SOCIAL PRISM

Volume 3(8), 2026, 182-196
Online ISSN: 3006-8886
Print ISSN: 3006-8878

The Relationship between Perceived Value of Concept Mapping and Self-Regulated Learning among University Students

Dr. Tayyaba Muhammad Akram[1], Asim Nazir[2], Rabia Hafeez[3], Nighat Sana Kirmani[4], Asfa Akbar[5]

[1]Lecturer, Department of Science Education, Institute of Education and Research, University of the Punjab, Lahore, Pakistan. Email: tayyaba.ier.pu@gmail.com
[2]Assistant Professor, Department of Science Education, Institute of Education and Research, University of the Punjab, Lahore, Pakistan
[3]Academic Affairs Specialist, Syed Babar Ali School of Science and Engineering (SBASSE), Lahore University of Management Sciences (LUMS), Lahore, Pakistan
[4]Assistant Professor, Department of Science Education, Institute of Education and Research, University of the Punjab, Lahore, Pakistan
[5]MPhil Scholar, Department of Advanced Studies in Education (DASE), Institute of Education and Research, University of the Punjab, Lahore, Pakistan

Abstract

This study examined the relationship between undergraduate students' perceptions of the concept mapping strategy (CMS) and their self-regulated learning (SRL). A correlational survey design was used. The sample comprised 533 undergraduate students (177 male and 356 female) enrolled in the Education and Science departments of two public and two private universities in District Lahore, Pakistan, selected through multi-stage sampling. Perceptions of concept mapping were measured with a 30-item questionnaire developed by Mirza and Akram (2022), and self-regulated learning was measured with the 36-item Academic Self-Regulated Learning Questionnaire (ASLQ) developed by Nambiar et al. (2022). A pilot study with 240 students supported the reliability of both instruments (Cronbach's alpha = 0.767 and 0.907). Data were analyzed in SPSS version 21.0 using descriptive statistics, Pearson correlation, independent-samples t tests and one-way ANOVA. Students reported favorable perceptions of concept mapping (mean item score = 4.33 out of 5) and fairly high self-regulated learning (mean item score = 4.20). There was a moderate, positive and statistically significant relationship between CMS and SRL ($r = 0.417$, $p < .001$). No significant differences were found in either variable by gender, university sector, age group or CGPA, and all effect sizes were small. Because the design was correlational, the findings show association rather than cause and effect. Universities may consider teaching concept mapping together with guidance on goal setting and self-monitoring, and experimental studies are needed to test whether concept mapping training improves self-regulated learning.

Keywords: Concept mapping strategy (CMS), self-regulated learning (SRL), undergraduate students, higher education

Introduction

Concept mapping (CM) is a learning method and educational tool that uses diagrams to show how concepts in a body of subject knowledge relate to one another. A good concept map does

Received 08 September 2026; Revised 17 September 2026; Accepted 06 October 2026; Published (online) 10 October 2026

Attribution 4.0 International (CC BY 4.0)

Corresponding Author Email: tayyaba.ier.pu@gmail.com

DOI: https://doi.org/10.69671/socialprism.3.8.2026.283

Online ISSN: 3006-8886
Print ISSN: 3006-8878

not list information at random. It shows the structure of knowledge through propositional statements that link concepts together (Yekta & Nasrabadi, 2004). Learners can build maps entirely with images, photos, and colors, or by placing key concepts in labeled boxes and connecting them. Instructors can also use CM to see what students understand and how they connect the material to course goals, in introductory units, midterm reviews, peer and self-assessment, or end-of-course reviews (Novak, 2012). Self-regulated learning (SRL) is related but different. It describes learners who set learning goals and then monitor, regulate, and control their cognition, motivation, and behavior, guided by those goals and their learning environment (Pintrich, 2004; Zimmerman, 2002). The current reliance on traditional and rote learning does little to build critical thinking, so educators need strategies that prepare students for critical thinking, creative problem solving and collaboration (Awofala, 2011). CM and SRL are two such ideas, and they are closely linked.

Research on how CM and SRL relate has gone in two directions. Most studies treat SRL as an outcome of CM. Novak (2012) observed that students who gained skill and experience in building maps began to report that they were "learning how to learn", and Chularut and DeBacker (2004) argue that concept mapping is well suited to helping students regulate their own learning. When students build a map, they can see for themselves how far it has progressed toward their goal. They judge it against their own standards, feel satisfied or dissatisfied, and may then seek more information or help, which is the cycle of self-observation, self-judgment, and reaction that SRL describes. Studies with English as a Foreign Language (EFL) learners support this view, showing that concept mapping instruction improved learners' self-regulation in vocabulary learning (Naderifar, 2018; Roy, 2011). Outside language learning, Alt and Naamati-Schneider (2021) reported gains in goal setting, task strategies and time management among health management students who built digital concept maps in an online course, and Fang et al. (2023) found that a concept mapping-based SRL approach supported both achievement and self-regulation in STEM activities. Sieben et al. (2021) likewise found that CM supported the quality of reflection among undergraduate medical students, and reflection is itself a self-regulatory skill. The relationship may also run the other way. Because CM demands high mental effort, SRL can be treated as an independent variable. Students with weak SRL skills may benefit less from CM (Lim et al., 2009), and self-efficacy may influence how readily they take up the strategy (Schaal, 2010; Sun & Chen, 2016). Nuuyoma and Fillipus (2020) found that nursing students saw CM as valuable but time-consuming and demanding, which suggests that skills such as time management shape how well CM works.

Despite this evidence, important gaps remain. Machado and Carvalho's (2020) review of CM in higher education reports benefits for critical thinking, exam performance, collaborative learning, and meaningful learning, and Chen and Hwang (2020) report similar gains in EFL critical thinking awareness and learning performance. However, the effect of CM on students' self-regulation in face-to-face or online courses has received much less attention (Alt & Naamati-Schneider, 2021). Existing findings also focus on EFL and health education settings and come mostly from outside South Asia. In Pakistan, particularly in Lahore, little is known about how undergraduate students view concept mapping, how these views relate to their self-regulated learning, and whether either differs across demographic groups. This study addresses that gap. It matters theoretically because it adds evidence on how a specific cognitive tool relates to students' ability to take control of their own learning. It matters practically because the findings can inform curricu-

Online ISSN: 3006-8886
Print ISSN: 3006-8878

lum design, classroom practice, and institutional policies that promote student-centered, self-directed learning in Pakistani higher education.

For this study, the two key variables are defined as follows. Concept mapping strategy (CMS) refers to a strategy that integrates verbal and visual thinking and presents it in a form that differs from traditional writing. Individual learners construct concept maps, build them in collaboration with other learners, or teacher-experts create and share them. In this study, CMS is operationalized as undergraduate students' scores on the concept mapping strategy questionnaire. Because this questionnaire asks about the usefulness of concept mapping, attitudes toward it and intention to use it, the score reflects students' perceptions of the strategy rather than a direct record of how often they construct maps. Self-regulated learning (SRL) is an active, constructive process in which learners set learning goals and then monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the environment's contextual features. In this study, SRL is operationalized as undergraduate students' scores on the self-regulated learning scale used for data collection. In line with the objectives of the study, the following research questions guided the exploration:

1. What is the level of concept mapping strategy and self-regulated learning among undergraduate students at the university level?
2. Is there a significant relationship between concept mapping strategy and self-regulated learning among undergraduate students at university level?
3. Is there a significant difference in concept mapping strategy and self-regulated learning among undergraduate students on the basis of demographic variables (gender. University sector, age group, and CGPA)?

Theoretical foundation of the study

This study rests on three connected theoretical perspectives: Constructivist Learning Theory, Ausubel's theory of meaningful learning, and Bandura's Social Cognitive Theory. Concept mapping (CMS) draws on the first two, while self-regulated learning (SRL) is explained mainly by the third. Together they give a reasoned basis for expecting the two variables to be related.

Constructivist Learning Theory holds that learners actively build knowledge through experience and interaction with the environment, rather than passively receiving information (Piaget, 1970; Vygotsky, 1978). Concept mapping follows this view closely. A learner who builds a map must choose the key concepts, decide how they connect, and fit new information into what they already know (Novak & Gowin, 1984). Concept maps are therefore a means of constructing knowledge as well as displaying it. Vygotsky's (1978) idea of the Zone of Proximal Development adds a further point. With suitable scaffolding, learners can reach higher levels of understanding than they could alone, and concept maps can serve as that scaffold by making a topic's structure visible and manageable. Concept mapping is also grounded in the cognitive tradition of learning theory, which explains learning through mental processes such as perception, memory, and judgment (Crowl et al., 1997).

The most direct basis for concept mapping is Ausubel's (1963) theory of meaningful learning. According to this theory, learning is meaningful when a person consciously and explicitly ties new knowledge to relevant concepts or propositions already held in memory. In rote learning, people make little effort to link new material to what they already know. Such information is

Online ISSN: 3006-8886
Print ISSN: 3006-8878

stored in isolation and is difficult to retrieve (Okebukola, 1990). Novak and his colleagues were interested in this difference between rote and meaningful learning and in the role of prior knowledge, and their research led to the development of concept mapping (Novak, 1981; Novak et al., 1983). In a concept map, concepts are arranged hierarchically, from the most general at the top to the most specific below, and are joined by labeled links that form propositions. Cross-links between different parts of the map show how separate areas of knowledge relate (Novak & Cañas, 2008). Meaningful learning is helped because concepts are seen as part of a network of relationships rather than as isolated items (Heinze-Fry & Novak, 1990). Building such a map is mentally demanding (Anderson-Inman & Horney, 1997), which is why learners' ability to manage their own learning matters.

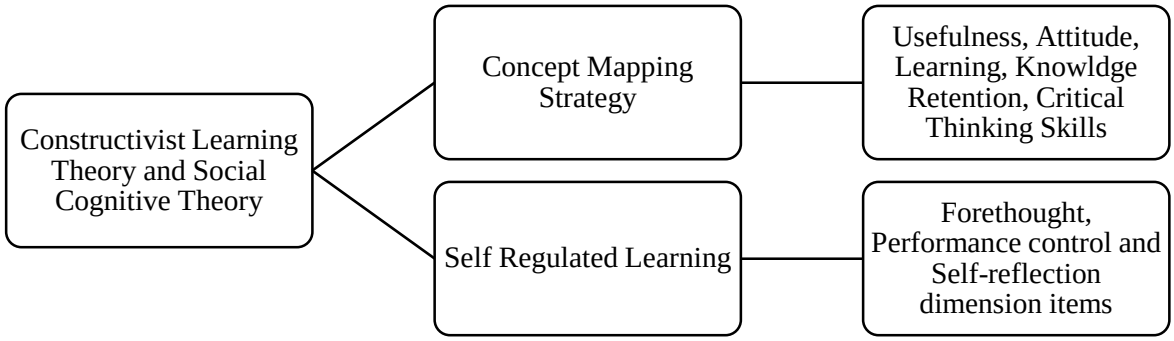
Bandura's (1986) Social Cognitive Theory explains self-regulation through goal setting, self-observation, self-judgment, and self-reaction. Goal setting is essential, because goals provide the standards against which learners compare their present performance (Bandura, 1986; Zimmerman, 1986). The other three components interact as learners pursue goals. Self-observation tells the learner whether they have reached a goal and what remains to be done (Schunk, 1990). Self-judgment evaluates that progress against personal standards. Self-reaction is the satisfaction or dissatisfaction that follows and may lead the learner to seek more information or help or to continue the strategy in other settings (Bandura, 1986; Schunk, 1994). Self-efficacy, defined as a person's belief in their ability to learn or perform at a given level, is central to this process. It influences the activities learners choose and how much effort and persistence they put into them, and ultimately their learning and achievement (Bandura, 1977, 1986; Schunk, 1991). Researchers agree that SRL has three main components: cognitive control, metacognitive control and motivational control (Pintrich, 2004; Zimmerman, 2000). Learners who set goals, choose and use strategies, and monitor their progress are more likely to perform well (Pintrich & De Groot, 1990; Zimmerman & Pons, 1986). Wittrock's (1989, 1991) generative learning theory supports this view, since it treats learners as active producers of knowledge who must be aware of and control their use of learning strategies.

These theories meet where concept mapping activity aligns with the stages of self-regulation. As a map takes shape, students can see how far it has moved toward the goal they set (self-observation). They compare the map with their own standards and revise it where it falls short (self-judgment). They then feel satisfied or dissatisfied, and may seek further information or help, or take up concept mapping again in other settings (self-reaction). Weinstein and Mayer (1986) describe learning strategies of this kind as helping learners stay on task, pick out what is important, organize material and maintain a positive frame of mind for study. Instruction in strategy use is a recognized way of promoting self-regulation (Corno & Mandinach, 1983; Schunk, 1986). Concept maps also help with planning and monitoring because they let learners organize their thoughts, set goals and check their understanding (Schraw, 1998). Empirical work supports this link, with studies showing benefits of concept mapping for self-regulation and metacognitive control (Cassata & French, 2006; Chularut & DeBacker, 2004). The same framework also allows for the reverse direction. Since concept mapping demands high mental effort, learners with weak self-regulation, low self-efficacy or poor time management may benefit less from it (Lim et al., 2009; Nuuyoma & Fillipus, 2020; Schaal, 2010). Taken together, the theories imply that concept mapping strategy and self-regulated learning are mutually related: mapping practice can strengthen self-regulatory skills, and those skills in turn shape how well students use and benefit from mapping. This study therefore examines the relationship between the two variables among

Online ISSN: 3006-8886
Print ISSN: 3006-8878

undergraduate students.

Figure 1: ***Theoretical Framework of the Study***



Methodology

Research Design

The research was quantitative in nature and used a correlational survey design. It was employed to investigate the relationship between concept mapping strategy and self-regulated learning among undergraduate students at the university level. A correlational design allows associations between variables to be examined without manipulating them, but it cannot establish cause and effect.

Sample of the Study

The study population was undergraduate students of public and private universities in Lahore, Pakistan. A multi-stage sampling technique was used to select the study sample (Figure 2). In the first stage, the universities in Lahore chartered by the Higher Education Commission (15 public and 21 private) were stratified by sector, and two public and two private universities were selected at random. In the second stage, students of four-year programs in two common departments (Education and Science) were selected through purposive sampling. In the third stage, the researcher selected students from each university using convenience sampling. The total sample consisted of 533 undergraduate students. Because the final stage relied on convenience sampling, the sample is not fully random, and the findings should be generalized with care. The profile of the sample is given in Table 1.

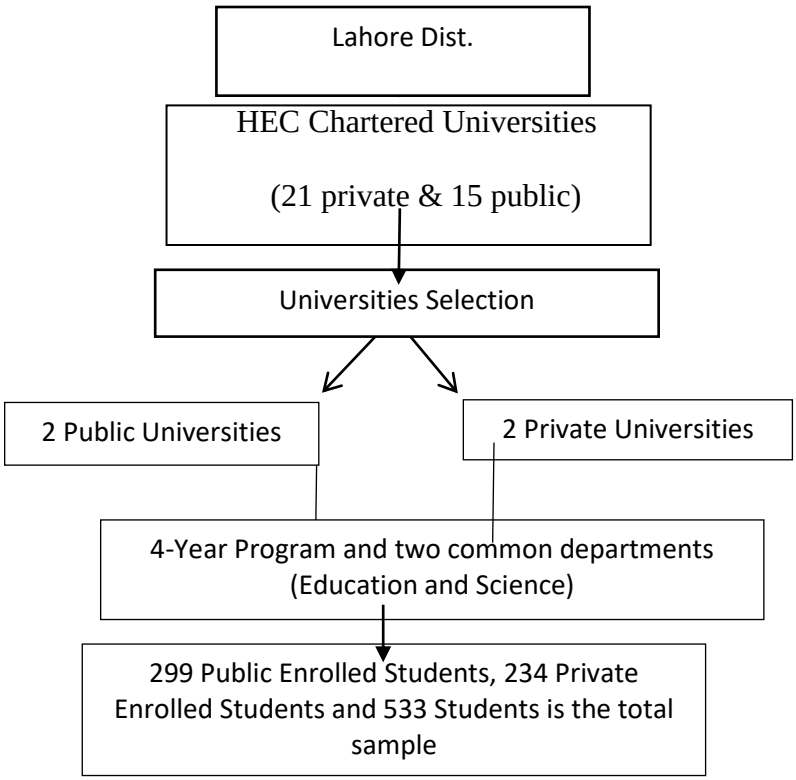
Table 1: ***Demographic Profile of the Sample (N = 533)***

Variable	Category	*n*	%
Gender	Male	177	33.2
	Female	356	66.8
University sector	Public	299	56.1
	Private	234	43.9
Department	Education	253	47.46
	Science	280	52.53
Age group	18-20	361	67.7
	21-23	162	30.4

SOCIAL PRISM
Online ISSN: 3006-8886
Print ISSN: 3006-8878

	24-26	10	1.9
CGPA	2.66-2.99	14	2.6
	3.00-3.22	124	23.3
	3.33-3.65	236	44.3
	3.66-3.99	159	29.8
Total		533	100.0

Figure 2: ***Sampling Description***



Instrumentation

Concept Mapping Strategy Questionnaire: CMS was measured with a 30-item closed-ended questionnaire developed by Mirza and Akram (2022). Items were rated on a five-point Likert scale from strongly disagree (1) to strongly agree (5). The questionnaire covers nine areas: the definition of concept mapping, the usefulness of concept mapping, concept mapping as an assessment tool, attitudes toward concept mapping, behavioral intention to use concept mapping, students' learning, critical thinking skills, knowledge retention, and students' achievement. Since most items ask students how they view concept mapping, the scale is read in this study as a measure of students' perceptions of and orientation toward the strategy. Total scores range from 30 to 150. **Self-Regulated Learning Questionnaire:** SRL was measured with the Academic Self-Regulated Learning Questionnaire (ASLQ) developed by Nambiar et al. (2022). It has 36 closed-ended items rated on the same five-point Likert scale, and covers three dimensions: forethought, performance control, and self-reflection. Total scores range from 36 to 180.

Online ISSN: 3006-8886
Print ISSN: 3006-8878

Pilot Testing

A pilot study was conducted with 240 undergraduate students who were not part of the main sample, to check the validity and reliability of the instruments. Two subject experts reviewed both instruments for content and face validity. Cronbach's alpha was 0.767 for the concept mapping strategy questionnaire and 0.907 for the self-regulated learning questionnaire, both above the commonly accepted value of 0.70. The study was delimited to public and private universities in District Lahore and to undergraduate students.

Data Collection

Before collecting the data, permission was obtained from the administration of each sampled university. Students were told the purpose of the study, participation was voluntary, and they were free to decline or to stop at any point. No names were recorded, and the information was used only for research purposes. The researcher visited each university in person to administer the questionnaires. The data were then entered into SPSS and screened for missing values and entry errors before analysis.

Data Analysis

Descriptive statistics (mean and standard deviation) were used to describe the levels of CMS and SRL (research question 1). Mean item scores were interpreted on the five-point scale, on which values above 3 indicate agreement. The Pearson product-moment correlation coefficient was used to test the relationship between CMS and SRL (research question 2). Independent-samples *t* tests and one-way ANOVA were used to compare both variables across gender, university sector, age group and CGPA (research question 3). Effect sizes were calculated as Cohen's *d* for *t* tests and eta squared for ANOVA and were interpreted using Cohen's (1988) guidelines. The level of significance was set at .05.

Results

This section presents the analysis of the data collected from 533 undergraduate students in public and private universities in Lahore. The results are reported in the order of the research questions: first the levels of concept mapping strategy (CMS) and self-regulated learning (SRL), then the relationship between them, and finally the comparisons across demographic groups. Each table is followed by a brief interpretation.

Understanding of perceived value of Concept Mapping Strategy and Self-Regulated Learning:

Table 2: ***Descriptive Statistics for Concept Mapping Strategy and Self-Regulated Learning (N = 533)***

Variable	Items	*M*	*SD*	Mean item score
Concept mapping strategy	30	129.93	7.24	4.33
Self-regulated learning	36	151.03	9.43	4.20

Table 2 shows that students' scores on both scales were high. The mean CMS score was 129.93 (*SD* = 7.24), which corresponds to a mean item score of 4.33 on the five-point scale, between

Online ISSN: 3006-8886
Print ISSN: 3006-8878

"agree" and "strongly agree". The mean SRL score was 151.03 (*SD* = 9.43), a mean item score of 4.20. On the whole, students held favorable views of concept mapping and described themselves as fairly self-regulated learners. The standard deviations are small relative to the possible ranges, which shows that most students answered toward the upper end of both scales.

Table 3: ***Distribution of Students Across Relative Levels of Concept Mapping Strategy***

Level	Score range	No. of Participants (N)	Percentage (%)	*M*
Upper	≥ 135	150	28.1	138.29
Middle	128–134	190	35.6	131.05
Lower	≤ 127	193	36.2	122.33

To describe variation within the sample, students were grouped into three levels according to their total scores (Tables 3 and 4). These groups are relative to this sample and should not be read as absolute levels. For CMS, 150 students (28.1%) scored 135 or above (*M* = 138.29), 190 students (35.6%) scored between 128 and 134 (*M* = 131.05), and 193 students (36.2%) scored 127 or below (*M* = 122.33). Even the lower group had a mean item score of about 4.08, which is still on the agreement side of the scale. The lower group therefore consists of students who were less enthusiastic about concept mapping than their peers, not students who rejected it.

Table 4: ***Distribution of Students Across Relative Levels of Self-Regulated Learning***

Level	Score range	No. of Participants (N)	Percentage (%)	*M*
Upper	≥ 157	158	29.6	161.45
Middle	149–156	179	33.6	152.65
Lower	≤ 148	196	36.8	141.15

A similar pattern appeared for SRL. In all, 158 students (29.6%) scored 157 or above (*M* = 161.45), 179 students (33.6%) scored between 149 and 156 (*M* = 152.65), and 196 students (36.8%) scored 148 or below (*M* = 141.15). The lower group's mean item score of 3.92 is close to "agree", so these students reported moderate rather than weak self-regulation. Even so, the grouping points to a sizeable group of students who may benefit from support in planning, monitoring and reflecting on their learning.

Relationship Between Concept Mapping Strategy and Self-Regulated Learning

Table 5: ***Pearson Correlation Between Concept Mapping Strategy and Self-Regulated Learning***

Variables	N	*r*	*p*
Concept mapping strategy and self-regulated learning	533	0.417	< .001

Table 5 shows a positive and statistically significant correlation between concept mapping strategy and self-regulated learning, r (531) = 0.417, $p < .001$, 95%. By Cohen's (1988) guidelines this is a moderate relationship. Students who viewed concept mapping more favorably tended to report stronger self-regulated learning. The coefficient of determination ($r^2 = .17$) shows that the two variables share about 17% of their variance.

Online ISSN: 3006-8886
Print ISSN: 3006-8878

Differences on the basis of Demographic Variables:

Table 6: ***Independent-Samples t Test for Concept Mapping Strategy by Gender***

Gender	N	*M*	*Df*	*t*	*p*
Male	177	129.12	531	-1.817	0.070
Female	356	130.33			

Table 6 shows that female students (M = 130.33) scored slightly higher than male students (M = 129.12) on concept mapping strategy, but the difference was not statistically significant, $t(531) = -1.82$, $p = .070$, $d = 0.17$. Male and female students therefore held similar views of concept mapping.

Table 7: ***Independent-Samples t Test for Concept Mapping Strategy by University Sector***

Sector	N	*M*	*df*	*t*	*p*
Public university	299	130.34	531	1.63	0.141
Private university	234	129.41			

As Table 7 shows, students at public universities (M = 130.34) and private universities (M = 129.41) did not differ significantly in concept mapping strategy, $p = .141$, $d = 0.13$. Students in both sectors held similar perceptions of the strategy.

Table 8: ***One-Way ANOVA for Concept Mapping Strategy by Age Group***

Source	Sum of squares	Mean square	*df*	F	*p*
Between groups	155.753	77.876	2	1.490	0.226
Within groups	27710.078	52.283	530		
Total	27865.831		532		

The one-way ANOVA in Table 8 shows no significant difference in concept mapping strategy across age groups, $F(2, 530) = 1.49$, $p = .226$, $\eta^2 = .006$.

Table 9: ***One-Way ANOVA for Concept Mapping Strategy by CGPA***

Source	Sum of squares	Mean square	*df*	F	*p*
Between groups	109.128	36.376	3	0.693	0.556
Within groups	27756.706	52.470	529		
Total	27865.831		532		

Concept mapping strategy also did not differ significantly across CGPA categories, $F(3, 529) = 0.69$, $p = .556$, $\eta^2 = .004$ (Table 9).

Table 10: ***Independent-Samples t Test for Self-Regulated Learning by Gender***

Gender	N	*M*	*df*	*T*	*p*
Male	177	150.15	531	-1.520	0.129
Female	356	151.47			

Online ISSN: 3006-8886
Print ISSN: 3006-8878

For self-regulated learning, the difference between female students (M = 151.47) and male students (M = 150.15) was not significant, $t(531) = -1.52$, $p = .129$, $d = 0.14$ (Table 10).

Table 11: ***Independent-Samples t Test for Self-Regulated Learning by University Sector***

Sector	N	*M*	*df*	*T*	*p*
Public university	299	151.64	531	1.686	0.092
Private university	234	150.26			

Students at public universities (M = 151.64) reported slightly higher self-regulated learning than those at private universities (M = 150.26), but the difference was not significant, $t(531) = 1.69$, $p = .092$, $d = 0.15$ (Table 11).

Table 12: ***One-Way ANOVA for Self-Regulated Learning by Age Group***

Source	Sum of squares	Mean square	*Df*	F	*p*
Between groups	153.163	76.581	2	0.861	0.423
Within groups	47126.087	88.917	530		
Total	47279.250		532		

Self-regulated learning did not differ significantly across age groups, $F(2, 530) = 0.86$, $p = .423$, $\eta^2 = .003$ (Table 12).

Table 13: ***One-Way ANOVA for Self-Regulated Learning by CGPA***

Source	Sum of squares	Mean square	*df*	F	*p*
Between groups	417.706	139.235	3	1.572	0.195
Within groups	46861.543	88.585	529		
Total	47279.250		532		

Table 13 shows self-regulated learning differ by CGPA, $F(3, 529) = 1.57$, $p = .195$, $\eta^2 = 0.009$ (Table 13). Across all eight comparisons the effect sizes were very small ($d \leq 0.17$, $\eta^2 \leq 0.009$). With 533 students the study had enough power to detect small differences, so the absence of group differences is unlikely to be only a matter of sample size.

Discussion

The main finding of this study is a significant, moderate, positive relationship between concept mapping strategy (CMS) and self-regulated learning (SRL) among undergraduate students in Lahore ($r = 0.417$, $p < 0.001$). Students who held more favorable views of concept mapping also reported stronger self-regulated learning. This agrees with the theoretical expectation that concept mapping and self-regulation support each other. In Social Cognitive Theory, self-regulation involves goal setting, self-observation, self-judgment, and self-reaction (Bandura, 1986). Building a concept map lets students see how their understanding is developing toward a goal, judge the map against their own standards and revise it (Schunk, 1990). The result also aligns with earlier work showing that concept mapping benefits self-regulation and metacognitive control (Cassata & French, 2006; Chularut & DeBacker, 2004), and with intervention studies in which concept mapping activities were followed by gains in self-regulation (Alt & Naamati-Schneider,

Online ISSN: 3006-8886
Print ISSN: 3006-8878

2021; Fang et al., 2023). The present study measured perceptions rather than training effects, but it extends this line of work to undergraduates in a Pakistani setting, where evidence is limited.

The size of the relationship deserves careful reading. An *r* of .417 means CMS and SRL share about 17% of their variance, so other factors explain most of the variation in each variable. This is consistent with the view that the link may run in both directions. Concept mapping may strengthen self-regulatory skills, and students with stronger self-regulation, higher self-efficacy, and better time management may use concept mapping more willingly and effectively (Lim et al., 2009; Nuuyoma & Fillipus, 2020; Schaal, 2010; Sun & Chen, 2016). Part of the shared variance may also come from the fact that both variables were measured through self-report questionnaires completed at the same time (Podsakoff et al., 2003). Because the design was correlational, the study cannot show which direction operates or whether either variable causes the other.

The results on demographic variables showed no significant differences in CMS or SRL by gender, university sector, age group, or CGPA. For CMS, the results were gender (t = -1.82, p = .070), university sector (p = .141), age (F = 1.49, p = .226) and CGPA (F = 0.69, p = .556). For SRL, they were gender (t = -1.52, p = .129), university sector (t = 1.69, p = .092), age (F = 0.86, p = .423) and CGPA (F = 1.57, p = .195). Two of these values, gender for CMS and university sector for SRL, were close to the .05 threshold, but the corresponding effect sizes were very small (d = 0.17 and 0.15). The pattern suggests that, in this sample, positive views of concept mapping and the habits of self-regulated learning are spread fairly evenly across groups rather than concentrated in particular ones. The lack of a CGPA difference is worth noting, as it suggests that favorable views of concept mapping and self-regulation are not simply features of higher-achieving students. One possible explanation is that students in the sample share similar instructional experiences, in which concept mapping is rarely taught explicitly and rote learning remains common. Under those conditions, demographic differences would be small. The high mean scores on both scales may also have left little room for group differences to appear. These interpretations should be tested rather than assumed.

Taken together, the findings suggest introducing concept mapping to all undergraduate students, not only selected groups. Because concept mapping asks learners to connect new knowledge with what they already know, it offers an alternative to rote learning, which has been described as a weakness of current practice (Awofala, 2011; Novak & Cañas, 2008). The moderate size of the relationship also supports the point that students need guidance in using the strategy, including help with time management, as Nuuyoma and Fillipus (2020) concluded.

Limitations

This study has some limitations that should be kept in mind. First, the design was correlational and cross-sectional, so it cannot show whether concept mapping strengthens self-regulated learning, whether self-regulated learners are drawn to concept mapping, or whether both depend on a third factor such as motivation. Second, both variables were measured through self-report questionnaires completed in a single session. Shared method variance and socially desirable responding may have inflated the correlation, and the high mean scores suggest a possible ceiling effect (Podsakoff et al., 2003). Third, the concept mapping questionnaire mainly captures students' perceptions of and attitudes toward the strategy, not how often or how well they actually construct maps. Fourth, the final sampling stage was convenience-based and limited to Education and Sci-

Online ISSN: 3006-8886
Print ISSN: 3006-8878

ence departments in four universities in one city, so the findings may not apply to other disciplines or regions. Finally, the instruments' validity rested on expert review and internal consistency; future work would strengthen it with confirmatory factor analysis among Pakistani students.

Conclusion

The study examined the relationship between concept mapping strategy and self-regulated learning among 533 undergraduate students from public and private universities in Lahore. It found a significant, moderate, positive correlation between the two variables: students who held more favorable views of concept mapping also tended to report stronger self-regulated learning. This supports the study's theoretical framework: Constructivist Learning Theory explains concept mapping as active knowledge construction, and Social Cognitive Theory explains how the monitoring and evaluation involved in building maps align with the processes of self-regulation. No significant differences in CMS or SRL were found by gender, university sector, age group or CGPA, and the effect sizes were very small, which suggests that the levels of both variables are similar across these groups. Since the study was correlational, the findings show association, not causation. Concept mapping can reasonably be considered a useful strategy for supporting self-regulated learning in Pakistani higher education, but experimental evidence is needed to confirm this.

Recommendations

The following recommendations are based on the findings of the study:

1. Universities should include concept mapping in teaching through workshops and training sessions, and integrate it across courses so that students practice it repeatedly rather than once.
2. Faculty development programs should prepare teachers to use concept mapping in instruction and assessment, including how to avoid asking students to memorize ready-made maps, which would defeat its purpose (Novak & Cañas, 2008).
3. Because no differences were found by gender, sector, age, or CGPA, concept mapping training should be offered to all students and not targeted at selected groups.
4. Concept mapping activities should be combined with guidance on self-regulation, such as goal setting, time management, and self-evaluation, since students with weak self-regulation may find the strategy demanding and time-consuming (Nuuyoma & Fillipus, 2020).
5. Teachers should encourage group concept mapping activities where students explain their reasoning and give each other feedback.
6. Institutions should review the use of concept mapping periodically, using student feedback and performance, and adjust how it is taught.
7. Future studies should use experimental or longitudinal designs, assess the quality of the concept maps students actually produce, compare academic disciplines, and examine how concept mapping relates to each dimension of self-regulated learning (forethought, performance control and self-reflection).

References

1. Alt, D., & Naamati-Schneider, L. (2021). Health management students' self-regulation and digital concept mapping in online learning environments. *BMC Medical Education, 21*, Article 110. https://doi.org/10.1186/s12909-021-02542-w
2. Anderson-Inman, L., & Horney, M. (1997). Computer-based concept mapping: Enhancing literacy with tools for visual thinking. *Journal of Adolescent & Adult Literacy, 40*(4), 302–306.
3. Ausubel, D. P. (1963). *The psychology of meaningful verbal learning*. Grune & Stratton.
4. Awofala, A. O. A. (2011). Effect of concept mapping strategy on students' achievement in junior secondary school mathematics. *International Journal of Mathematics Trends and Technology, 2*(3).
5. Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215.
6. Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall.
7. Cassata, A. E., & French, L. (2006). Using concept mapping to facilitate metacognitive control in preschool children. In A. J. Cañas & J. D. Novak (Eds.), *Concept maps: Theory, methodology, technology. Proceedings of the Second International Conference on Concept Mapping*. Universidad de Costa Rica.
8. Chen, M. R. A., & Hwang, G. J. (2020). Effects of a concept mapping-based flipped learning approach on EFL students' English-speaking performance, critical thinking awareness and speaking anxiety. *British Journal of Educational Technology, 51*(3), 817–834. https://doi.org/10.1111/bjet.12887
9. Chularut, P., & DeBacker, T. K. (2004). The influence of concept mapping on achievement, self-regulation, and self-efficacy in students of English as a second language. *Contemporary Educational Psychology, 29*(3), 248–263. https://doi.org/10.1016/j.cedpsych.2003.09.001
10. Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.
11. Corno, L., & Mandinach, E. B. (1983). The role of cognitive engagement in classroom learning and motivation. *Educational Psychologist, 18*(2), 88–108.
12. Crowl, T. K., Kaminsky, S., & Podell, D. M. (1997). *Educational psychology: Windows on teaching*. Brown & Benchmark.
13. Fang, J. W., He, L. Y., Hwang, G. J., Zhu, X. W., Bian, C. N., & Fu, Q. K. (2023). A concept mapping-based self-regulated learning approach to promoting students' learning achievement and self-regulation in STEM activities. *Interactive Learning Environments, 31*(10), 7159-7181.
14. Heinze-Fry, J. A., & Novak, J. D. (1990). Concept mapping brings long-term movement toward meaningful learning. *Science Education, 74*(4), 461–472. https://doi.org/10.1002/sce.3730740406
15. Lim, K. Y., Lee, H. W., & Grabowski, B. (2009). Does concept-mapping strategy work for everyone? The levels of generativity and learners' self-regulated learning skills. *British Journal of Educational Technology, 40*(4), 606–618. https://doi.org/10.1111/j.1467-8535.2008.00872.x

Online ISSN: 3006-8886
Print ISSN: 3006-8878

16. Machado, C. T., & Carvalho, A. A. (2020). Concept mapping: Benefits and challenges in higher education. *The Journal of Continuing Higher Education, 68*(1), 38–53. https://doi.org/10.1080/07377363.2020.1712579
17. Mirza, S. R. (2022). *Students' views about constructing conceptual mapping as a learning strategy* [Bachelor's dissertation, University of the Punjab]. Institute of Education and Research.
18. Naderifar, A. (2018). The comparative effect of concept mapping and vocabulary notebook keeping on Iranian EFL learners' self-regulation in vocabulary learning. *Cogent Education, 5*(1), Article 1491782. https://doi.org/10.1080/2331186X.2018.1491782
19. Nambiar, D., Alex, J., & Pothiyil, D. I. (2022). Development and validation of Academic Self-regulated Learning Questionnaire (ASLQ). *International Journal of Behavioral Sciences, 16*(2), 89–95. https://doi.org/10.30491/IJBS.2022.321176.1730
20. Novak, J. D. (1981). Applying learning psychology and philosophy of science to biology teaching. *The American Biology Teacher, 43*(1), 12–20.
21. Novak, J. D. (2012). Concept mapping: A strategy for organizing knowledge. In S. M. Glynn & R. Duit (Eds.), *Learning science in the schools* (pp. 229–245). Routledge.
22. Novak, J. D., & Cañas, A. J. (2008). *The theory underlying concept maps and how to construct and use them* (Technical Report IHMC CmapTools 2006-01 Rev 01-2008). Florida Institute for Human and Machine Cognition.
23. Novak, J. D., & Gowin, D. B. (1984). *Learning how to learn*. Cambridge University Press.
24. Novak, J. D., Gowin, D. B., & Johansen, G. T. (1983). The use of concept mapping and knowledge vee mapping with junior high school science students. *Science Education, 67*(5), 625–645.
25. Nuuyoma, V., & Fillipus, S. K. (2020). Nursing students' perceptions and experiences of concept mapping as a learning tool in a human physiology course. *African Journal of Health Professions Education, 12*(3), 98–102. https://doi.org/10.7196/AJHPE.2020.v12i3.1330
26. Okebukola, P. A. (1990). Attaining meaningful learning of concepts in genetics and ecology: An examination of the potency of the concept-mapping technique. *Journal of Research in Science Teaching, 27*(5), 493–504.
27. Piaget, J. (1970). *Science of education and the psychology of the child*. Viking.
28. Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review, 16*(4), 385–407.
29. Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33–40.
30. Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903.
31. Roy, D. (2011). Designing concept maps from procedural visuals: An innovative approach towards information processing in EFL context. *International Journal of Arts & Sciences, 4*(18), 13–26.
32. Schaal, S. (2010). Cognitive and motivational effects of digital concept maps in preservice science teacher training. *Procedia – Social and Behavioral Sciences, 2*(2), 640–647. https://doi.org/10.1016/j.sbspro.2010.03.077

33. Schraw, G. (1998). Promoting general metacognitive awareness. *Instructional Science, 26*(1–2), 113–125.
34. Schunk, D. H. (1986). Verbalization and children's self-regulated learning. *Contemporary Educational Psychology, 11*(4), 347–369.
35. Schunk, D. H. (1990). Goal setting and self-efficacy during self-regulated learning. *Educational Psychologist, 25*(1), 71–86.
36. Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist, 26*(3–4), 207–231.
37. Schunk, D. H. (1994). Self-regulation of self-efficacy and attributions in academic settings. In D. H. Schunk & B. J. Zimmerman (Eds.), *Self-regulation of learning and performance: Issues and educational applications* (pp. 75–99). Lawrence Erlbaum Associates.
38. Sieben, J. M., Heeneman, S., Verheggen, M. M., & Driessen, E. W. (2021). Can concept mapping support the quality of reflections made by undergraduate medical students? A mixed method study. *Medical Teacher, 43*(4), 388–396. https://doi.org/10.1080/0142159X.2020.1834081
39. Sun, J. C.-Y., & Chen, A. Y.-Z. (2016). Effects of integrating dynamic concept maps with interactive response system on elementary school students' motivation and learning outcome: The case of anti-phishing education. *Computers & Education, 102*, 117–127. https://doi.org/10.1016/j.compedu.2016.08.002
40. Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
41. Weinstein, C. E., & Mayer, R. E. (1986). The teaching of learning strategies. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 315–327). Macmillan.
42. Wittrock, M. C. (1989). Generative processes of comprehension. *Educational Psychologist, 24*(4), 345–376.
43. Wittrock, M. C. (1991). Generative teaching of comprehension. *The Elementary School Journal, 92*(2), 169–184. https://doi.org/10.1086/461686
44. Yekta, Z. P., & Nasrabadi, A. N. (2004). Concept mapping as an educational strategy to promote meaningful learning. *Journal of Medical Education, 5*(2).
45. Zimmerman, B. J. (1986). Becoming a self-regulated learner: Which are the key subprocesses? *Contemporary Educational Psychology, 11*(4), 307–313.
46. Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). Academic Press.
47. Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice, 41*(2), 64–70.
48. Zimmerman, B. J., & Pons, M. M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal, 23*(4), 614–628.