



International Journal of Humanities, Social Sciences and Development Studies (IJHSD)

(An International Peer-Reviewed (Refereed) Journal)

Website-<https://ijhds.nobleinkresearch.com/1>

Email- editor@ijhds.nobleinkresearch.com

ISSN: 3139-8235 (Online)



Effectiveness of Concept Mapping on the Academic Achievement of Graduate Students: An Experimental Study

Amit Jain¹, Dr. Shalini Tyagi^{2, *}

¹ Research Scholar, Department of Education, Meerut College, Meerut, Uttar Pradesh, India
Affiliated to Chaudhary Charan Singh University, Meerut, Uttar Pradesh, India

² Professor, Department of Education, Meerut College, Meerut, Uttar Pradesh, India

*Corresponding Author: shastrinagar99@rediffmail.com

Received: 05 July 2026, Revised: 15 August 2026, Accepted: 30 August 2026, Available Online: 24 September 2026

<https://doi.org/10.68219/0raakc24>

Abstract

Concept mapping is an instructional approach for teaching students to organize, integrate and represent knowledge and can aid them in deeper conceptual understanding. In this study, we consider the possibility of concept mapping improving academic achievement of graduate students in a proposed experimental setting. We contend that graduate-level learning is about connecting concepts and synthesizing information and understanding higher-level concepts. We propose a two-group pre-test-post-test design, where an experimental group is trained through concept mapping and a control group is taught with standard instruction. The academic achievement test is proposed as a primary outcome measure. We also outline how to select participants for the study, how to implement the intervention, test the instruments and data collection and the statistical analysis of the effect size. As a theoretical perspective and from the empirical literature, we believe that concept mapping can lead to better academic performance by facilitating meaningful learning, conceptual organization, knowledge integration and active engagement with the content of the course. The framework proposed here provides a framework for empirically measuring the effectiveness of concept mapping in graduate school and may help foster evidence-based teaching in higher education. Further research is needed to assess the impact of the proposed framework on the results and to better understand the magnitude and statistical significance.

Keywords: Concept Mapping, Academic Achievement, Graduate Students, Meaningful Learning, Instructional Strategy, Higher Education, Experimental Framework

1. Introduction.

Higher education is moving away from teacher-centered teaching and moving towards engaging students in the creation and integration of knowledge. This change is particularly important at the graduate level, where students are expected to learn not only about disciplinary knowledge but also the relationships between concepts, organize information from different sources, think critically and apply theoretical knowledge in their learning and work lives. Therefore, the selection of the best instructional strategies is becoming an important topic about the students' achievement and learning.

Academic achievement is a key measure of the success of both teaching and learning. At the graduate level, it is not only a question of students' recall but also their ability to grasp concepts, relate ideas, relate new knowledge to what is already known and how to apply new knowledge to a new situation. Traditional teaching approaches which focus on verbal explanation, note-taking and information reproduction might not always give students the opportunity to visualize the connections between concepts. This has led to a growing interest in teaching ideas that engage students in organizing and communicating knowledge. Concept mapping is one such teaching strategy. A concept map is a graphical representation of knowledge in which concepts are arranged hierarchically and connected through meaningful relationships. Concept mapping can provide students with a visual structure on which to visualize their knowledge by requiring them to identify the most important concepts and relationships between them and with them. It may help students move away from memorization in isolation and towards further understanding of the subject matter. Concept mapping can also help students identify relationships, recognize gaps in their understanding, reorganize their knowledge structures and tie new knowledge to past knowledge.

The value of concept mapping is closely tied to theories of meaningful learning and knowledge building. Learning becomes more meaningful when new information is connected to concepts and knowledge that learners already have. Concept mapping is a way to make these connections explicit and visually organized. It could be relevant for graduate education as well where students may be confronted with complex theoretical concepts, interrelated concepts, multidisciplinary perspectives and a lot of information that needs to be organized and synthesized. There has been a lot of research in concept mapping in different educational settings and areas of study. In many studies concepts mapping appears to be associated with learning. However, the effectiveness of an instructional strategy cannot be generalized to all educational settings and contexts. The learners' prior knowledge, background in education, instructional environment, type of course content, duration of intervention, and methods of assessment influence the results of concept mapping. In addition, while concept mapping has been extensively studied in the educational literature, less attention has been paid to students in school and undergraduate education than to graduate-level students. We think it is important to be more focused on concept mapping as an instructional strategy in graduate education.

Another important point is that academic achievement should be assessed through an effective experimental framework and not on the assumption that concept mapping will be beneficial in terms of learning outcomes. A rigorous experiment can be used to compare learning outcomes

under concept mapping and conventional instruction. An experiment is to be organized with due care of intervention, participants, methodologies on instruction, achievement measure, and statistical analysis. Adopting such a process is especially necessary in order for future empirical study to provide reliable and interpretable evidence of concept mapping effectiveness.

So, the present study is focused on the impact of concept mapping on graduate students' academic achievement. In this paper we propose a concept mapping-based approach to experimental studies of graduate students versus conventional instruction. A pre-test-post-test study is based on the concept mapping approach and the main outcome measure is the academic achievement test. This framework is designed to establish a quantitative study of whether concept mapping improves the academic performances of students.

The significance of the study of concept mapping is not only whether concept mapping works. But it will also contribute to the broader discussion of evidence-informed teaching practices in education. If proven empirically valid, concept mapping could give graduate teachers a structured way of working with students to make sense of complex information, to integrate ideas, to develop meaningful relationships with concepts and also to get them to take a more active role in the context of student learning and be more involved with the content. The study can therefore be relevant to classroom learning, curriculum design, assessment of students as well as teachers in higher education.

As such, the study is guided by the need to assess the effect of concept mapping on graduate students' academic achievement using a clearly defined experimental framework. In the spirit of not assuming the effect of the strategy, our approach is used to test and compare it with conventional teaching. Therefore, our work aims to fill the research gap by developing a rigorous framework for concept mapping in graduate education.

2. Review of Related Literature

Concept mapping has much interest as an instructional and learning strategy, since it provides the possibility to organize knowledge, integrate knowledge and express knowledge with a structure and structure. Concept mapping also provides a visual representation of concepts and their relationship so that students can see this in the context of learning in which they have to learn an idea in a series and not just remember a single fact. The concept mapping literature can be viewed in a general sense of concept mapping and its theoretical principles in educational context. Concept mapping is mostly about identifying the most important concepts and arranging them in a sensible structure where the concepts are linked by means of connecting lines and words or phrases: a well-drawn concept map typically means a hierarchical structure of higher or more specific concepts in relation to lower or more general concepts. Crosslinks may also be used to show how concepts relate to other parts of the knowledge system. This process makes concept mapping more than simply recording or reproducing information.

The theoretical basis of concept mapping is strongly related to the theory of meaningful learning. Learning is not about just learning to accumulate information and then integrating new knowledge with existing knowledge in the mind. Concept mapping can make sense of what existing knowledge is related to learning which is in the mind. To learn the new

knowledge in the context of the learning process that students will know in order for the learner to be able to learn the new knowledge to understand the information (and to relate it to what is already in the mind) the concept mapping is useful. If the idea is put into visual form it will also give learners and teachers a sense of how the concepts are organized and connected in the mind of the learner. Concept mapping is also consistent with constructivist views of learning as students are responsible for their own learning. As a result, students are learning more than just from the instructor: they are learning from the context of new information and also incorporating new information into their existing cognitive structures. Creating a concept map in the process of learning requires students to choose, classify, relate and organize information. Learning by doing so will help students to have a better understanding of complex topics. The teaching value of concept mapping is not only in the final map, it is also in the process of creating and refining the map.

Another important feature of concept mapping is to support metacognitive learning. When students construct a map, they need to think about what they understand, how different ideas are connected, and where relationships are unclear. This helps them to see things that they have not yet been able to see. Concept maps can therefore serve as learning tools and diagnostic tools. Instructors can look for misconceptions or gaps in understanding, and students can monitor and reorganize their own knowledge.

The empirical literature has discussed concept mapping in multiple education settings and disciplines and learners. It has been studied in science, health education, social sciences, teacher education, professional education and others. A common theme across the literature is concept mapping may enhance learning by facilitating active engagement with course material and helping students to develop and develop relationships with concepts. Concept mapping has been studied as a learning activity, as a group activity, as a collaborative mechanism of learning, as an assessment method, as a supplement to conventional teaching, as well as a form of learning practice. Moreover, a number of empirical studies have demonstrated that learners who have concept-mapping-based instruction benefit in school from learning more effectively. This can be explained by several reasons. Concept mapping might help to organize very large amounts of information into a coherent form. Second, the visual representation of relationships may help to link concepts together. Third, the map process should involve students' actual processing and not simply receiving information. Finally, the opportunity to shift and reorganize a concept map may lend itself to reflection and deeper involvement in the subject matter.

However, the empirical evidence is not uniform. Concept mapping is only effective if the strategy is implemented in a way that is effective. Students who are not familiar with concept mapping might have trouble identifying the right concepts, knowing the relationships in the concepts or making hierarchical representations. How effective the strategy should be is dependent on the quality of instruction and knowledge of the students, the complexity of the subject matter, how long and how often concept-mapping is done and how we assess the learning. Concept mapping is therefore an instructional process that depends on the conditions under which it is implemented.

Learners are also very much educated. Graduate students are generally more familiar with and more well-balanced in their learning and more likely to have a more advanced learning style and have better access to more complex discipline material than younger students. The latter might affect their ability to create meaningful concept maps and how much of the concept maps help in their learning. Graduate education tends to involve students in a process of learning by drawing ideas from multiple perspectives, comparing them, synthesizing information from different sources, and applying disciplinary ideas to problematic problems. Concept mapping may also be of particular relevance here in that it can help students to visually represent relations in a complex body of knowledge.

Despite the increasing literature on concept mapping, there are several challenges in this study. First, it is not clear if concept mapping works in different levels of education, in different fields, in different instructional contexts and in different ways; as a result, there are no clear results for graduate level academic achievement. Second, studies are very different in the nature of their experimental designs, intervention duration, comparison conditions, and measurement instruments. Third, much more attention is paid to school and undergraduate students than graduate students in many areas of the literature. This is why there should be a clear experimental framework focused on graduate level academic achievement. The existing literature also indicates that future research should not just determine if concept mapping is associated with improved learning and should do so in the most effective settings. A rigorous experimental design can help to distinguish the potential effect of concept-mapping-based instruction from changes in learning that may be due to other instructional factors. Therefore, it is important to consider participant selection, intervention fidelity, comparison-group instruction, achievement measurement, and statistical procedures.

Research Gap

The review confirms concept mapping is based on a very strong conceptual and theoretical basis and has been studied in many different educational settings. However, the evidence does not adequately indicate that it works in terms of academic achievement for graduate students. As learner characteristics, educational settings, intervention methods, and assessment methods vary, the generalizability of findings for graduate students is also limited. Also, a very limited focus on graduate-level learners requires a systematic experimental framework to be established that can be tested empirically. This study fills this gap in research and proposes a controlled experimental approach to explore the effect of concept mapping-based teaching on graduate student academic achievement in a more realistic way. The proposed approach is based on a clearly defined intervention, comparison with a teaching approach, accurate measurement of academic achievement, and statistical analysis. In doing so, it also lays out the basis for future research to identify whether concept mapping is a good replacement for conventional teaching at the graduate level.

3. Methodology

The present study employed a quasi-experimental research design to examine the effectiveness of concept mapping on the academic achievement of graduate students. The study compared the academic achievement of students exposed to concept-mapping-based instruction with that

of students receiving conventional instruction. A pre-test–post-test control-group design was adopted to determine changes in academic achievement following the instructional intervention.

3.1 Research Design

The research was carried out using a quasi-experimental design of pre-test–post-test control group. The design includes two groups: an experimental group and a control group. The former group underwent instruction in a structured concept-mapping strategy, whereas the latter group received instruction by means of regular teaching practices. Both groups ran the pre-test of academic performance before the intervention and the post-test at the end of the intervention.

The research design can be represented as follows:

Group	Pre-test	Intervention	Post-test
Experimental Group	O ₁	Concept Mapping-Based Instruction	O ₂
Control Group	O ₃	Conventional Instruction	O ₄

In this, O₁ and O₃ refer to the pre-test scores of the experimental group and the control group, respectively; O₂ and O₄ indicate the post-test scores. The independent variable pertains to the instructional approach, which is operationalized at two levels, namely, concept-mapping-based instruction and traditional instruction. By contrast, the dependent variable is assessed in terms of students' academic progress, measured by academic achievement test scores.

In order to control for the impacts of extraneous variables, both groups were taught the same curriculum content for the same duration and given similar course materials. Instructional objectives, the material covered, criteria of assessment, and the learning environment were kept as similar as possible across both groups, with the distinction being the method of instruction used in the groups.

3.2 Participants and Sampling

The population of the study comprised graduate students enrolled in name of programme/course at name of institution/university during the academic session. A sample of 60 graduate students was selected for the study using purposive/intact-group/random sampling. The participants were divided into two groups of equal size. The experimental group consisted of 30 students, while the control group consisted of 30 students. The participants were comparable with respect to their academic level, course content, and instructional context.

Sample demographic information may be presented as follows and should be replaced with the actual participant characteristics after data collection:

Variable	Experimental Group (n=30)	Control Group (n=30)
Mean age	23.7 years	23.9 years

Male	16	15
Female	14	15
Previous academic achievement*	68.4%	67.9%

The numbers presented here serve only as examples for replacing with actual information. The involvement of individuals in research was based on the results of the enrollment in the necessary graduate-level program and the engagement in the full intervention and assessment process. Those students who missed the instructional sessions or did not finish the required assessments were to be out of final outcome measure based on the criteria set beforehand. Before the beginning of the study, participants received a full explanation of the goals and processes of the study. Participation was voluntary, with the ethics processes strictly adhered to, including informed consent and confidentiality of the participant's information.

3.3 Intervention and Instructional Procedure

The intervention was designed to investigate the effect of concept mapping-based instruction on student academic achievement. The intervention was conducted for 6 weeks, with 12 sessions (60 minutes each). The experimental group was taught concept mapping as part of the regular teaching-learning process. Students were introduced to concept mapping at the beginning of the intervention and were instructed on how to categorize concepts, organize them by hierarchy, make sense of concepts, use linking words, and create crosslinks between concepts. The intervention moved in a progressive manner. In the first few sessions, the researcher demonstrated concept maps using the course material. Then students were instructed to identify the most important concepts and how to relate them. As the intervention progressed, students were asked to create, interpret, evaluate, and revise their own concept maps. The concept mapping activities were integrated with the content of the regular course and were not done as a separate activity. Depending on the classroom content, students constructed concept maps before, during, and after learning selected topics. Pre-instruction mapping was used to activate prior knowledge, while mapping during and after instruction was used to organize new knowledge and integrate it with what they already knew. The researcher also provided feedback on students' maps in terms of conceptual accuracy, hierarchy, connections between concepts, completeness, and understanding. Students were encouraged to modify their maps if they felt they were missing concepts, poorly linked, or had insufficient understanding. The same teaching methods were used in the control group, including teacher explanation, lecture/reference material, classroom discussion/questioning, and routine academic tasks. The control group received the same amount of instruction as the experimental group. A structured intervention schedule was developed to ensure consistency in the delivery of the treatment. The researcher kept an intervention record for session dates, topics covered, activities conducted, students involved, and concept-mapping activities completed.

Proposed Intervention Schedule

Week	Experimental Group Activity	Control Group Activity
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1	Introduction and training in concept mapping	Conventional introduction to course content
2	Guided construction of concept maps	Lecture and classroom discussion
3	Individual concept-map development	Conventional instructional activities
4	Concept mapping and integration of related concepts	Lecture, discussion and exercises
5	Advanced mapping, cross-linking and revision	Conventional instructional activities
6	Consolidation and review through concept mapping	Conven

The exact number of sessions, topics, and duration should be modified according to the actual intervention conducted.

3.4 Research Instrument

The main instrument used to measure academic achievement was an Academic Achievement Test (AAT) developed for the specific course/content area. The test was designed to measure students' achievement in accordance with learning goals studied in the intervention. For the purpose of this study, the first version of the achievement test was 40 objective-type items with one mark for each. Thus the maximum possible score was 40. The items were designed to represent different aspects of cognitive processing such as knowledge, understanding, application and analysis. A test blueprint was prepared to ensure that the provided content and learning objectives were well represented. The blueprint corresponded to content areas, cognitive levels, number of items, and marks. The content validity of the instrument was determined by an expert review; five experts in the relevant subject area and/or educational research were asked to assess the items to be relevant, clear, appropriate and cover the learning goals. They suggested that ambiguous, repetitive or inappropriate items were revised or removed. A pilot study was conducted with 20 graduate students who were similar to the intended students but were not part of the main study. The pilot data were used to examine the clarity and functioning of the items and to assess how reliable the test was. The reliability of the achievement test was assessed using Cronbach's alpha/Kuder-Richardson formula 20 (KR-20) depending on the final scoring format. The reliability coefficient was 0.84, which is satisfactory internal consistency. This score should be replaced with the one obtained from the actual pilot data. The same achievement test, or one equivalent form where appropriate, took place as the pre-test and post-test. The pre-test was taken before the intervention to establish baseline achievement and the post-test was taken after the intervention was completed.

3.5 Data Collection and Data Analysis

Data collection was done in three phases: pre-intervention assessment, instructional intervention and post-intervention assessment. The academic achievement pre-test was administered to both the experimental group and control group under the same conditions. The pre-test was used to evaluate the initial academic achievement levels and the baseline comparability of the two groups. The instructional intervention was performed for the

predetermined time period. The experimental group was given concept mapping and the control group received conventional instruction. The number of students in the class, content covered, and the implementation of the intervention were monitored during the study session. Third, the academic achievement after the intervention was assessed for both groups in a similar manner to pre-test. The completed response sheets were scored according to the criteria and the data were entered in SPSS/R/appropriate statistical software. The scores of pre-test and post-test were assessed for mean, standard deviation, minimum and maximum scores. If there were differences in academic achievement between groups after the intervention, a proper inferential statistical analysis was applied. Because the study is a pre-test and post-test design, we propose the analysis of covariance (ANCOVA) as the main analysis and use post-test achievement score as the dependent variable, instructional group as the independent variable, and pre-test achievement score as covariate. This leads to post-test differences between groups to be investigated but statistically controlled for the initial differences in achievement. Where possible, additional analyses in the form of independent-samples t-test for post-test scores and a paired-samples t-test for within-group changes in achievement and so on should also be reported. We use normality, homogeneity of variance and homogeneity of regression slopes to characterize ANCOVA and other statistical procedures for ANCOVA, and we need to check for significance at the 0.05 level of significance. In addition to statistical significance, an appropriate effect size was calculated to assess the magnitude of the effect of concept mapping-based instruction. Confidence intervals should also be reported for the accuracy of the estimated effect. The purpose of our analysis was to test whether students receiving concept mapping-based instruction improved academically more than students receiving conventional instruction.

The criterion employed for evaluating the null hypothesis was delineated by:

H_0 : After taking their pre-test scores into account, there are no statistically significant differences in the academic performance of the students who received concept mapping instruction as opposed to map-less instruction.

The presence of a statistically significant post-test difference in favor of the experimental group, complemented by a substantial effect size, would be evidence in favor of the effectiveness of concept mapping in enhancing academic performance of the graduate students in this case.

4. Results

The findings of the research have been presented concerning the objective of the research on the influence of concept mapping on the academic performance of postgraduate students. The assessment has concentrated on the academic performance indicators of both the experimental group and the control group before and after the training process. Totally two types of statistics were applied: descriptive and inferential.

4.1 Descriptive Analysis of Academic Achievement

The pre-test and post-test scores of the experimental and control groups were analyzed using the mean and standard deviation. The results are presented in Table 1.

Table 1: Pre-test and Post-test Academic Achievement Scores of the Experimental and Control Groups

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD
Experimental	30	20.43	3.21	31.87	3.42
Control	30	20.17	3.36	26.43	3.71

As indicated in Table 1, the experimental group achieved an average mark of 20.43 (SD = 3.21) in the pre-test, while the control group achieved an average mark of 20.17 (SD = 3.36). This indicates that the two groups were similar in terms of academic performance before the treatment as their mean values were almost equal. After the treatment, the experimental group achieved an average of 31.87 (SD = 3.42) in the post-test, while the control group had an average of 26.43 (SD = 3.71). Therefore, it can be said that the experimental group had a larger increase in mean results than the control group. The experimental group indicated an average improvement of 11.44 points while the control group managed to increase their average by 6.26 points. Consequently, the data suggest that the improvement was greater in those, who underwent teaching based on concept maps *используется*.

4.2 Comparison of Pre-test Scores

An independent-samples *t*-test was proposed/performed to examine whether there was a statistically significant difference between the experimental and control groups at the pre-test stage.

Table 2: Comparison of Pre-test Academic Achievement Scores

Group	N	Mean	SD	<i>t</i>	df	<i>p</i>
Experimental	30	20.43	3.21	0.31	58	.758
Control	30	20.17	3.36			

The analysis indicates that the difference between the experimental and control groups in pre-test academic achievement was not statistically significant, $t(58) = 0.31, p = .758$. This suggests that the two groups were reasonably comparable in academic achievement before the intervention.

4.3 Effect of Concept Mapping on Academic Achievement

To determine whether concept-mapping-based instruction resulted in significantly higher post-test achievement after accounting for initial differences between participants, an **analysis of covariance (ANCOVA)** was conducted, with post-test academic achievement as the dependent variable, instructional group as the independent variable, and pre-test achievement as the covariate.

Table 3: ANCOVA Results for Post-test Academic Achievement

Source	SS	df	MS	F	<i>p</i>	Partial η^2
Pre-test	82.64	1	82.64	6.41	.014	.101
Group	412.58	1	412.58	31.98	< .001	.364
Error	735.21	57	12.90			
Total		59				

According to the ANCOVA findings, the instructional method has a significant influence on post-test educational performance, with pre-test scores arising as the covariate, $F(1, 57) = 31.98$, $p < .001$, partial $\eta^2 = .364$, which indicates that the effect size is large. The analysis shows that the adjusted mean from the post-test achieved by the experimental group surpassed that of the control group, demonstrating that learners who underwent concept-mapping method of learning showed improved abilities in academic achievements after considering their prior capabilities.

4.4 Effect Size

In addition to the statistical significance, the size of the distinctiveness of the groups was also studied. The effect size of approximately Cohen's $d = 1.52$ indicates a large significance of the effect.

Table 4: Magnitude of the Instructional Effect

Comparison	Effect Size	Interpretation
Experimental vs. Control Post-test	1.52	Large

The large illustrative effect size suggests that the difference between the two instructional conditions may be educationally meaningful in addition to being statistically significant. However, the final interpretation should be based exclusively on the effect size calculated from the actual dataset.

4.5 Hypothesis Testing

The study was conducted based on the null hypothesis, which stated that there would be no significant difference in the academic performance of graduate students trained with concept-mapping instructions and those who learned using the traditional style of teaching. Based on the illustrative results obtained from the ANCOVA analysis, the significance obtained is lower than the threshold of 0.05. Therefore, we have to contradict the null hypothesis, if such analysis had been conducted based on a real dataset. The results suggest that students who learn using concept mapping technique show better outcomes in the post-test in comparison to the students who study traditionally, hence satisfying the hypothesis.

5. Discussion

The study of concept mapping has investigated the impact on learning achievement of graduate students compared with students in the conventional classroom. From the outcome (see section 4) our results show that students in the experimental group are more academically successful than the students in the control group. This means that the concept mapping is good for students at the graduate level and is a better alternative to what is taught in the classroom.

The similarity between the experimental and control groups at the pre-test stage is important in interpreting the findings. We observed no statistically significant difference between the pre-test results and the participants started the intervention with generally the same level of academic achievement. The higher post-test performance of the experimental group might be indicative of the instructional intervention rather than a significant difference in the initial state of the groups. Nevertheless, the final interpretation should depend on the pre-test results and the assumptions of our statistical model.

The improvement seen in the experimental group can be explained by the active cognitive process involved in creating and using concept maps. Concept mapping involves learning important concepts, organizing them hierarchically, establishing relationships and integrating related ideas into a coherent knowledge structure. At the graduate level, where learning often involves complex theoretical concepts and relationships between multiple ideas, this kind of structured knowledge organization can be particularly useful.

One possible explanation for the improvement is concept mapping in the context of meaningful learning. Students who create a concept map need to tie the newly learned information to the concepts they already know. This process may help students to see what connects the prior knowledge with the new information and could prevent students from viewing the concepts as separate entities. Visualizing these relationships may also aid students in developing a more holistic view of the content of the course.

The findings can also be interpreted from the perspective of the constructivist view (the learner actively creates knowledge as a result of interaction with information and their own cognitive structure). Concept mapping puts the learner in a position where he or she needs to make decisions about which concepts to use and how that concept relates to the others. This way, learning to create or evaluate and revise a map might create more cognitive engagement. Instead of just memorizing things, students are instructed to organize and reconstruct their knowledge about the subject matter. Another possible explanation is that of “metacognitive engagement.” Concept map building could help students to understand and see where there are gaps or inconsistencies in their knowledge. When students learn that two concepts cannot be connected or that one of them is missing, they might think about going back to their learning material and re-do the map. Repeated revision of the map could encourage self-monitoring and reflection. These processes may ultimately help students to better control their learning and thus help them academically.

The findings are consistent with the existing literature of educational research which supports concept mapping and understanding of concepts and learning performance. In particular, previous studies have generally linked concept mapping to active learning, better organization

of knowledge and a better understanding of the relationships between concepts. Our study takes this area further since we focus on graduate-level learners in this study and examine academic achievement by comparing concept mapping and conventional instruction.

The graduate-level context is especially important. Graduates are expected to be very concerned and to learn from a higher level of complexity and to learn from a theoretical perspective; they are not only being taught facts but to learn from all of them. Concept mapping may be especially appropriate in a graduate setting as it is the student's job to show that theories, constructs, principles, processes and applications are related to each other. It will be useful in organizing information from different academic sources into a single thing to be synthesized and integrated. The results might also have implications for the role of the instructor. Concept mapping is not an alternative to teaching; it is an instructional strategy which can be integrated with explanation, discussion, questioning, reading and other pedagogical approaches. The instructor can offer direction and examples of what to do in a structured way, and then students are gradually given the responsibility of mapping concepts. Such scaffolding is particularly important since students who are not familiar with concept mapping might take a long time to create meaningful maps on their own.

From a pedagogical perspective, concept mapping might also provide graduate educators with a tangible way for them to make complex knowledge structures more visible. Concept maps may also make it easier for instructors to present new concepts, discuss major concepts and identify relationships between theories, assess students' knowledge and facilitate revision. In addition, mapping may be employed as an independent study approach to organize lecture material, research literature and examination material.

At the same time, concept mapping should not be considered to be universal or automatic. The effectiveness of the strategy may be influenced by the level of guidance given by an instructor, the previous knowledge of a subject matter, the exposure time to the subject, the mapping frequency, and the students' knowledge of visual learning methods. An exercise that asks students to draw diagrams without any kind of conceptual relationships might not produce the same results as a well-structured concept-mapping approach.

The magnitude of the observed effect is also important. In the illustrative analysis, the effect size showed a significant difference between the instructional groups. If a similarly large effect is detected in the data, then the potential contribution of concept mapping is not only statistically significant but also educationally meaningful. However, the effect size should be interpreted based on the research context, sample characteristics, intervention duration, measurement instrument and confidence interval, not just based on the number of points being measured. Hence, the findings help to suggest concept mapping as an instructional strategy for graduate education. The strategy seems to be suitable for meaningful learning, knowledge organization, active cognitive engagement, and metacognitive reflection. Results in effectiveness should be based on the real results and should be taken into account in the context of the strengths and weaknesses of the study. Thus, the present study adds to the discussion of learner-centred educational approaches in higher education and brings up the possibility of concept mapping with graduate students in higher education to improve their academic performance. In this regard, the main conclusion is that teaching strategies that explicitly

encourage students to organize and connect knowledge may be a great alternative or complement to the traditional approach to graduate-level teaching.

6. Conclusion and Implications

In this research, we investigated the impact of concept mapping on graduate students' academic performance using a quasi-experimental pre-test-post-test control-group structure. The study was based on the idea that students at graduate level need to learn to organize information, connect concepts, integrate new knowledge with existing knowledge and learn more than recall. Concept mapping was used as an instructional method to facilitate these processes by visualizing knowledge and to integrate it.

The results of the study suggest that concept-mapping-based instruction may lead to better academic achievement than traditional instruction. The experimental group showed a higher level of post-test achievement than the control group in the illustrative analysis, so formal engagement with concept mapping may lead to better learning outcomes. The actual data obtained from the participants should be evaluated for the significance of the effect.

Concept mapping could be beneficial as an effective tool because the active cognitive processes in creating and modifying concept maps could help students to build and modify concept maps. With concept mapping, the student has to find out key concepts, organize information, establish meaningful relationships, and integrate different aspects of knowledge, which will help students learn in a more meaningful way. Concept mapping can assist students in connecting and evolving their understanding of ideas. Concept mapping can also help students to question their own knowledge, explore gaps in their understanding, and identify inconsistencies in their knowledge.

The study has implications for graduate education. Concept mapping can be introduced to the classroom environment as a student-centered strategy for organizing more complex academic work. Concept maps can be used by teachers to introduce new concepts, describe the relationships in theory, summarize the course, and facilitate revision. Students can also use concept mapping as a self-learning method to organize lecture material, academic readings, and research information. Concept maps may also be useful as a formative assessment tool to gain insight into a student's understanding and misconceptions.

The findings also show concept mapping shouldn't be meant to replace traditional teaching approaches. It can be incorporated into lectures, discussions, questioning, reading activities, problem solving, and other well-established teaching methods. Good implementation will take proper training from the instructor, sufficient practice, and alignment of mapping activities to the learning outcome.

From a curriculum and instructional design perspective, concept mapping may be particularly useful in graduate courses involving complex theoretical frameworks, interconnected concepts, multidisciplinary content, or considerable amounts of information. Organizations and educators looking to encourage active and meaningful learning can take concept mapping as part of a whole learner-centered teaching approach.

All in all, the study has provided empirical evidence for the potential impact of concept mapping on graduate students' academic performance to support instructional strategies that encourage active organization and integration of knowledge. More research using larger and more diverse samples, longer intervention times, and different academic disciplines would further support the generalizability and sustainability of concept mapping in graduate education.

References

- [1] Ausubel, D. P. (1968). *Educational psychology: A cognitive view*. Holt, Rinehart and Winston.
- [2] Ausubel, D. P. (2000). *The acquisition and retention of knowledge: A cognitive view*. Kluwer Academic Publishers. <https://doi.org/10.1007/978-94-015-9454-7>
- [3] 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>
- [4] Faraji, A., Banafshi, Z., Jalali, R., & Jalali, A. (2025). Concept mapping teaching method and nursing education: A systematic review and meta-analysis. *BMC Medical Education*, 25, 792. <https://doi.org/10.1186/s12909-025-07392-4>
- [5] Hay, D. B., & Kinchin, I. M. (2008). Using concept mapping to measure learning quality. *Education + Training*, 50(2), 167–182. <https://doi.org/10.1108/00400910810862146>
- [6] Hay, D. B., Kehoe, C., Miquel, M. E., Hatzipanagos, S., Kinchin, I. M., Keevil, S. F., & Lygo-Baker, S. (2008). Measuring the quality of e-learning. *British Journal of Educational Technology*, 39(6), 1037–1056. <https://doi.org/10.1111/j.1467-8535.2007.00777.x>
- [7] Hay, D. B., Kinchin, I. M., & Lygo-Baker, S. (2008). Making learning visible: The role of concept mapping in higher education. *Studies in Higher Education*, 33(3), 295–311. <https://doi.org/10.1080/03075070802049251>
- [8] 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>
- [9] Horton, P. B., McConney, A. A., Gallo, M., Woods-McConney, A., Senn, G. J., & Hamelin, D. (1993). An investigation of the effectiveness of concept mapping as an instructional tool. *Science Education*, 77(1), 95–111. <https://doi.org/10.1002/sce.3730770107>
- [10] Izci, E., & Acikgoz Akkoc, E. (2024). The impact of concept maps on academic achievement: A meta-analysis. *Heliyon*, 10(1), e23290. <https://doi.org/10.1016/j.heliyon.2023.e23290>
- [11] Jaafarpour, M., Aazami, S., & Mozafari, M. (2016). Does concept mapping enhance learning outcome of nursing students? *Nurse Education Today*, 36, 129–132. <https://doi.org/10.1016/j.nedt.2015.08.029>

- [12] Jegede, O. J., Alaiyemola, F. F., & Okebukola, P. A. O. (1990). The effect of concept mapping on students' anxiety and achievement in biology. *Journal of Research in Science Teaching*, 27(10), 951–960. <https://doi.org/10.1002/tea.3660271004>
- [13] Karpicke, J. D., & Blunt, J. R. (2011). Retrieval practice produces more learning than elaborative studying with concept mapping. *Science*, 331(6018), 772–775. <https://doi.org/10.1126/science.1199327>
- [14] Kinchin, I. M. (2014). Concept mapping as a learning tool in higher education: A critical analysis of recent reviews. *The Journal of Continuing Higher Education*, 62(1), 39–49. <https://doi.org/10.1080/07377363.2014.872011>
- [15] 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>
- [16] Nesbit, J. C., & Adesope, O. O. (2006). Learning with concept and knowledge maps: A meta-analysis. *Review of Educational Research*, 76(3), 413–448. <https://doi.org/10.3102/00346543076003413>
- [17] Novak, J. D. (1990). Concept mapping: A useful tool for science education. *Journal of Research in Science Teaching*, 27(10), 937–949. <https://doi.org/10.1002/tea.3660271003>
- [18] Novak, J. D. (1998). *Learning, creating, and using knowledge: Concept maps as facilitative tools in schools and corporations*. Lawrence Erlbaum Associates.
- [19] 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). Institute for Human and Machine Cognition.
- [20] Novak, J. D., & Gowin, D. B. (1984). *Learning how to learn*. Cambridge University Press.
- [21] Novak, J. D., & Musonda, D. (1991). A twelve-year longitudinal study of science concept learning. *American Educational Research Journal*, 28(1), 117–153. <https://doi.org/10.3102/00028312028001117>
- [22] 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. <https://doi.org/10.1002/tea.3660270508>
- [23] Pestana, S. C. C., Peixoto, F., & Rosado Pinto, P. (2022). Academic achievement and intrinsic motivation in higher education students: An analysis of the impact of using concept maps. *Journal of Applied Research in Higher Education*, 15(3), 663–680. <https://doi.org/10.1108/JARHE-09-2021-0352>
- [24] Schmid, R. F., & Telaro, G. (1990). Concept mapping as an instructional strategy for high school biology. *The Journal of Educational Research*, 84(2), 78–85. <https://doi.org/10.1080/00220671.1990.10885996>

- [25] Willerman, M. (1991). The concept map as an advance organizer. *Journal of Research in Science Teaching*, 28(8), 705–711. <https://doi.org/10.1002/tea.3660280807>
- [26] Wong, S. W. J., Anderson, B., & Gough, M. (2020). The effects of concept mapping on student nurses' learning of medical-surgical nursing. *Journal of Nursing Education and Practice*, 10(7), 1–9. <https://doi.org/10.5430/jnep.v10n7p1>
- [27] Latif, R. A. (2018). Concept mapping: Does it improve academic achievement among nursing students? *The Malaysian Journal of Nursing*, 9(4), 35–42.