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Title

Development, Preliminary Validation, and Reliability of the Notetaking Abilities and Strategies

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Abstract

With the increased use of technology in the classroom, notetaking methods have expanded. Current notetaking assessments for university students no longer reflect the options available or do not provide a comprehensive measurement of student preferences, skills, and perceptions of usefulness of notes. The *Notetaking Abilities and Strategies of University Students (NASUS)* questionnaire was created to address this gap in notetaking assessments while also examining university student preferences, perception of skills, desire to improve notetaking skills and methods of taking notes in class. The purpose of this study was to examine the psychometric properties of the NASUS questionnaire, specifically, content validity, test-retest reliability, construct validity and concurrent validity. The results show the NASUS to be a reliable and valid assessment that can be used by colleges and universities to generate a profile of their students' notetaking preferences and habits, while monitoring changes in habits and preferences over time in order to provide appropriate resources.

Keywords: notetaking, validity, reliability, iGen

Background

Notetaking is a critical aspect of academic success in higher education, as the acts of taking and using notes facilitates learning (Boyle, Forchelli, & Cariss, 2015; McGuire, 2015; Peverly, Vekaria, Reddington, Sumowski, Johnson, & Ramsay, 2013). Researchers have been posing questions about the complex nature of notetaking and have recognized its importance for decades (Carrier, Williams, & Dalgaard, 1988; Morehead, Dunlosky, Rawson, Blasiman, & Hollis, 2019; Shellow, 1925). Traditionally, the primary method of notetaking has been handwriting, though notetaking methods have expanded with the development of portable technological devices (Luo, Kiewra, Flanigan, & Peteranetz, 2018; Quade, 1996). Many students now engage in digital notetaking through methods such as typing notes on a laptop, tablet, or smartphone.

With the advent of digital notetaking, researchers started studying the similarities and differences between digital and handwritten notes (Bui, Myerson, & Hale, 2013; Luo et al., 2018; Mueller & Oppenheimer, 2014). The current literature has focused on the quality of students' notes and the impact of this quality on students' academic learning (Boyle et al., 2015; Chen, Teo, & Zhou, 2017). Studies have been conducted to examine the verbatim nature of students' notes, and the ways students use different types of notes to enhance their learning (Luo et al., 2018; Mueller & Oppenheimer, 2014).

Another important aspect of notetaking is students' perceptions of their own notetaking ability (Carrier et al., 1988). Little is known about current students' perceptions of their notetaking abilities, although in a recent study, it was found that nearly 60% of students reported wishing they had better notetaking habits (Morehead et al., 2019). This desire to enhance

notetaking habits is important, as current college students are digital natives and may have very different perceptions of digital notes than past generations (Twenge, 2017).

Over the past decade, the number of notetaking methods have expanded, along with our knowledge of the characteristics of quality notes (Bonner & Holliday, 2006; Boyle et al., 2015; Mueller & Oppenheimer, 2014). As technology continues to evolve and current generations use this new technology for notetaking, findings from past studies may lose relevance. To understand notetaking practices with the evolution of technology, studies using measurements tools capturing the full scope of 21st century notetaking options are required.

An extensive review of the literature found a limited number of existing measurement tools related to notetaking, which include surveys and self-assessments created by Penn State University, University of Redlands, Montgomery College, and University of Pennsylvania. Each of these measurement tools focused on an aspect of notetaking such as pre-class preparedness and post-class review of notes. None were comprehensive measurement tools of notetaking preferences, skills, and perceptions of usefulness that captured the broad range of notetaking techniques and skills of the 21st century. The exception is the recent notetaking survey utilized by Morehead et al. (2019) which addresses most aspects of students' self-perception of their own notetaking practice. However, Morehead et al. (2019) did not provide any information about the development, validity or reliability of this survey. An evaluation of the psychometric properties of an instrument gives its users confidence that it will provide reliable, valid, meaningful information that can be used in making decisions (Knekta, Runyon, & Eddy, 2019). Therefore, the development of a new comprehensive, valid, and reliable questionnaire with a psychometric property evaluation to address the gaps in existing measurement tools was necessary.

To meet this need, the Notetaking Abilities and Strategies of University Students questionnaire (NASUS) was created. This comprehensive self-report questionnaire of students' notetaking practices was designed to capture information about all aspects identified in the literature to impact learning as it relates to notetaking. Specifically, the questionnaire asks questions related to methods of notetaking, reasons for taking notes, self-perception of quality of notes taken, satisfaction with notetaking approach, time spent with using one's notes, and reasons that students may want to improve their notes. A study was conducted to develop the Notetaking Abilities and Strategies of University Students (NASUS) questionnaire, then estimate its psychometric properties, specifically content validity, test-retest reliability, construct validity, and concurrent validity. The questionnaire was developed in a manner that would allow institutions of higher education to obtain a notetaking practice profile of its students, and measure changes in practices over time.

Method

The NASUS questionnaire development was performed using an iterative process (Portney & Watkins, 2009) described under the umbrella of content validity. Next, the complete set of items included in the NASUS questionnaire was given to a sample of graduate students to estimate its test-retest reliability. Given that the intent was for the NASUS to measure change in notetaking practices overtime, estimating its test-retest reliability was important (Portney & Watkins, 2009). Concurrently, the questionnaire was given to a sample of undergraduate students to establish construct and concurrent validity.

The NASUS consists of several different questions with different types of items designed to assess the types of notetaking strategies that students use. However, at this time, we made no assumptions about whether or not the items within each question formed scales with

multidimensional structure to be explored with factor analysis. Instead, we assume that within each question, items are unidimensional, or function on their own as indicators of the presence or absence of a particular strategy.

Content Validity

The four steps to establishing the content validity of a new measurement tool were used within this study: defining the purpose, identifying the content domain, generating items, and determining the degree to which the content of the tool measures the intended constructs (Portney & Watkins, 2009).

Purpose and Content Domain

Two of the authors identified the questionnaire's purpose and content domain through a review of the literature. The purpose was to develop a self-report questionnaire that would capture the broad array of notetaking strategies used by students in the 21st century as well as the value of the taken notes from their point of view. The content domain of the NASUS was defined as the current students' notetaking strategies, perceived notetaking abilities, satisfaction with their current notetaking techniques, volition related to notetaking, interactions with completed notes, and degree of desire to improve their notetaking abilities.

Item Generation

To ensure comprehensiveness, a multi-step process was used to generate the items to be included in the questionnaire. First, graduate students (n=28) were enlisted to generate the items within each domain of the questionnaire. These students were given the purpose and content domain of the questionnaire, and asked to individually draft potential items. The students then formed five teams who compiled their items and chose the response format in order to draft five questionnaires. The teams recruited experienced notetakers to complete and provide feedback

about their draft questionnaires. Using the information gathered, each team revised their

questionnaire. Two authors collected the five teams' questionnaires, collated items, and modified

response choices to ensure cohesiveness and allow meaningful interpretation. To ensure that all

possible response choices were included, questions for which it was appropriate (e.g., Question

1) had items with "Other, please specify." The questionnaire was then shared with a third author

for final revision, including a cross reference with the literature, before being administered to

subjects for test-retest reliability as well as construct and concurrent validity.

The resulting questionnaire has ten questions (see Appendix). The first six questions

pertain to students' assessments of their own notetaking techniques, strategies, and degree of

confidence and satisfaction with notetaking. Questions 7 and 8 ask students about how they use

their notes whereas questions 9 and 10 ask about the types of classes that they are taking.

Comprehensive descriptive statistics for all questions across three time periods in a single

semester are described in (Masked authors, in press).

Test-Retest Reliability Procedure

To estimate the test-retest reliability of the NASUS, subjects enrolled in graduate courses

in design and health science programs were recruited (n=65). These subjects completed the

NASUS questionnaire in class, twice within a two-week period. The questionnaire

administration took 5-8 minutes. The average age of subjects was 24.563 (SD = 5.87), and the

average current Grade Point Average was 3.6997 (SD=0.21). Additional characteristics of this

sample are provided in Table 1. Of note, within this sample were students in an accelerated

bachelor's to master's program in their first year of graduate school which also count as the final

year of the baccalaureate degree. Their perception of their status at the university led to some in

the sample to reporting their status as undergraduate students. The test-retest reliability of the

questionnaire was established using statistical approaches appropriated based on the response

scale of the questions.

Construct and Concurrent Validity Procedure

To estimate the construct and concurrent validity of the NASUS, subjects enrolled in

undergraduate courses in STEM-related programs were recruited (n=138). These subjects

completed the NASUS questionnaire in class, during the first week of the semester. The subjects'

ages were on average 18.43 (SD=1.00). All were considered full time students. One-hundred six

participants took the SAT prior to college, with a self- reported average score of 1249.93 (SD=

191.72), placing them at the 85th percentile nationally. Fifteen participants reported taking the

ACT prior to college with a self-reported average score of 28.3, placing them at the 90th

percentile nationally. Table 2 further describes the characteristics of this sample.

Given the variety of scales used within the NASUS questionnaire, a composite score

cannot be meaningfully calculated. Further, the structure of some of the questions or the question

topic rendered them unfit for validity estimation. Finally, since there is no gold-standard for

which to compare the NASUS, we opted to perform construct and concurrent validity by

targeting specific questions. Concurrent validity is commonly applied in situations without a

gold-standard which would enable criterion-referenced validity (Allen & Yen, 1979).

Results

Content Validity

Content validity is not amenable to quantitative statistical analysis thus no numerical

values are provided. However, the process used to ascertain the content validity of the NASUS

questionnaire is provided in the Method section of this article. Although subjects during the test-

retest reliability and validity portions of the study could have added missing items to the

questionnaire using the "Other, please specify" option, none did so. This suggests that the

questionnaire captures the breath of students' self-perception about the notes they take in class.

Test-Retest Reliability

Test-retest reliability is arguably the best way to actually determine reliability of an

instrument, compared with single-administration internal consistency measures (Allen & Yen,

1979). Since there are three types of items on the NASUS—ordinal "percent of time" scales,

binary selected / not select scale options, and Likert-type scale—we applied different analyses to

each item type and averaged the estimates. Test-retest reliability for binary/select-all items was

judged using the percentage of students answering in the same manner across the two

administrations. On average, for Question 2, 85% of students selected the same answer; Question

3 had 89% answering the same; Question 6 had 75% answering the same; and Question 8 had an

average of 84% answering the same. Across the ordinal "percent of time" items that comprise

Question 1, the average test-retest reliability, using Spearman's rho, was $\rho = .68$. For the two

questions (Question 4 and Question 5) containing Likert-type items, composite scores were

computed by averaging items within each question (coefficient alphas = 0.88 and 0.77,

respectively). Both questions showed good test-retest reliability with Pearson correlation

coefficients: $r = .81$ for Question 4; $r = .82$ for Question 5.

Construct Validity: Factor Structure of Q4 and Internal Consistency of Q5

Question 4 of the NASUS and its 14 items asked subjects to provide their opinion about

their notetaking abilities related to confidence and competence, defined as *organization and*

clarity. An exploratory factor analysis was performed to determine the factor structure behind

Question 4 using a Maximum Likelihood extraction with Oblimin rotation with a 2-factor

solution (Table 3). Eight items loaded strongly on the first factor which we refer to as *confidence*

in notetaking abilities. Three items loaded strongly on the second factor which we refer to as

organization and clarity. The three remaining items either did not load strongly on either factor,

or had cross-loadings that were of the same magnitude on both factors (see bottom of Table 3).

These three items were thus removed from the NASUS questionnaire included in the Appendix.

The two factors were correlated with $r = .68$, however, we view these as two distinct constructs.

This two-factor structure needs verification within a second sample, but for the purposes of

concurrent validity, composite scores were made for the two factors.

Question 5 of the NASUS is made of three items which clearly refer to satisfaction with

notetaking, thus no factor analysis was performed on these items. Instead, internal consistency

was evaluated using Cronbach's alpha and Gutman's Lambda 6. Both measures showed

adequate internal consistency (alpha = .83, Lambda 6 = .82). Thus, these items also formed a

composite scale. Table 4 gives the means, standard deviations, and intercorrelation among these

three composite scores, along with internal consistency estimates.

Concurrent Validity

To illustrate the validity of the items comprising Question 4 and Question 5, we

examined the concurrent validity with other relevant items using regression. The first examined

whether the three composites (confidence, competence, and satisfaction) could predict the

number of ways subjects self-reported a desire to improve their notetaking (Question 6). The

dependent variable was the total number (out of eight possible options) of ways a subject

reported wanting to improve their notes. The mean number of reported notetaking improvements

was 3.58 (SD = 2.05). A regression analysis with confidence, organization and clarity, and

satisfaction as predictors, and degree of desired improvements as the dependent variable was

significant ($F(3, 135) = 7.14$, $p < .001$, $R^2_{adj} = .12$). Neither confidence ($b = 0.17$, p = .54) nor

organization and clarity (*b* = -0.16, *p* = .47) significantly predicted improvement, but satisfaction showed a significant negative association with improvement (*b* = -0.69, *p* = .004). The latter result provides evidence of concurrent validity of the satisfaction items as one would expect a lower level of satisfaction with one's notes when the person expressed a higher degree of desire to improve their notes.

Next, three items from Question 2 were selected based on their content vis a vis confidence, organization, and satisfaction. The three items were all binary items (endorsed, left blank). Thus, a logistic regression was used to examine concurrent validity of those items with the composites from Questions 4 and 5. The first item was "I use abbreviations in my notes" which 68% of subjects endorsed. None of the composite scales significantly predicted endorsement of this item (Table 5). The odds ratios indicate only modest changes in the chances of endorsing this item for changes in the scores of the composites, with large confidence intervals. The second item was "I summarize the lecture as it is being presented" which 71% of subjects endorsed. Endorsement of this item was significantly predicted by the confidence composite scores. Table 6 illustrates this, along with an estimated 235% increase in the odds of endorsing this item as confidence increases by one unit. Odds ratios were modest for the other predictors. The last item analyzed was "I try to write everything the instructor says" which 48% of subjects endorsed. This item was significantly predicted by organization composite scores, while the other composites did not show significant relationships with this item (Table 7). The odds ratios illustrate a more modest effect of increases in organization scores (80% increase in the odds of endorsement with a unit increase in organization) compared with the effect of increasing confidence on the "summarize" item.

Discussion

The NASUS questionnaire was developed in a multi-step iterative approach involving numerous stakeholders and a literature review to improve its content validity. The resulting questionnaire piloted as part of this validation study asked subjects to provide any additional missing items to questions. None were proposed by the subjects suggesting that the questionnaire captures the breadth of needed response choices related to notetaking. The multi-step iterative approach with analysis for missing items after piloting the questionnaire is an integral component of content validity, specifically to ensure there are no gaps in assessment (Streiner, Norman, & Cairney, 2015).

The NASUS questionnaire demonstrated strong test-retest reliability across two administrations. This was true of all of the different types of items on the NASUS, though with different types of items, we were not able to summarize with a single correlation coefficient to indicate reliability. Rather, across the various measures of consistency across two administrations of the NASUS, there is evidence that regardless of item type, people tend to report in the same way on each of the items.

The construct validity of the NASUS questionnaire was estimated by comparing questions and items within the questionnaire. Items within Question 4, as expected, fall into two related but distinct constructs: confidence in notetaking and the degree of perceived competence (organization and clarity of notes) in notetaking. Question 4's items were reorganized visually within the questionnaire (see Appendix) to capture these two constructs. There is a high degree of internal correlation between all items of Question 5 suggesting that this question measures one construct, named satisfaction. The three constructs (i.e., confidence, competence and satisfaction) show a moderate to high degree of intercorrelation.

Concurrent validity was estimated within the measurement tool as no other valid and reliable measures of notetaking were identified in the literature (Allen & Yen, 1979). Thus, concurrent validity of the NASUS was estimated, in part, through an analysis of the degree of association between the three composites (i.e., confidence, competence and satisfaction) and subjects' degree of desire to improve their own notetaking abilities (Questions 4, 5 and 6). Satisfaction was negatively associated with the degree of desired notetaking improvements by students whereas confidence and competence were not associated with this area of desired improvement. Further, concurrent validity was estimated by comparing responses for Questions 4 and 5, to selected, relevant items of Question 2. Confidence was positively related to the odds of endorsing the use of a "summarization of lecture" strategy, while organization was positively related to the "I try to write everything the instructor says" strategy. Using abbreviations in one's notes, the third item included in the analysis, was not predictive of confidence, competence, or satisfaction. Overall, these results illustrate concurrent validity of the Likert scale items and select binary items related to reported notetaking strategies.

Of note, the NASUS was developed as a self-report measurement tool to capture both student perceptions of their notetaking ability and the pattern of strategies used by students. However, the NASUS does not capture the actual quality of student notes. A subsequent validation study of the NASUS compared to valid and reliable measures of actual note quality is needed and planned. A remaining need related to the NASUS is the development of a measurement model for the tool. It will be important to explore more fully whether or not the questions on the NASUS should be considered psychometric scales in the sense that responses are caused by some underlying latent variable, or whether they are best considered as indices or composites (DeVellis, 2016).

Conclusion

The NASUS questionnaire, in this first validation study, appears to be a reliable and valid assessment of postsecondary education students' self-perception of their notetaking abilities in terms of methods of notetaking, reasons for taking notes, quality of notes taken, satisfaction with notetaking approach, time spent with using one's notes, and degree of desire to improve one's notes. The NASUS could be used by colleges and universities to generate a profile of their student body's perception of notetaking habits and preferences to guide academic support programing and resources. The NASUS may also be used to monitor changes in notetaking habits and preferences over time or in response to supportive programming.

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Authors' contributions

MCC wrote the abstract, methods, discussion, and conclusion of the manuscript. MCC and RH completed data analysis, while RH also wrote the results section. MCP and AG co-wrote the background, and MCP also contributed to the discussion, methods, and conclusion sections. MCC, MCP, and AB participated in editing the manuscript. MCC and AB participated in recruitment, data collection, and data entry. All authors conceptualized the study and read the manuscript prior to submission.

Declarations

NASUS QUESTIONNAIRE

Appendix

Notetaking Abilities and Strategies of University Students

This questionnaire is designed to learn about your note-taking techniques, abilities, preferences and

satisfaction. Please answer each question to the best of your ability.

1. How often do you currently use each of the following note-taking techniques in class?

Note-Taking Techniques Used	How often do use each technique?				
	Never	1-25%	26-50%	51-75%	76-100%
Handwritten Notes					
1. I handwrite my notes on printed PowerPoint™ Slides	☐	☐	☐	☐	☐
2. I handwrite my notes on the handout provided by the instructor	☐	☐	☐	☐	☐
3. I handwrite on my own notebook paper	☐	☐	☐	☐	☐
4. I handwrite on a tablet PC or iPad	☐	☐	☐	☐	☐
Typed Notes					
5. I type my notes in Microsoft Word™, Google Docs or other word processing software	☐	☐	☐	☐	☐
6. I type my notes on the PowerPoint™ slides	☐	☐	☐	☐	☐
7. I type my notes in notetaking software such as Sonocent, Evernote, or OneNote	☐	☐	☐	☐	☐
8. I type my notes on my phone	☐	☐	☐	☐	☐
Other Notetaking Techniques					

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9. I audio record the lectures	☐	☐	☐	☐	☐
10. I video record the lectures	☐	☐	☐	☐	☐
11. I take a picture of the notes written on the board	☐	☐	☐	☐	☐
12. I copy someone else's notes	☐	☐	☐	☐	☐
13. I have a person who take notes for me	☐	☐	☐	☐	☐
14. I do not take notes during class	☐	☐	☐	☐	☐

2. Which note taking strategy do you currently use regularly? (Select all that apply)

☐ I use abbreviations when taking notes

☐ I summarize the lecture as it is being presented

☐ I try to write everything the instructor says

☐ I compare notes with my classmates after class

☐ I include pictures or diagrams in my notes

☐ I highlight parts of my notes

☐ I underline parts of my notes

☐ I color code my notes

☐ I do not use any strategies while taking notes

3. What are your primary reasons for taking notes in class? (Select all that apply)

☐ To help me pay attention in class

☐ To help me remember information shared in class

☐ To help me understand the information shared in class

☐ To help me understand course content without having to read the textbook

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☐ To have as a resource to complete course assignments

☐ To have as a resource to study for quizzes and/or exams

☐ I doodle instead of taking notes in class

☐ I do not take-notes in class

4. What is your opinion of the notes that you currently take in class? (Circle the number that reflects your opinion)

Statements	Impression					
1. I am competent at listening to lectures and taking notes at the same time	1 Strongly disagree	2	3	4	5	6 Strongly agree
2. I am able to write or type all the important information shared in class	1 Strongly disagree	2	3	4	5	6 Strongly agree
3. I feel I am writing or typing everything I need during class	1 Strongly disagree	2	3	4	5	6 Strongly agree
4. I summarize key points from lectures in my notes	1 Strongly disagree	2	3	4	5	6 Strongly agree
5. I am confident in my note-taking abilities	1 Strongly disagree	2	3	4	5	6 Strongly agree
6. My notes are useful when I complete assignments	1 Strongly disagree	2	3	4	5	6 Strongly agree

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7. My notes are useful when I study for quizzes or exams	1 Strongly disagree	2	3	4	5	6 Strongly agree
8. I find taking notes is difficult	1 Strongly disagree	2	3	4	5	6 Strongly agree
9. My notes are well organized	1 Strongly disagree	2	3	4	5	6 Strongly agree
10. My notes are detailed	1 Strongly disagree	2	3	4	5	6 Strongly agree
11. I cannot read my handwritten notes	1 Strongly disagree	2	3	4	5	6 Strongly agree

5. What is your degree of satisfaction with your current note-taking approach?

1. I am satisfied with the way(s) I currently take notes in class	1 Strongly disagree	2	3	4	5	6 Strongly agree
2. I am satisfied with the quality of notes I am taking in class	1 Strongly disagree	2	3	4	5	6 Strongly agree
3. I want to change the way I take notes in class	1 Strongly disagree	2	3	4	5	6 Strongly agree

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6. I would like to make my notes more (select all that apply)

☐ Legible   ☐ Helpful

☐ Accurate   ☐ Complete

☐ Concise   ☐ Clear

☐ Organized   ☐ Time efficient

☐ I would not like to improve my notes.

7. How many hours on average do you spend after each class organizing or reviewing your notes?

_____

8. With your notes, which organizing and reviewing strategies do you use? (Select all that apply)

☐ I create flash cards (e.g., paper, Quizlet)

☐ I create test questions to assess my own learning

☐ I write all the information that I recall on a blank piece of paper to assess my own learning

☐ I write connections in my notes using the textbook, other readings and materials, classroom

discussion, problem sets, etc.

☐ I explain the information in my notes out loud

☐ I create pneumonics, sayings, songs or games

☐ I draw and label diagrams, models, etc.

☐ I review my notes with a tutor

☐ I do not use any organizing or reviewing strategies with my notes

9. What types of classes are you currently enrolled in? (Select all that apply)

☐ Entirely in person (e.g., lecture, lab, studio)

☐ Entirely online class

☐ Hybrid class (Combination of online and in person)

NASUS QUESTIONNAIRE

10. Do your notetaking strategies change depending on the class subject or type of the class (i.e., on campus class, online class, hybrid class)?

□ Yes

□ No