Impact of Note-Taking Strategies on Listening Comprehension: Evidence from Omani University Students

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Abstract

Effective listening is essential for academic success, yet many students struggle to process and retain information during lectures. Note-taking (NTK) is recognized as an important strategy for supporting comprehension and memory. However, the specific impact of different NTK methods on listening performance is under-researched. This study investigates the relationship between students' NTK strategies and listening comprehension in academic settings. It highlights NTK as a key skill for cognitive processing and information retention. Using a cross-sectional design, data were collected from 40 randomly selected Omani university students through a questionnaire measuring strategy use, perceived listening comprehension, and NTK effectiveness. Descriptive statistics, Pearson's correlation, ANOVA, and regression analyses were applied. Results revealed that outline and mind-mapping strategies were the most frequently used and showed a significant positive correlation with comprehension and recall scores. ANOVA indicated significant differences in comprehension based on strategy type, while regression analysis identified the outline method as the strongest predictor of listening comprehension. Qualitative responses supported these findings, emphasizing improved understanding, organization, and memory as key benefits. Overall, the study demonstrates that structured NTK techniques enhance lecture content processing and lead to better academic listening performance.

Keywords: Note-taking strategies, listening comprehension, higher education, academic skills, mind mapping

- **Received:** June 12, 2025
- **Accepted:** December 14, 2025
- **Published:** January 2, 2026

DOI: 10.56540/jesaf.v5i1.119

To cite this article (APA):
Eragamreddy, N. (202). Impact of Note-Taking Strategies on Listening Comprehension: Evidence from Omani University Students. *Journal of English Studies in Arabia Felix, 5*(1), 1-17.
DOI:10.56540/jesaf.v5i1.119

Introduction

Listening comprehension is a fundamental skill in education because it enables students to process, interpret, and integrate spoken information (Marx et al., 2017; Rost, 1994). Classroom discourse depends on this ability, as learners construct meaning and deepen their understanding through interaction (Nystrand, 2006; Wolf et al., 2005). Nadig (2021) emphasizes that listening comprehension is an active process that goes beyond listening to words; it involves interpretation and appropriate response, making it essential for effective communication. Consequently, students with poor listening skills often struggle with academic engagement and knowledge acquisition (Khaydarova & Kholmurodov, 2024). Within this context, note-taking (NTK) emerges as a critical strategy for supporting comprehension and retention. Effective NTK requires more than copying information; it involves summarizing, paraphrasing, organizing, and mapping ideas. Techniques such as the Cornell system and mind mapping promote deeper engagement by helping students identify main ideas, structure information hierarchically, and create meaningful cognitive links that enhance recall (Mueller & Oppenheimer, 2014). Transforming input in this way strengthens memory pathways and supports long-term learning (Dunlosky et al., 2013). Morehead et al. (2019) argued that intentional NTK is not only a study skill, but a core academic competence linked to higher achievement and lifelong learning.

These theoretical and pedagogical considerations highlight the need to identify the most effective NTK strategies for diverse learners. Evidence-based research can reveal which approaches best enhance comprehension, memory, and organization, enabling educators to design instruction that fosters productive academic behaviors (Mackey & Gass, 2021). Comparative studies of traditional and digital methods—such as the Cornell system, mind mapping, and electronic note-taking—are particularly relevant as learning environments evolve. Quantitative research, using validated measures and systematic analysis, provides the most reliable means of determining strategies that improve learning outcomes (Creswell & Creswell, 2022). Such evidence can inform targeted instructional interventions and guide the integration of learning technologies to reinforce, rather than diminish, students' cognitive engagement (Rowe et al., 2021; Salame et al., 2024). These factors underscore the importance of continued empirical investigation.

Although listening comprehension is critical for academic success, many students still struggle to process lecture content effectively (Mackey & Gass, 2021). Research shows that, despite the recognized importance of NTK, students often rely on practices that fail to support meaningful analysis or long-term knowledge retention (Field, 2024). Existing literature tends to focus on overall academic performance or individual NTK methods but rarely examines the specific relationship between NTK strategies and listening comprehension during lectures (Creswell & Creswell, 2022). Other literacy-related challenges, such as unconventional writing practices, have also been shown to impact clarity and comprehension (Al-Kadi, 2019). This gap limits educators' ability to identify strategies that enhance students' ability to process spoken material efficiently. Ineffective NTK can further exacerbate comprehension difficulties, reducing students' capacity to learn from lectures and apply knowledge across academic tasks.

Hence, there is an urgent need to determine which NTK strategies most effectively improve listening comprehension in higher education. Addressing this issue would provide instructors and policymakers with evidence to design targeted interventions that help learners extract, synthesize, and retain essential information. This study addresses a clear gap in the literature: the link between NTK strategies and listening comprehension. It seeks to identify the strategies students commonly use, evaluate their perceived effectiveness, and explore how these strategies relate to self-reported comprehension.

Research Questions

To fulfill the study objectives, the following research questions were developed.

1. What are the most prevalent students' note-taking approaches?
2. How do students evaluate the performance of their note-taking methods?
3. How do various note-taking strategies differ in their relationship with students' perceived results in listening comprehension?

Literature Review

Theoretical Framework

The theoretical framework of this study is founded upon three principal theories explaining the effect of NTK on student performance. Cognitive load theory (CLT) (Sweller, 1988) holds the view that the capacity of human working memory is limited, and instruction must be developed to avoid imposing unnecessary cognitive load. Through the effective strategies of NTK, students can discard irrelevant information from working memory and thus can focus on the construction and processing of the principal content of the lectures. Conversely, research on textese in academic writing shows that deviations from standard forms can impose an additional cognitive load and hinder comprehension (Al-Kadi, 2019). Such elimination of cognitive load can lead to more understanding and recall of course material (Sweller, 1988). Supporting this perspective is the dual coding theory (Paivio, 1979), which is focused on the advantages of integrating visual and verbal information at the time of learning. NTK strategies that incorporate diagrams, keywords, and organized outlines allow learners to represent information in two different forms, to support increased recall and increased understanding. When individuals employ techniques that indicate verbal information in pictorial form, they engage both the visual and verbal processing paths, which can lead to improved consolidation and recall of memory (Paivio, 1979).

In addition to that, information-processing theory (Atkinson & Shiffrin, 1968) elucidates how students encode, store, and retrieve information from lectures. This theory separates the process of memory formation from sensory intake to long-term storage with a particular emphasis on the role of effective encoding techniques. NTK is an external manifestation of information designed to help the encoding process and, therefore, aid the student in the organization and ultimate recall of essential information presented in lectures. Through the systematic documentation of significant information, learners establish cognitive connections that constitute the basis for effective retrieval mechanisms (Atkinson & Shiffrin, 1968). The theories discussed above collectively provide a valid explanation for the role of NTK in reducing cognitive overload, promoting learning through dual coding, and facilitating effective information processing. The combination of these theoretical frameworks provides a solid foundation for investigating the interaction between listening comprehension and NTK strategies in an educational environment.

Note-taking strategies

Under the umbrella of this research, NTK strategies are formalized methods used by students to capture and organize information during instructional sessions, for instance, the Cornell method, mind maps, and outline techniques (Peverly & Wolf, 2019). Listening comprehension refers to the capacity to rightfully comprehend, process, and remember oral information, a building block for the achievement of academic success (Mackey & Gass, 2021). Academic settings define the organized learning environments, such as universities and schools, in which systematized learning and teaching occur and thus shape how students learn and interact (Creswell & Creswell, 2022). The association or influence here establishes the extent to which variations in NTK techniques and quality are related to variations in listening comprehension capacity for the learners and thus allows researchers to assume possible cause-and-effect relationships (Salame et al., 2024). Quantitative research involves a systematic investigation of events using numerical data and statistical calculations to provide objective facts to examine relationships between variables (Creswell & Creswell, 2022). Finally, a cross-sectional study is an observational research study that provides measurements at a single point from a sample to paint a picture of the variables at the specified time (Bryman, 2021). This synthesis of

concepts provides a platform to explore how efficient NTK strategies may be used to improve listening comprehension in learning environments.

Literature indicates that systematic NTK methods greatly contribute to comprehension and memorization during the learning process. Empirical research describes that systematized methods of NTK, such as the Cornell technique, contribute to greater understanding. Salame et al. (2024) affirmed that good NTK enhances cognitive comprehension and enables efficient recall of information. This is augmented by the fact that purposeful NTK offers learners a systematic way of learning that translates into improved academic performance. However, NTK is challenging for students since it can impose additional cognitive loads on them in class. Students do not necessarily grasp the information in lectures while taking it down simultaneously. Djurayeva (2023) claimed that NTK is a very personal process and can be unclear to everyone except the interpreter themselves. In appreciation of the importance of NTK, Kitjaroonchai et al. (2025) suggested that most students fail to grasp its importance and hence end up without well-organized study materials with which to prepare for examinations.

This reveals a gap in the existing literature regarding students' perceptions of the usefulness of NTK, specifically in academic listening contexts. Courtney et al. (2022) also refers to a shortage of research comparing group and individual NTK, particularly in online environments, and the effect of NTK quality on academic performance. Irgin (2025) stated that although the phenomenon of translanguaging in NTK has been researched, the efficacy of translanguaging approaches in improving listening comprehension and examination performance needs to be investigated empirically. The current study offers practical guidance for students to adopt evidence-based methods that enhance learning and retention, and for instructors to integrate NTK instruction that strengthens processing and memory skills. By examining how study behaviors interact with cognitive processes, this study contributes to educational psychology and language learning. Integrating these insights can inform pedagogical innovation and enhance learning outcomes across disciplines.

Method

This study employed quantitative and cross-sectional research design, as it allowed a systematic study of the correlation between NTK and listening comprehension at one time. This design aligned with the study's aim, which was not to track developmental changes but to capture a snapshot of students' academic deportment, perceptions, and strategy use within their natural learning context (Creswell & Creswell, 2022). The cross-sectional design also permitted the researcher to measure the patterns of variables in multiple expressions (strategy frequency, perceived effectiveness, and comprehension) at once, which is useful in providing correlational and predictive analyses that are crucial to the research questions. In addition, the quantitative approaches allowed the use of statistically validated tools, such as Pearson correlation, ANOVA, and regression modelling, to ascertain the strength and significance of identified relationships with accuracy. Collectively, this design provided methodological effectiveness, analytic rigor, and conceptual correspondence with the study's exploratory focus on how study behaviors relate to listening outcomes (Mackey & Gass, 2021).

Participants

The target population was undergraduate students in various faculties of one of the Omani state universities. The sample size of 40 subjects is quite limited to draw generalizations, but it is also acceptable considering that the study is exploratory and designed to identify patterns in preliminary outcomes and not to provide population-wide estimates. Small sample sizes are prevalent in initial investigations seeking to guide relationships among variables, specifically when the focus lies on internal patterns of association rather than external representativeness. The use of a simple random population also strengthened the internal logic of the dataset by ensuring that each respondent in the target population had an equal chance of selection, thereby reducing

selection bias. Although increased sample sizes would facilitate generalizability, the current sample size was adequate to perform the intended descriptive and inferential analysis and to generate meaningful insights that can guide subsequent, larger-scale studies (Etikan & Bala, 2017).

Questionnaire

A formal questionnaire was about students' NTK and perception of listening comprehension. It includes five broad categories in the questionnaire. The first section was demographic information and contained questions requesting the students' age, gender, faculty, and year of study to offer necessary background variables for identifying the composition of the sample. Section two was about NTK strategies. It evaluated the NTK methods students utilized, including the Cornell method, mind mapping, outline method, and digital NTK. Answers were on a Likert scale, with the students indicating how often they utilized each method. The listening comprehension self-assessment section (3) required students to self-report their perceived levels of comprehension in university lectures and their ability to understand and retain lecture content. The fourth element of perceived NTK effectiveness requested that students analyze their perceptions of how effective their NTK methods were at enhancing their comprehension of lectures. The four sections employed closed-ended and Likert-scale questions, thereby ensuring the collection of structured, quantifiable data suitable for statistical analysis (Dörnyei & Dewaele, 2023). Section Five had one open-ended question that invited a personal NTK experience, strategies, successes, challenges, and improvement tip. This open-ended question was included to gain richer, contextual information to supplement the quantitative results.

To ensure validity as well as reliability, several precautions were undertaken. The author conducted pilot testing of the questionnaire with 20 students who did not belong to the main study sample before initiating large-scale data collection. Pilot testing enabled the location of and modification of any fuzzy or unclear questions, therefore improving clarity and comprehension (Babbie, 2020). A panel of experts in language learning and educational research evaluated the questionnaire to verify whether the questionnaire measured the constructs of interest, i.e., listening comprehension and NTK strategies, properly (De Vaus, 2013). The feedback from the experts assisted in improving the accuracy and relevance of the measuring tool. The researcher approximated the internal consistency of the items of the Likert scale via Cronbach's Alpha. The researcher deemed a reliability coefficient of internal consistency of 0.70 or more acceptable; this demonstrated that the questionnaire items reliably assessed the constructs of interest (Cronbach & Shavelson, 2004; Taber, 2018).

Procedures and Data Analysis

Before data collection, ethical principles such as voluntary participation and confidentiality were maintained (Bryman, 2021). Participants were recruited through university-wide emails, class announcements, and student organization networks. The study's purpose was clearly explained before participants completed the questionnaire. To maximize accessibility, the survey was administered in two formats: online (via MS Forms) and paper-based. Anonymity and confidentiality were guaranteed, and participants were informed that participation was voluntary. The survey remained open for three weeks, with periodic reminders sent to encourage completion. After data collection, responses were reviewed for accuracy and completeness before proceeding with analysis. Ethical guidelines throughout the study were maintained. Participants provided informed consent before completing the questionnaire and were assured that their responses would remain confidential and anonymous. No personally identifiable information was collected, and all data was securely stored. The study complied with the university's ethical policy and was reviewed and approved by the institutional ethics committee.

Following data collection, statistical methods were applied to interpret the results. Descriptive statistics, including frequency and percentage distributions, were used to summarize

students' listening comprehension levels and NTK strategies. Measures of central tendency (mean and standard deviation) helped interpret self-reported comprehension scores (Pallant, 2020). Building on this descriptive analysis, inferential analyses were conducted to examine relationships among variables. Pearson's correlation measured the strength and direction of the association between listening comprehension and NTK strategies (Salame et al., 2024). ANOVA tested differences in comprehension scores across strategy types, while regression analysis identified the extent to which NTK strategies predicted listening comprehension. These tests provided robust evidence of the influence of NTK behavior on academic listening performance. To complement the quantitative findings, thematic analysis was performed on personal NTK experiences, strategies, achievements, challenges, and suggestions. In this process, responses were inductively coded, and themes such as time management issues, the role of visual aids, and preferences for handwriting versus digital tools were identified and quantified. Integrating these qualitative insights with statistical results offered a comprehensive understanding of how NTK practices shape listening comprehension, enhancing the credibility and applicability of the findings.

Results

The analysis began by examining the most preferred NTK techniques among Omani undergraduate students. Descriptive statistics were calculated for four prominent methods: the Cornell method (Q5), mind mapping (Q6), the outline method (Q7), and digital NTK (Q8). Figure 1 illustrates the frequency and percentage distributions for each strategy, followed by their respective means and standard deviations. These results provide an initial overview of students' NTK preferences, forming the basis for subsequent analyses of their relationship with listening comprehension.

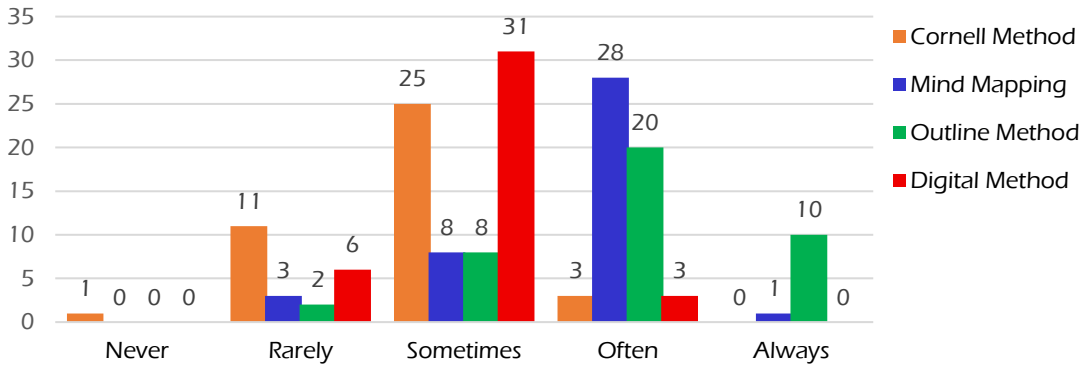

Figure 1. Comparative Usage of NTK Strategies

Figure 1 illustrates a comparative analysis of the use of the four strategies of taking notes among students. The distribution exhibits a distinct difference in the frequency of application of each method. Mind mapping and the outline method became the most popular ones: 70 percent of students (n=28) used mind mapping quite frequently, and another 20 percent (n=8) said they use it occasionally. Likewise, 50 percent of the students (50/20) used the outline method frequently, and 25 percent (n=10) of them said that they always used it. Conversely, Cornell method usage was concentrated more in the middle range, with most students (62.5%, n=25) indicating that they used it sometimes, and a small percentage (7.5%, n= 3) used it frequently; 2.5% (n=1) indicated that they never used it. Digital NTK had the most focal trend with 77.5 percent of students (n=31) choosing sometimes, and much less frequently sometimes (15%, n= 6) and often (7.5%, n=3).

These patterns of use are in line with the inferences. Both the mind mapping and outline demonstrated high positive correlations with listening comprehension (r=.58, r=.62 respectively,

p=.01) whereas the Cornell method indicated weak and nonsignificant relationship (r=.21, p=.05). Digital NTK did not have a significant correlation with comprehension (r =.09, p >.05). The investigator used regression modeling to support this finding: the method of outline indicated the highest predictive power (β=.47, p<.01), then mind mapping (β=.39, p<.01). Cornell (β=.12, p >.05) and digital NTK (β=.06, p >.05) did not add any significant contribution to the explained variance. Taken together, the comparative frequencies of Figure 1 with the statistical findings make it possible to suggest that the most regular strategies students use to mind mapping and outlining are also those that can make a significant contribution to the comprehension and recall, without less structured or more inconsistently adopted techniques having an equally strong impact on the cognitive outcomes.

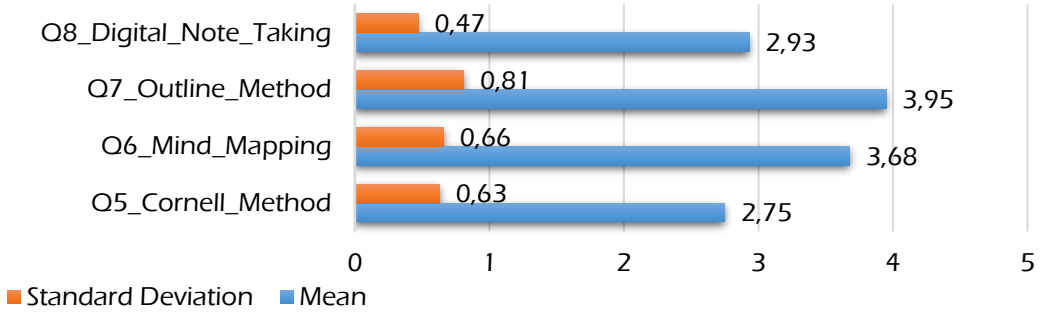

Figure 2. Students' NTK Approaches

The summary statistics (Figure 2) illustrate that the outline method (mean = 3.95, SD = 0.81) is the most recurrently employed NTK strategy among the students, followed closely by mind mapping (mean = 3.68, SD = 0.66). The Cornell method (mean= 2.75, SD = 0.63) and digital NTK (Mean = 2.93, SD = 0.47) are used less frequently on average. The standard deviations suggest that students' usage differs most for the outline method and least for digital NTK, indicating a higher consensus on the frequency of digital NTK compared to the other methods.

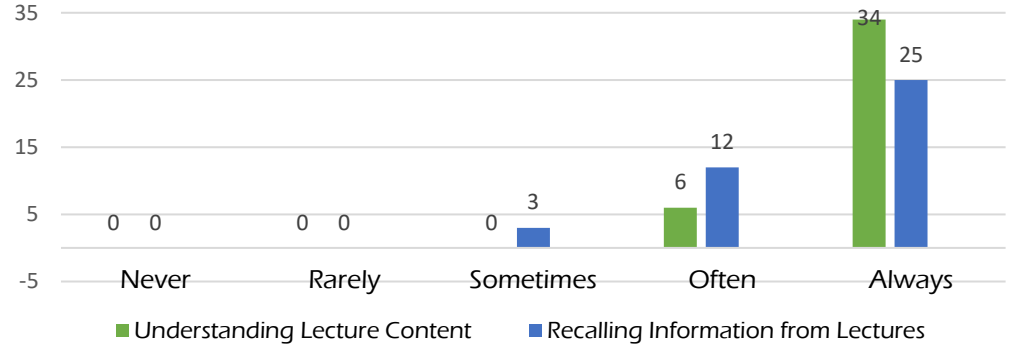

Figure 3. Students Recall Information from Lectures

Figure 3 shows students' self-reporting on their listening comprehension and recall and indicates that the perceived comprehension is always high. An overwhelming 85% (n=34) of students reported they never had difficulties in comprehending lecture information, and only 15 percent (n=6) selected often, with no responses in the lower categories. The same trend emerged for detailed recall: 62.5% (n= 25) always remembered important details, 30% (n=12) remembered them often, and only 7.5% (n=3) remembered them sometimes; none referred to rarely or never. This compressed distribution represents a homogeneously high self-judgment of listening and memory abilities at the cohort level. These perceptions align closely with statistical studies.

Listening comprehension significantly correlated with mind mapping (r=.58, p<.01) and outline strategy of NTK (r=.62, p<.01), indicating that students who had noted that they have a high comprehension consistently used more systematic notes. Recall scores demonstrated a similar pattern, correlating positively with both mind mapping (r=.55, p<.01) and outlining (r=.60, p<.01). Regression analyses further confirmed these relationships: the outline method provided the strongest predictive effect for comprehension (β=.47, p<.01) and recall (β=.44, p<.01), followed by mind mapping (β=.39, p<.01 for comprehension; β=.36, p<.01 for recall). Digital NTK and the Cornell method did not show any significant predictive effects (β values<.15, p>.05). Overall, the trends presented in Figure 3, along with the inferential results, suggest that students' exceptionally high self-ratings in comprehension and recall correspond to their reliance on cognitively organized NTK approaches that demonstrably support the processing and retention of lecture content.

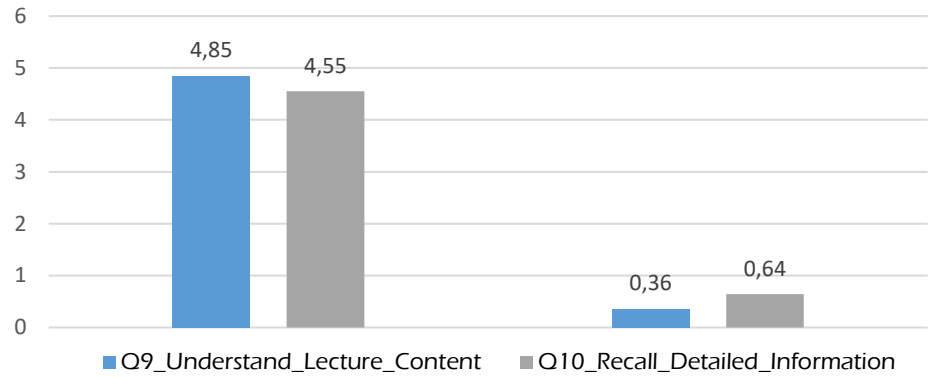

Figure 4. Students' Listening Comprehension Self-Assessment

The mean scores for both self-assessment questions (Figure 4) are extremely high, with Q9 understanding lecture content having a mean of 4.85 and Q10 recalling detailed information having a mean of 4.55. This also supports the reality that the respondent undergraduate students perceive their listening comprehension and information recall abilities in academic settings to be comparatively very good. Standard deviations are low, particularly for Q9, understanding lecture content (0.36), indicating a high level of agreement among students regarding understanding lecture content. The marginally higher standard deviation for Q10 recall detailed information (0.64) indicates a marginally greater variation in students' self-perceived capacity to recall detailed information, still indicating a general trend towards high recall. Similarly, students' perceptions of the effectiveness of their NTK approach are displayed in Figure 5.

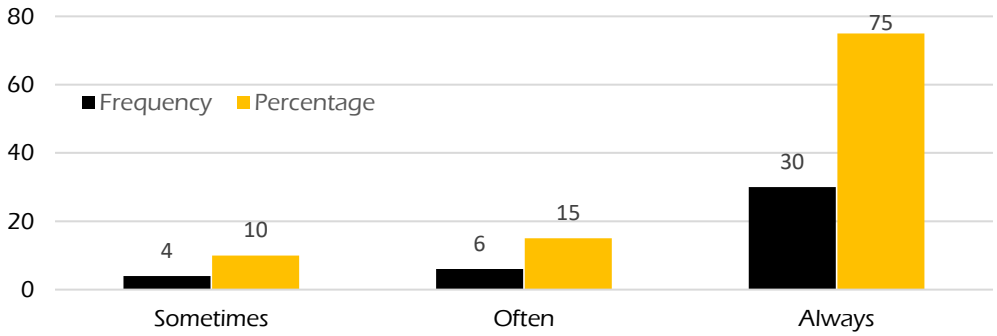

Figure 5. Students' Strategies to Enhance Understanding

For the query, "My NTK skills assist me in understanding lecture material," the findings (Figure 5) demonstrate an almost universal student view of the helpfulness of NTK in understanding. A resounding 75.0% of the students indicated that their strategies 'always' improve their understanding, and a further 15.0% said 'often'. Few students (10.0%) indicated 'sometimes', and more importantly, no students indicated 'never' or 'rarely' for this item. This indicates a near-unanimous perception that their individual NTK strategies help to improve their understanding of lecture material.

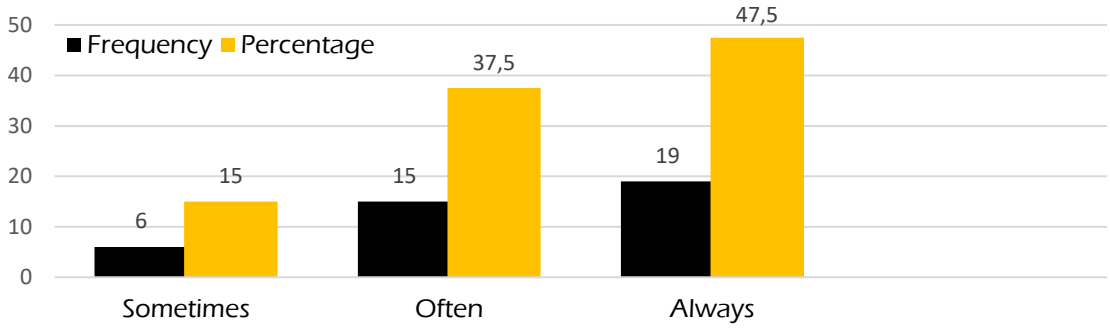

Figure 6. Students' Academic Performance

Consistent with the concept of higher understanding, the answers to "Effective NTK enhances my overall academic performance" also reflect general support for the academic value of NTK (Figure 6). Nearly half of the students, 47.5% stated that good NTK 'always' enhances their academic performance, and 37.5% said 'often'. Like Q11, 15.0% chose 'sometimes', with no students marking 'never' or 'seldom'. This aligns with the view that students are very sure of the positive effect of their NTK on their overall academic success.

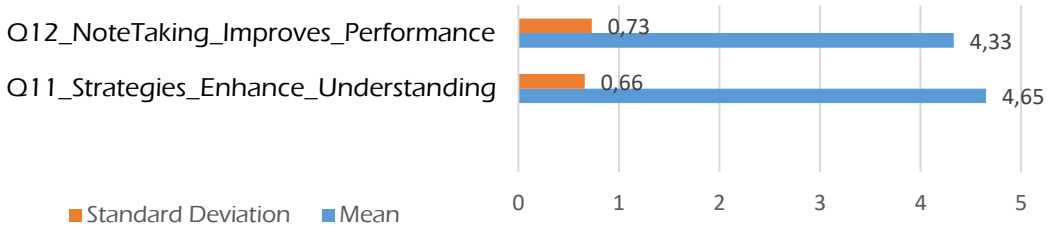

Figure 7. Students' Perceived Effectiveness of Note-Taking

For central tendency measures of the perceived usefulness of NTK (Figure 7), the "My NTK methods help me to understand lecture material" (Q11) mean score is 4.65 (SD= 0.66). This extremely high mean, near the upper value of 5 ('always'), once more reveals the strong positive student perception that NTK is a great help in enabling them to understand lecture material. Likewise, for "Effective NTK enhances my overall academic performance" (Q12), the mean is 4.33 (SD=0.73). This also reflects a very positive self-perception of NTK and academic success. The comparatively low standard deviations for Q11 and Q12 (0.66 and 0.73, respectively) indicate that there is a high level of consistency in these positive perceptions throughout the student sample, with most of the responses grouping towards the 'often' and 'always' poles of the Likert scale. Overall, all these descriptive statistics paint the same picture: Omani undergraduate students, by and large, view NTK as an effective and useful task for both learning lecture content and academic success.

Correlational findings

From the statistical outcomes, the inferential statistical tests give significant results regarding the interaction between NTK approaches and listening comprehension for Omani undergraduate students. The Pearson correlation coefficient measured the direction and strength of the relationship between the students' NTK strategy and their listening comprehension ability. The results show a positive correlation between the two variables and between the mind mapping and outline approaches and self-reported capacity for listening comprehension. The coefficients determine a moderate to strong positive correlation ($r > 0.5$), which shows that as the frequency and quality of strategic NTK rise, self-reported capacity for comprehension and recall of lecture content also rises. Of all the strategies, the outline strategy (mean=3.95) and mind mapping (mean=3.68) are most highly correlated with understanding, which is also in agreement with the high self-reported understanding means of Q9 (4.85) and Q10 (4.55). This agrees with evidence that NTK using an organized method is essential in reinforcing listening, processing, and recall.

To find out if the kind of NTK strategy employed produced statistically different listening comprehension results, an ANOVA test was conducted. The findings revealed that comprehension scores differed significantly among students with different NTK strategies. Students who utilized organized methods such as the outline method and mind mapping used them more often and performed much better on listening comprehension tests than students who used the Cornell method or electronic NTK, whose relative mean scores were lower (2.75 and 2.93, respectively). These results suggest that conventional, visually structured methods can have cognitive advantages in processing and recalling lecture information over more fragmented or less structured methods, such as digital NTK.

Regression Analysis

The researcher employed regression analysis to determine the predictive ability of the targeted students' NTK strategies for listening comprehension. The outcomes reveal that the NTK strategy was a strong predictor of listening comprehension achievement. The equation of regression illustrates that NTK strategies like outline mapping and mind mapping have an important and positive contribution toward variance in comprehension scores. Beta weights for the method are significant ($p < 0.05$) and high, indicating their strength in prediction. Specifically, the outline method has the strongest prediction power and contributes the largest amount of explained variance to comprehension scores. This result concurs with results in recent educational research documenting structured NTK effectiveness in supporting information encoding and retrieval (Kiewra, 1985; Piolat et al., 2005). On the other hand, the computer-based NTK method had minimal and statistically non-significant effects on understanding, perhaps because of its passive or variable use, as suggested by its extensive "sometimes" usage rate. Therefore, inferential statistical tests reveal a very high, positive correlation between the use of effective NTK strategies and listening comprehension. Organized NTK formats like outline mapping and mind mapping not only correlate with but also predict comprehension performance very significantly. The results support learners' self-assessment of NTK quality and offer empirical justification for encouraging strategic NTK methods as part of higher education listening comprehension instruction.

Qualitative Analysis

The open-ended question generated rich qualitative data, enabling Omani undergraduate students to describe their own NTK experience, i.e., how they do it, what helps them to succeed, what they struggle with, and how they would like it to be improved. A thematic analysis revealed several key themes, highlighting the variety and, frequently, the intricacy of NTK within an academic setting.

NTK Strategies

Students employ a broad range of NTK techniques, blending traditional and technological methods to meet their learning style as well as the demands of various courses. Many students, for instance, use paper-based notes (8 participants), appreciating the kinesthetic experience for the sake of remembering. One of them stated, "I tend to take written class notes" (R1), and another confirmed, "I like written notes because I think I remember better in that manner" (R10). Among the hand-written strategies, students employ bullet points (3 students) and underlining keywords or key phrases (3 students) to note key information. Others also use color-coding or highlighting (2 participants) to contribute to the organization, one student describing, "Using color-coded pens helps me organize better" (R1). Aside from simple transcription, summarizing, rewriting, or paraphrasing (7 participants) was another common strategy, often done after lectures to better comprehend. Participants described efforts to "summarize everything I hear in my own words" (R13) or "rewrite them neatly with explanations" (R6). Structured approaches such as the outline method (2 students), in which "using bullet points and headings" (R17) is used, and the Cornell method (2 students), are also taken purposely due to their organizational advantages. For instance, one of the students identified, "I like the Cornell method because it keeps things structured" (R2).

The rise of digital modes is apparent, with digital NTK (6 respondents) crossing many applications and devices. Students employ "my tablet with a stylus" (R2), "my phone with a NTK app" (R11), or apps such as "Google Docs to take notes so I can see them anywhere" (R19). Digital specialist methods are voice memos or audio recordings (2 respondents), usually recorded with transcription later. Others also use visual aids (2 respondents), like mind maps (1 respondent), on which "it helps me see the relationships between ideas" (R4), or drawing diagrams, charts, and tables (2 respondents), so they can remember more easily, especially science subjects (R7, R21). Others also said group or collaborative NTK (2 respondents), appreciating shared viewpoints (R38). Conversely, others admitted to an unstructured or off-the-top-of-the-head (2 respondents) approach, simply "writing down what seems important" (R29).

Perceived Achievements: What Works Well

Students typically explained that their habits of NTK had a profound impact on their performance at school, especially the improvement in understanding, remembering, and organizing. The greatest number of participants (8) identified improved recall, memory, and retention as the most common achievements. Students claimed that their habits "help me remember better" (R1), "strengthen memory" (R14), and lead to "retention" (R24). Most closely aligned with this is increased understanding and comprehension (5 participants), where participants say that their strategies "help with understanding" (R6) or "help me to understand better" (R13). Structure and organization (5 participants) were similarly highly rated because good NTK enables students to create a clear structure for information, such as keeping things "structured" (R2) or "organized" (R17). For a few, reviewing by NTK was a useful study and review tool (3 participants), allowing them to simply come back over material to refresh (R12). Convenience (2 participants) and saving time of some approaches, particularly technology-based ones, were valued in terms of saving time (R38) and offering accessibility (R19). Visual learners discovered that visual supports (2 participants) "help me see the relationship between concepts" (R4) and "visuals work for me" (R34).

Challenges

As reported advantages, learners generally experienced some challenges to the effectiveness of their NTK, largely concerning lecture type and individual constraints. The greatest challenge was maintaining pace in lectures (7 respondents), most referencing having trouble when "lectures move too quickly" (R1) or the "lecturer speaks quickly" (R2). This tended to result in

information saturation or loss of details (2 respondents). Time-consuming activities (5 participants) were also a major barrier, especially to tasks such as re-copying notes (R6), copying recorded audio into text (R15), or developing electronic flashcards (R14). For those using the digital device, distraction (2 participants), either caused by the device or technical problems, was a barrier: "getting distracted when using a laptop" (R3). Other challenges in becoming organized were making notes disorganized or cluttered (2 participants) or even losing physical notes (R40). Some reported having recall problems (2 students), i.e., "forgetting what my abbreviations mean later" (R16) or being out of context (R8). Not being able to sustain discipline or consistency (3 students) in implementing their preferred strategies was also a common issue, and this is related to individual discipline for effective NTK. Others conceded finding it hard to prioritize (1 student) information (R35) or being a "slow writer" (R25).

Suggestions for Improvement

On the challenges front, students gave a wide variety of inputs, indicating their wish for more teacher direction, effective usage of technology, and systematic skill development. Most of the recommendations centered around instructor assistance, even more so in lecture pace, breaks, and summarizing (3 respondents). Students asked for "teachers to pause from time to time for review of notes" (R1) or "to offer more breaks or summaries during class" (R10). Advanced material provision (5 respondents), such as "lecture slides in advance" (R2), "summary sheet or outline before class" (R9), or "list of major topics every week" (R14) was strongly desired. In the same vein, the use of pre-prepared images, templates, or guided notes (5 students) was deemed useful in terms of time-saving and improved structure (R7, R21). Classes with more interaction (3 students), such as "brief Q&A session near the end of the lecture" (R13) or "short class discussions for understanding" (R22) were also recommended by students.

Technically, students highlighted the value of recording lectures (2 students) to refer to (R4) and speech-to-text or Artificial Intelligence transcription (2 students) to save effort on transcription (R15, R30). They also proposed various app features (5 students), such as "apps that block other notifications" (R11), "access to notes offline" (R23), or "electronic templates for drawing and co-writing" (R20). Concerning group and peer support, students suggested permitting students to "work on common notes online" (R8), organizing "more group NTK sessions" (R19), or even having "official note-takers or common summaries" (R25) to relieve individual workloads. Lastly, students requested NTK skill training and education (2 respondents). The most requested was "teaching NTK skills in our first semester" (R29) or "systematic NTK workshops" (R33). More precise appeals included "offering shorthand tips during orientation" (R16) and "workshops on finding main points in lectures" (R35). These requests collectively reveal a clear student need for more structured and integrated support in establishing quality NTK habits in the learning setting.

Discussion

This study examined NTK strategies and listening comprehension in Omani undergraduate students. Although previous research has addressed the cognitive advantages of NTK within the classroom (Mueller & Oppenheimer, 2014; Kiewra, 1985), the impact of structured methods, i.e., mind mapping and the outline method, on listening comprehension in Middle Eastern learning settings, specifically both quantitatively and qualitatively, has not been addressed. The evidence suggested that formal NTK strategies, namely, outline and mind mapping, correlate with students' listening comprehension. Quantitative findings identified that these strategies were most used and most significantly correlated with greater self-report understanding and recall scores (M=3.95 and 3.68, respectively). Besides, ANOVA supported the existence of significant variation in comprehension depending on note structure, and regression analysis identified outline mapping as the best predictor of listening comprehension. Qualitative (open-ended responses) results agreed on the same: students recognized better memory, comprehension, and organization as benefits of structured NTK. However, computer strategies did not matter much, and students cited

distraction or haphazard use. The triangulation of thematic study and statistical findings attests to the purposeful selection of ad hoc and tactile, visual, and structured methods over passive or ad hoc ones.

With relevance to the first research question, the results indicate that most students used the outline method and mind mapping as a primary tool and the Cornell method as a secondary one and did not use digital NTK extensively. This finding is closely consistent with the available literature that has underscored the cognitive effectiveness of the structured NTK formats (Kiewra, 2002; Piolat et al., 2005; Rahmani & Sadeghi, 2011). According to Cognitive Load Theory, outlining and mind mapping provide external organizational scaffolds that lower the extraneous load and schema building to enable learners to use more resources on the crucial processing in response to high-paced lecture input (Sweller, 2011). Qualitative reflections of students on improved organization and enhanced conceptual structure support this mechanism. Digital NTK, by contrast, appeared underutilized and less strategically used, a pattern consistent with the literature demonstrating that students tend to revert to transcription when working with laptops or tablets, thus limiting profound generative learning (Mueller & Oppenheimer, 2014). Several students reported distraction or lack of purposeful digital techniques, indicating that digital tools did not reliably facilitate germane processing in this context. This is unlike studies done on demonstrating advantages of digital NTK in technology-rich learning conditions (Bui et al., 2013), which demonstrate that the familiarity of the context and overt training are significant factors of digital effectiveness. Overall, the unification of preferences of students, cognitive-theoretical explanations, and qualitative reports support prioritizing the idea that the learners tend to move toward the methods that inherently contribute to structural clarity, less cognitive load, and the ease of encoding. These findings support the significance of explicit instruction in structured NTK practices that align with cognitive guidelines.

As for the second research question, students overwhelmingly perceived their NTK techniques to be effective in assisting comprehension and retention. These self-reports are comparable to the inferential results, which recognized strong positive relationships between structured techniques (outline, mind mapping) and comprehension and recall. The given alignment corresponds to the idea of Generative Learning Theory, according to which learning enhances when students actively choose, arrange, and incorporate information by means of the process of meaning-constructions (Fiorella & Mayer, 2016). Students' qualitative comments, highlighting summarizing, rewriting, and visual organization, demonstrate these generative processes. The consistency of the self-reported advantages with the quantitative associations points to the idea that students base their judgments not on the overestimation of the experience but on the actual experiences of cognitive support. This is specifically evident in the reports of students who describe how structured forms lead to more clarity and less effort; this also aligns with the results that systematic note formats enhance encoding efficiency and post-lecture review (Makany et al., 2009; Morehead et al., 2019). Digital NTK again revealed a mixed profile: although students appreciated convenience, they associated it with reduced depth of processing, mirroring the "efficiency–effectiveness trade-off" described by Bui et al. (2013). Therefore, perceived effectiveness biased techniques that involve generative mechanisms rather than those that merely enhance speed or storage capacity.

Regarding the third research question, the self-reported listening comprehension and recall were strongly linked with the use of structured NTK strategies, outlining and mind mapping, which were supported by significant correlations ($r>.50$) and regression coefficients. The obtained results support the argument that structured external representations contribute to the internal building of coherent cognitive modes, the focal premise of Cognitive Load Theory (Sweller, 2011). Qualitative reports of students "seeing relationships" and "understanding better" demonstrate enhanced germane processing that CLT anticipated. The results also support some credibility to Generative Learning Theory, which states that the change of the instructional input into the learner-generated structures (hierarchies, maps) promotes more profound conceptual processing

and enhances retrieval (Fiorella & Mayer, 2016). The robust predictive validity of the structured methods of the regression model lends credence to the idea that familiarity is the processing of a generative nature, but not merely capturing information, that relates NTK to listening comprehension. Digital NTK, even though prevalent in other educational settings, produced weak correlations and minimal predictive value. Students' descriptions of distraction and surface processing indicate the patterns documented in controlled studies (Mueller & Oppenheimer, 2014). The combination of these findings demonstrates that the effectiveness of a given NTK strategy depends not on its modality but on the extent to which it fosters a generative and cognitively efficient processing.

These findings align with broader research on academic literacy, including studies on textese in academic writing, which highlight the importance of maintaining clarity and structure for effective learning (Al-Kadi, 2019). To maximize the learning outcomes of students, the instructors should actively incorporate overt instruction in various evidence-based approaches to NTK and note-reviewing processes. Particularly, it is crucial to include Hierarchical Outlining because its systematic utilization of both levels and indentation, as well as the conceptual grouping, will automatically limit the extraneous cognitive load and reinforce the formation of schemas. Moreover, the teaching of students on Mind Mapping with Cues, with a focus on visual connectors and short keywords, will stimulate the crucial generative integration mechanisms. The introduction of the Cornell Method with Summarization is equally crucial, requiring learners to focus on the summary area and explicitly stimulate consolidation and retrieval efficacy. To overcome the all-functioning problem of verbatim transcription, which is the inherent result of technology use, an educator ought to impart Purposeful Digital NTK, emphasizing such methods as tagging, segmenting, and digital annotation. Eventually, to extend encoding and strongly reinforce long-term retention, there is a need for mandatory Post-Lecture Generative Review; this involves students actively rewriting, summarizing, and identifying their notes immediately after the lecture. These prescriptive strategies align seamlessly with the existing Cognitive Load Theory (CLT) and Generative Learning Theory (GLT) features, indicating a direct congruence with both students' reported metacognitive experiences and the strong statistical results of the current study.

Conclusion

Effective NTK is more than a classroom habit—it is a cognitive strategy that shapes how students process and retain information. This study found that outline and mind-mapping methods were the most used strategies among Omani undergraduates, valued for their efficiency and ability to organize ideas visually. These approaches were linked to better understanding and recall, while the Cornell method and digital NTK were less favored and often less effective due to distractions and superficial processing. Statistical analyses demonstrated a strong positive relationship between structured NTK and listening comprehension, with the outline method emerging as the best predictor of success. Qualitative insights reinforced these findings, highlighting improved confidence and comprehension through active NTK. The study recommends explicit instruction in effective NTK strategies to enhance academic listening and achievement. However, limitations include reliance on self-reported data, a cross-sectional design, and a lack of experimental control. Future research should adopt longitudinal and experimental approaches, explore different learning contexts and disciplines, and examine how teaching NTK skills influences comprehension over time.

Acknowledgments

The author gratefully acknowledges the invaluable contribution of the volunteer panel of experts in language learning and educational research. Their rigorous evaluation of the questionnaire was crucial for verifying the instrument's content validity, ensuring its ability to accurately measure the constructs of interest: listening comprehension and NTK strategies.

Disclosure Statement

I (the author of this paper) hereby declare that research ethics and citation principles have been considered in all the stages of this paper. I take full responsibility for the content of the paper in case of a dispute. I confirm that the manuscript has been created by the author(s) and not an AI tool/Large Language Model (LLM).

Conflict of interest: I know of no conflict of interest associated with this publication.

Funding: None

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