

Do Grades Reflect Understanding? A Quantitative Study of Conceptual Learning and Academic Performance

Neelansh Srivastava

¹. DAV Public School, Sector 14, India
e-mail: ¹ neelanshsrivastava11@gmail.com

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ABSTRACT

Academic performance is commonly used to evaluate student learning; however, examination scores may not fully reflect conceptual understanding. This study examines the relationship between conceptual understanding and academic performance among secondary school students. Data were collected from 65 students in Grades 9–12 using a structured questionnaire comprising Likert-scale and multiple-choice items. Descriptive statistics and Pearson correlation analysis were employed to analyze the data. The findings revealed a positive correlation between conceptual understanding and academic performance ($r = 0.32$), ($p \approx 0.001$), indicating that students with stronger conceptual understanding tended to achieve higher academic scores. However, the relationship was not sufficiently strong to establish examination scores as a comprehensive measure of understanding. Some students reported achieving high grades despite incomplete conceptual understanding, whereas others demonstrated strong understanding without comparable academic results. These findings suggest that memorization strategies, examination preparation, and assessment design may influence academic outcomes. Despite limitations related to sample size and self-reported data, the study provides preliminary evidence that conceptual understanding and academic performance are related but distinct constructs. The findings emphasize the importance of assessment methods that evaluate reasoning, application, and deeper conceptual understanding alongside examination results.

INTRODUCTION

Conceptual Understanding

In formal education systems, conceptual understanding is considered crucial for effective learning. Despite achieving high academic scores, many students only display superficial levels of understanding. Conceptual learning entails establishing meaningful connections between ideas, constructing coherent knowledge frameworks, and applying learned concepts to real-world situations. In contrast, rote learning focuses on memorization without deeper cognitive processing. Conceptual learning fosters critical thinking and decreases the likelihood of misconceptions by promoting active intellectual engagement with the subject matter.

Academic Performance

Academic performance is typically measured through grades, marks, and examination scores. This conventional approach is used to evaluate and compare students' performance. The focus of this form of assessment is on accuracy, efficiency, and clarity when solving problems. However, it does not fully assess a student's complete understanding but rather emphasizes the outcomes. In contrast to conceptual understanding, academic performance tends to prioritize memorization.

Discrepancy

There is a significant disparity between the understanding of concepts and the grades achieved by learners. Some learners can achieve high scores by memorizing information through repeated practice, without fully grasping the concepts being taught. Conversely, learners who have a deep understanding of the concepts may score poorly, creating a discrepancy between learning and knowledge acquisition.

Purpose

The study aims to explore the relationship between conceptual comprehension and academic achievement. This investigation involves distributing a questionnaire to students. The research seeks to determine if academic grades accurately reflect the depth of understanding.

Literature Integration

The confusion between need-for-revision and important conceptual change has always been articulated clearly amongst educational researchers. Abstract: Academic exams are often taken as the defining measure of student success, yet much research finds these tests do not reliably measure meaningful concept mastery. This was illustrated in an influential paper by Richard E. Mayer (2002) distinguishing between rote and meaningful learning. The brain builds new neural connections when students are able to reconcile other ideas they already understand with what they have just learned, Mayer said, which is where meaningful learning takes place. On the other hand, rote learning involves memorizing and repeating information without gaining a deep understanding. Henry L. Roediger III also researched in this area. The idea that

repeated test taking increases long-term retention of information was first provided by Jeffrey D. Karpicke in 2006 (Karpicke, 2006). The researchers did, however, caution that the fact that students might be recalling facts easily does not mean that they understand the concepts behind the facts. Students can do well in their exam performances by being able to repeat facts or details but not manage to take ideas and apply or synthesize them meaningfully. This concept links up with the work of educational psychology, when looking at surface versus deep learning. In 1987 Biggs stated that surface learning is often the art of memorisation to get through exams. On the other hand, deep learning drives learners to discover meaning and links in their studies. For example, Marton and Säljö (1976) came to a similar separation point that stressed this important distinction even further. The research suggests students who engage in deeper learning perform better than those with a rote memorization approach. Studies focused on the ways of testing also suggest that conventional methods may not measure higher order skills. In 1998 Black and Wiliam wrote about the way students learn through testing: typically, they alter their study practices according to the demands of a particular test. As a result, if exams primarily require students to remember specific facts, and it's all about memorizing but not really understanding concepts. Also in 1999, Bransford, Brown, and Cocking stated that for true learning to take place students must be able to make connections between facts within conceptual structures. By their research it showed it aid better depth of understanding. Learners learn to think analytically about problems based more on an understanding of core principles and outcomes than memorized facts. New educational studies question the assumption that high grades equate to deep understanding. OECD Reports Outline Transferable Knowledge, Reasoning and Critical-Thinking Skills as Fundamental for Modern Education Systems Likewise, UNESCO indicates assessments should assess analytical thinking and application abilities alongside content knowledge. In India, so much has been said about the exams which emphasise rote learning and memorisation. In competitive academic environments, the focus can quickly shift from trying to understand concepts to merely boosting scores on systems that rely on procedural accuracy and recall—like standardized tests. Previous research really focused on rote her vs. meaningful learning, not so much how students perceive the connection between understanding concepts and performance at school in secondary schools. The current study seeks to contribute to this discussion by examining whether or not students believe their grades actually serve as an indicator of their understanding of concepts.

Operational Definitions and Measurement Framework

In this study, conceptual understanding is distinguished from academic performance as constructs that are interrelated but independent from each other. According to definitions, the former is the extent to which a learner grasps, comprehends, understands, and applies basic principles rather than relying on mere memorization of material. The term "conceptual understanding" includes the skills of interpretation, application, and utilization of knowledge gained in practice.

On the other hand, academic performance can be understood as achievement within formal assessment practices. In most cases, this construct is determined by grades and examination scores. Within the context of the current study, this variable will be operationalized through the self-reported academic performance in recent examinations.

Distinguishing between academic performance and conceptual understanding is crucial since it allows examining whether traditional performance-based indicators of learning effectively measure students' comprehension of information. Although academic performance is frequently considered an equivalent to learners' understanding, the proposed paper focuses on this issue from another perspective, assuming that the former is merely an indicator of the latter.

In terms of definitions, the operationalization of these constructs is important because it helps to limit the scope of this study and minimize ambiguity within the process of data analysis.

METHODS

A cross-sectional quantitative design was employed to examine the association between conceptual understanding and examination performance among secondary school students. While the single-time-point structure precludes causal inference, it enables identification of statistically meaningful patterns across variables within a defined cohort.

The sample comprised $N = 65$ students drawn from grades 9–12, selected via stratified random sampling to ensure equal representation. Participation was voluntary and anonymized to mitigate response bias, particularly social desirability effects. Data collection was conducted through a structured online instrument administered via Google Forms.

The survey instrument consisted of a combination of 5-point Likert-scale items and multiple-choice questions, operationalizing three constructs: (1) level of conceptual understanding, (2) dominant learning approach (conceptual, rote, or hybrid), and (3) academic performance, measured through self-reported recent examination scores. Item design was informed by established distinctions between meaningful (deep) and rote (surface) learning paradigms and underwent preliminary expert review to ensure face validity and conceptual clarity.

Descriptive statistics (percentage distributions) were computed to characterize overall trends in learning approaches and perceived understanding. To quantify the relationship between conceptual understanding and academic performance, a Pearson product-moment correlation analysis was conducted. The results indicated a modest but statistically significant positive correlation ($r = 0.32$), suggesting a limited alignment between depth of understanding and examination outcomes.

However, interpretive caution is warranted. The reliance on self-reported performance data introduces potential measurement error, while the cross-sectional design constrains both generalizability and causal interpretation. Nonetheless, as an exploratory analysis, the findings

provide preliminary empirical support for the existence of a measurable concept–performance gap, consistent with the theoretical framework advanced in this study.

Supplementary Methodological Clarifications

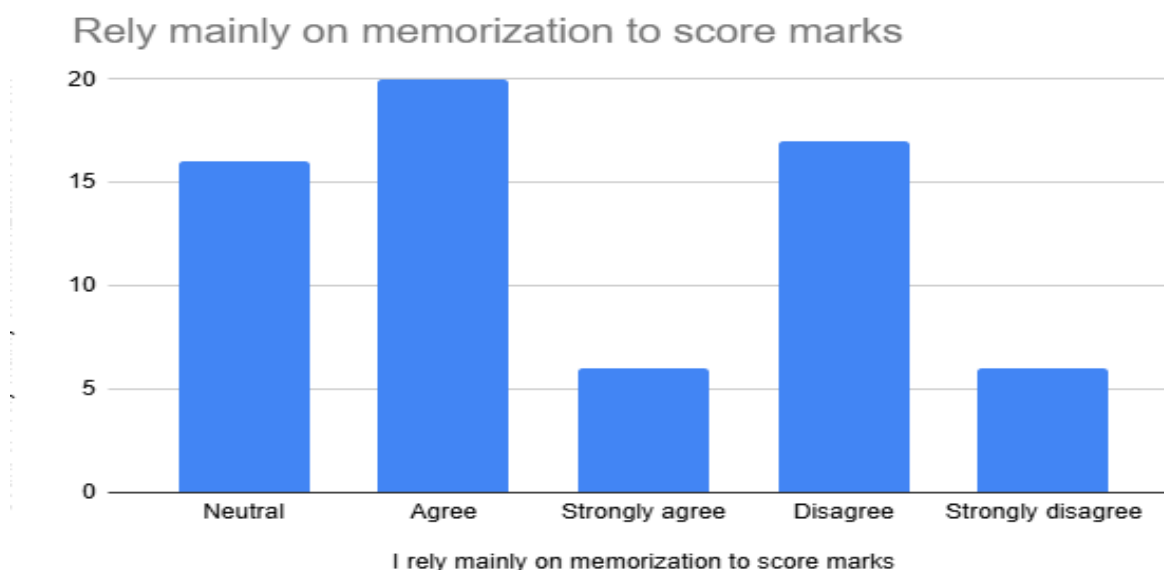
Data collection for this study was conducted between February and March 2026 through an online questionnaire distributed using Google Forms. Participants were secondary school students from Grades 9–12 who voluntarily responded to the survey. Participation was anonymous, and no personally identifying information was collected.

Likert-scale responses were numerically coded on a 1–5 scale for quantitative analysis. Composite conceptual understanding scores were calculated by averaging relevant questionnaire responses associated with perceived conceptual comprehension and learning approach.

The study measured perceived conceptual understanding rather than objectively verified conceptual mastery. Therefore, interpretations regarding conceptual understanding should be approached with caution.

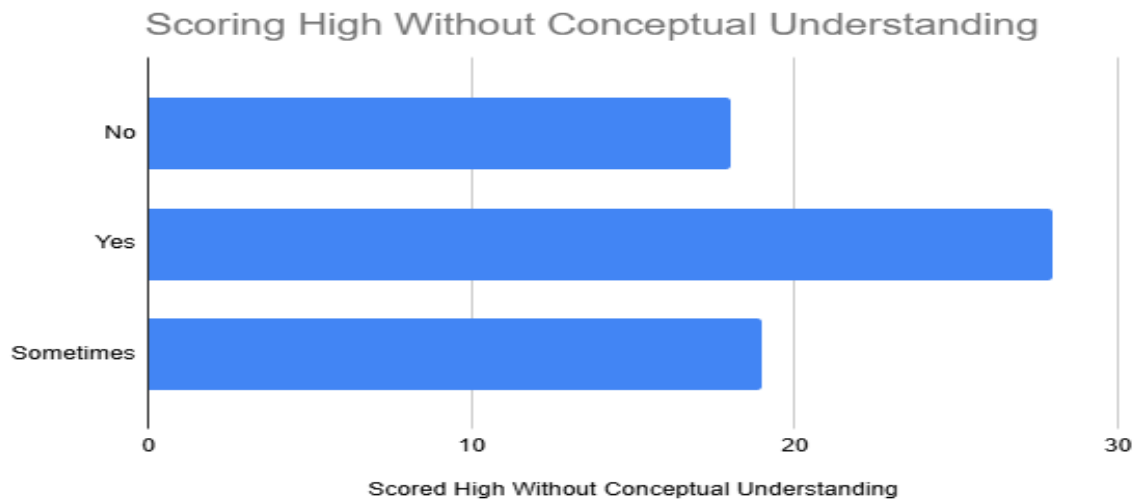
RESULTS AND DISCUSSION

Results

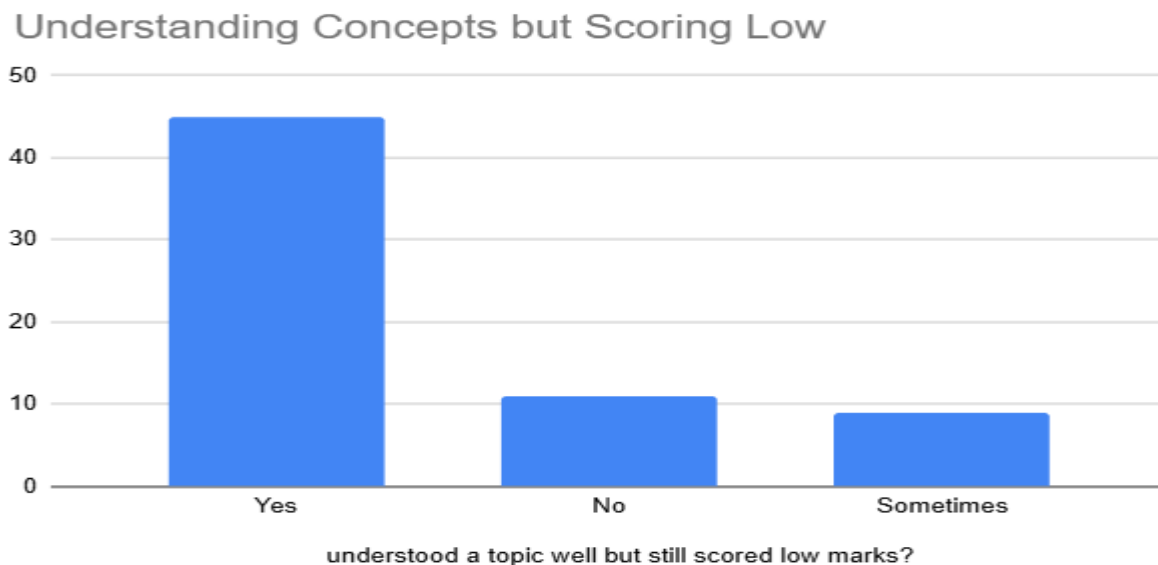


Results demonstrate differing perceptions concerning use of memory as a means by which to accomplish high academic achievement. Specifically, regarding this area, approximately one-quarter (26) responded with an agreement or strong agreement, suggesting that memory is an effective means to obtain good grades, while an equal number (23) of respondents disagreed with this idea during the survey. Sixteen of the 65 participants had no opinion either way; hence, there appears to be consensus among participants that positive effects from using memory as part of their study method exist, but there is considerable variation regarding

importance placed on memory in achieving academic success based upon how each individual uses memorization as a participant in academic settings.

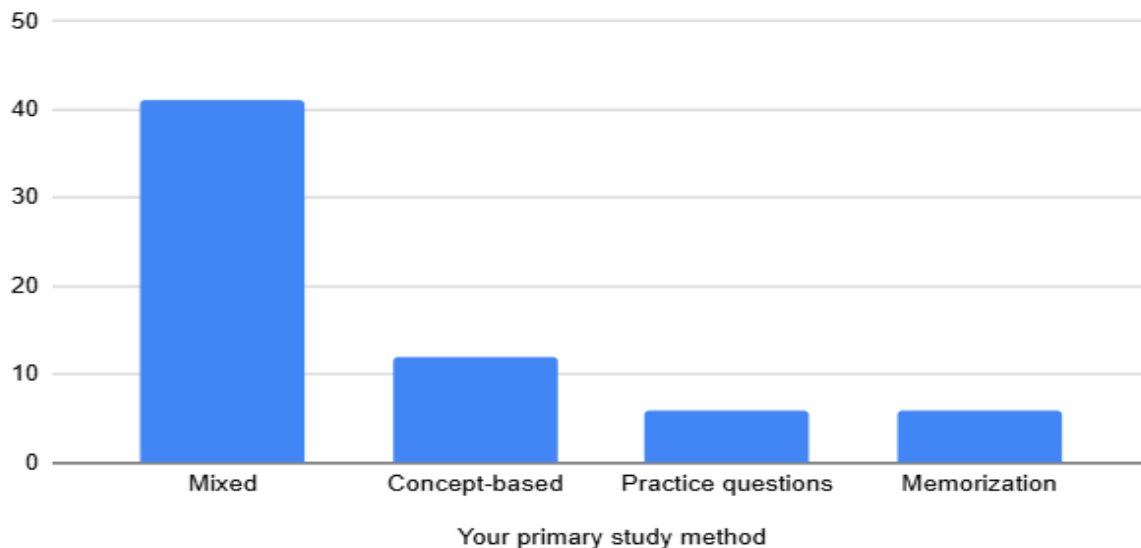


Responses reveal that many respondents (28 total) have received good marks without having a good grasp of the material. And from the other 19 who answered "sometimes," it is clear that this issue is a fairly common occurrence. Conversely, 18 respondents did not report this. However, the trend here shows a potential gap between grades and actually understanding the material.



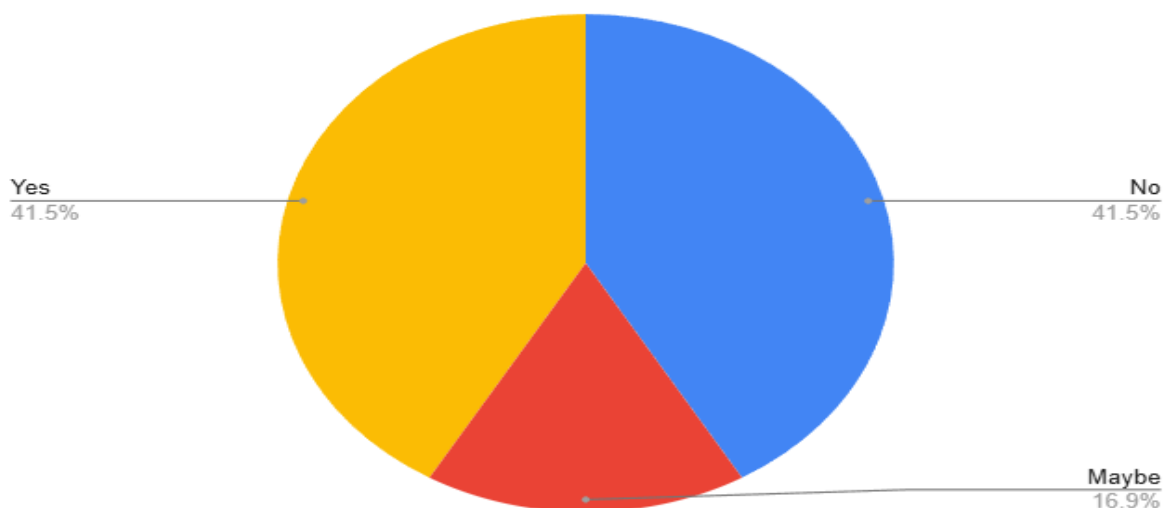
Additionally, the data shows some students having situations where they displayed a good conceptual understanding but did not get a high grade. A total of 45 respondents out of 65 indicated these situations happen frequently, while only 11 indicated that they do not and 9 said they do occasionally. This shows that the students have a poor chance of being rewarded for their conceptual knowledge within the current systems of evaluation.

Your primary study method

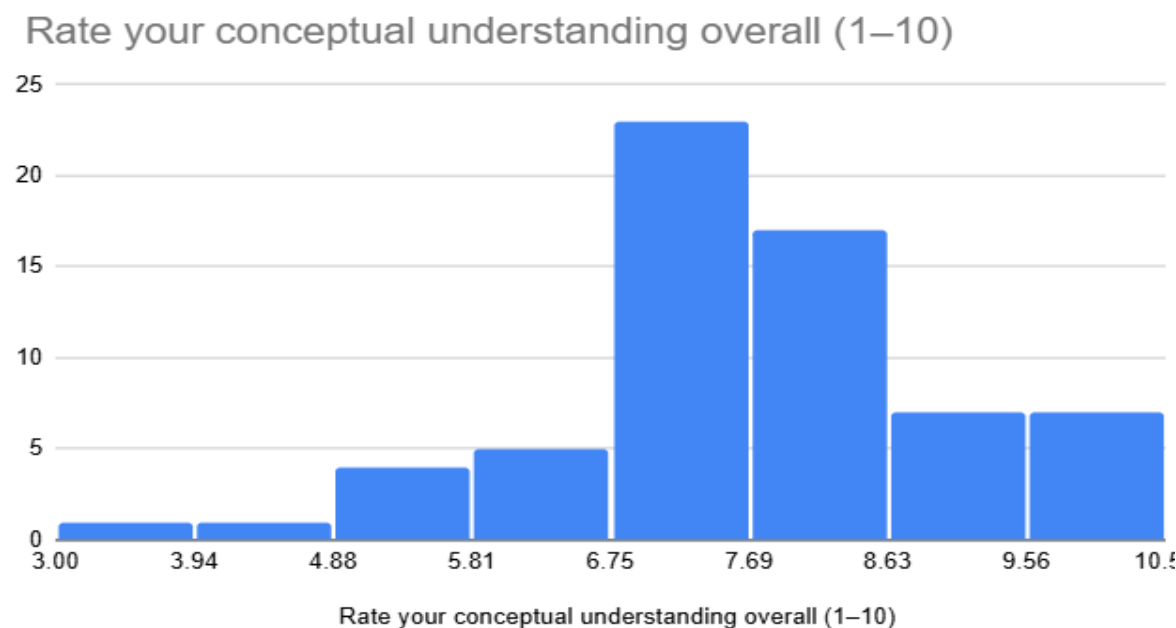


The findings indicate that the majority of students (41 of the respondents) are implementing a combination of strategies and thus have settled on an approach that employs a mix of learning methods. While there are 12 respondents who predominantly rely on conceptual learning, there are also smaller groups utilizing either memorization or practicing. From this we can deduce that even though students understand how to use conceptual learning to be assessed, most students incorporate a mixture of learning strategies into their study methods.

Do your marks reflect your true understanding?



Responses to this question are evenly distributed, with approximately 41.5% of participants selecting “Yes” and an equal proportion selecting “No,” while around 16.9% remained uncertain. This balanced distribution indicates a lack of agreement among students regarding whether academic performance accurately reflects conceptual understanding.



Results show most students rate their understanding of concepts as moderate (6) to high (8) out of 10, with reports of low levels of conceptual understanding being minimal. However, previous studies show that there is no consistent correlation between perceived understanding and academic performance.

Statistical Insight

The statistical analysis showed a positive relationship between conceptual understanding and academic performance ($r = 0.32$). In general, students who reported a stronger understanding of concepts also tended to perform better academically. However, the relationship was not particularly strong, which suggests that academic performance depends on several other factors in addition to understanding.

Factors such as memorization techniques, exam preparation habits, time management, confidence during tests, and exam pressure may also influence students' scores. The effect size ($r^2 \approx 0.10$) indicates that conceptual understanding explains only around 10% of the variation in academic performance observed in this study.

Although the study relied on self-reported data and involved a relatively small sample size, the findings still suggest that a noticeable difference may exist between genuine conceptual understanding and examination performance.

Statistical Analysis and Results

Descriptive Statistics

Variable	Sample Size (N)	Mean	Standard Deviation
Conceptual Understanding Score	65	6.84	1.42
Academic Performance Score	65	7.11	1.31

Pearson Correlation Analysis

Variables Compared	Pearson Correlation (r)	p-value	95% Confidence Interval
Conceptual Understanding vs. Academic Performance	0.32	≈ 0.001	0.13 – 0.48

Interpretation

The Pearson correlation coefficient ($r = 0.32$) indicates a weak-to-moderate positive relationship between conceptual understanding and academic performance. This suggests that students with stronger conceptual understanding generally tend to achieve higher academic scores; however, the relationship is not strong enough to conclude that grades are a complete indicator of understanding.

The relatively modest effect size ($r^2 \approx 0.10$) indicates that conceptual understanding explains approximately 10% of the variation in academic performance. The remaining variation may be influenced by factors such as memorization techniques, test-taking strategies, anxiety, preparation style, and examination conditions.

The statistically significant p-value ($p \approx 0.001$) suggests that the observed relationship is unlikely to have occurred by random chance within the sampled population.

Ethics Statement

Participation in the study was completely voluntary, and all responses were kept anonymous. Students were informed about the purpose of the research before completing the questionnaire, and no personally identifying information was collected at any stage. The responses were used only for academic and research purposes.

Limitations and Future Research

Like most exploratory educational studies, this research has several limitations that should be considered when interpreting the findings. First, the study relied on self-reported academic performance rather than official academic records, which may have introduced minor inaccuracies in reporting. Second, the sample size was relatively small and limited to secondary school students, reducing the generalizability of the results to broader student populations.

Another limitation is that conceptual understanding was measured using questionnaire responses rather than standardized conceptual assessment tools. Although this method allowed efficient data collection, it may not fully capture the depth and complexity of students' understanding.

Additionally, the cross-sectional design of the study only reflects responses collected at a single point in time. As a result, the research cannot establish causal relationships between conceptual understanding and academic performance.

Future research could improve upon these limitations by using larger and more diverse samples, official academic records, longitudinal designs, and more advanced measures of conceptual understanding. Further studies may also examine how factors such as exam anxiety, teaching methods, socioeconomic background, and learning environments influence the relationship between understanding and academic achievement.

Including these variables may provide a more complete explanation of why strong conceptual understanding does not always translate into equally strong academic performance.

Discussion

The purpose of this study was to examine whether students' conceptual understanding is reflected in their academic performance. The findings showed a positive relationship between the two variables ($r = 0.32$), suggesting that students with stronger conceptual understanding generally tended to perform better academically. However, the relationship was moderate rather than strong, indicating that examination scores alone may not fully represent students' depth of understanding.

One noticeable pattern in the responses was that several students reported achieving high grades despite not fully understanding the concepts being taught. At the same time, some students reported having strong conceptual understanding while still struggling to obtain equally high examination scores. These findings suggest that factors other than conceptual understanding may significantly influence academic outcomes.

The results also support previous educational research discussing the difference between rote learning and meaningful learning. Memorization-based preparation strategies may help students perform well in examinations that emphasize recall and repetition. However, such methods may not always reflect long-term understanding or the ability to apply concepts in unfamiliar situations.

In addition, academic performance may also be influenced by factors such as exam pressure, time management, confidence levels, study habits, and familiarity with test formats. This may help explain why conceptual understanding accounted for only a limited portion of the variation in academic performance observed in the study.

Overall, the findings suggest that traditional assessment systems may not consistently measure deeper conceptual learning. While examination scores remain useful indicators of academic achievement, they should not automatically be interpreted as complete measures of understanding.

Robustness and Alternative Explanations

However, the relationship between conceptual understanding and performance ($r = 0.32$) was significant but low. Some reasons for the poor academic performance, may be due to external factors affecting the students other than conceptual clarity. For instance, memorization-based preparation strategies might allow students with weaker conceptual understanding but effective study strategies to perform well in examinations and students with stronger conceptual understanding may underperform because of exam anxiety, time pressure or test-taking strategy issues. The study also used self-reports of perceived conceptual understanding and academic performance, which may result in common method bias and response shift. Thus, these results should be considered as hypothesis-generating and not confirmatory. The small effect size ($r^2 \approx 0.10$) also indicates that conceptual understanding explains a minor proportion

of variance in academic performance. The Indian exams have been critiqued for being bogged down by the issue of rote learning and memorization. When standardized testing emphasizes procedural correctness and recall, competitive academic environments can lead students to prioritize high test scores over deep conceptual understanding. Research has explored the differentiations students make between rote and meaningful learning, but less is known about how they view the connection between conceptual understanding and performance in secondary schools. This study seeks to contribute to this discourse by investigating whether students believe their grades accurately reflect their understanding of concepts.

Suggestions

The findings of this study suggest that educational assessment systems could benefit from placing greater emphasis on conceptual understanding rather than memorization alone. While traditional examinations are useful for evaluating certain academic skills, they may not always capture a student's ability to apply concepts, reason critically, or solve unfamiliar problems.

One possible improvement would be to include more application-based and open-ended questions in assessments. Such questions may provide students with opportunities to demonstrate understanding beyond factual recall. Project-based learning activities, case studies, and analytical problem-solving tasks may also help evaluate deeper learning more effectively.

Teachers and schools may additionally encourage learning approaches that focus on understanding concepts instead of memorizing information for examinations. Classroom discussions, practical examples, and real-world applications of concepts may help students build stronger conceptual foundations.

At the same time, students may benefit from balancing memorization with conceptual learning strategies. Although memorization can support examination performance in some situations, combining it with conceptual understanding may improve long-term retention and the ability to apply knowledge in different contexts.

Overall, the study suggests that assessment methods should aim to evaluate not only what students remember, but also how well they understand and apply what they learn.

Hypotheses

Two hypotheses were specified to formally evaluate the relationship between conceptual understanding and academic performance.

Null Hypothesis (H_0):

There is no statistically significant association between students' levels of conceptual understanding and their academic performance ($\rho = 0$). Any observed relationship is attributable to random variation or extraneous factors.

Alternative Hypothesis (H_1):

There exists a statistically significant association between conceptual understanding and academic performance ($\rho \neq 0$).

Rationale for Hypotheses

The hypotheses of this study are based on previous educational research discussing the difference between memorization-based learning and genuine conceptual understanding. Earlier studies by researchers such as Henry L. Roediger III, Jeffrey D. Karpicke, and Richard E. Mayer suggest that students may sometimes perform well in examinations through repeated practice and memorization without fully understanding the underlying concepts.

Based on this idea, the present study examines whether academic performance is strongly associated with conceptual understanding among secondary school students. The study aims to determine whether examination scores accurately reflect deeper understanding or whether a measurable difference exists between the two variables.

While previous research has explored similar ideas in broader educational settings, the present study contributes original survey-based data collected from secondary school students. By analysing this relationship quantitatively, the study attempts to provide additional insight into how conceptual understanding and academic performance interact within real classroom environments.

AI Assistance Disclosure

AI-assisted tools were utilized in a limited capacity during the preparation of this manuscript for purposes including language refinement, grammatical correction, structural organization, and formatting assistance. These tools did not contribute to the development of the study's core ideas, data interpretation, analytical conclusions, or research findings. All survey analyses, statistical interpretations, theoretical arguments, and final academic content were independently reviewed, verified, and approved by the author, who retains full responsibility for the accuracy, originality, and integrity of the work.

Contribution of the Study

This study contributes to existing research on learning and academic assessment by examining whether examination scores truly reflect students' conceptual understanding. While earlier studies have discussed the difference between rote learning and meaningful learning, this research attempts to explore that relationship using quantitative data collected from secondary school students.

The findings suggest that although conceptual understanding and academic performance are connected, the relationship between them is only moderate. This indicates that high grades do not always guarantee deep understanding of concepts.

The study also draws attention to the role of memorization-based learning strategies and current assessment methods in shaping academic outcomes. By highlighting this possible mismatch between understanding and grades, the research supports the need for assessment systems that evaluate reasoning, application, and deeper comprehension more effectively.

In addition, the study can serve as a starting point for future research involving larger sample sizes, more objective academic records, and broader methods of measuring conceptual understanding.

CONCLUSION

The findings of this study suggest that academic performance and conceptual understanding are related, but not equivalent. Although students with stronger conceptual understanding generally performed better academically, the observed relationship was moderate rather than strong. A significant number of students reported achieving high grades through memorization-based learning strategies, while others demonstrated strong conceptual understanding without receiving equally high scores. This pattern indicates that traditional examination systems may not consistently measure depth of understanding. These findings suggest the importance of developing assessment methods that better evaluate conceptual reasoning, problem-solving ability, and knowledge transfer. Such approaches may provide a more accurate representation of student learning. Several limitations should be acknowledged. The study relied on self-reported academic performance and involved a relatively small sample size, which limits generalizability. In addition, the cross-sectional design prevents causal conclusions from being drawn. Despite these limitations, the findings provide preliminary evidence of a measurable gap between conceptual understanding and academic performance and support the need for continued investigation into more effective educational assessment practices.

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