivation, as students identified benefits such as previewing and reviewing lectures, improving their comprehension, and a greater sense of self-fulfillment. The intervention group's quiz performance was higher than the domestic group's, with no significant difference on the midterms; overall, incorporating note-taking tools such as concept mapping into college economics classes may increase international students' classroom achievement.

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