

## NEW MATH TEACHING METHODOLOGIES FOR ELL STUDENTS

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### ABSTRACT

Lecture notes provide a gauge for what is important in the textbook. However, taking notes for ELL (English Language Learners) students is not an easy task as ELL students are unable to communicate fluently or learn effectively in English. In this research, we attempt to analyze the effects of augmenting Mathematics Lectures with pre-written handouts on the note taking of ELL students and consequently on the academic performance of ELL students. The research was conducted over a period of four consecutive semesters on a Freshman Mathematics subject at the American University of Sharjah in UAE and a mixed qualitative and quantitative approach was employed. The introduction of the new teaching methodologies reflected positively on the students' performance in subsequent exams and based on the conducted survey, the majority of the students indicated the positive impact of being exposed early in the lecture to written notes on their own note taking.

**KEYWORDS:** Teaching, Education, ELL Students, Methodologies, Note Taking, Academic Performance, Learning

### I. INTRODUCTION

Taking notes during class hours would usually save them from the problems caused by last minute studying. More importantly, students who do a good job of taking notes during classes would usually find easier to study for exams affecting their academic performance for the following reasons:

- Good notes give students a starting point when studying for exams and major points the lecturer would usually want the students to focus on. Studying a number of chapters from the course textbook days before the exam can be both time consuming and daunting. Good notes will help students understand what material is important and what material is only secondary. Note taking provides students with direction, keeps them organized, and helps them keep up with their studies.
- Students that learn to take notes do a better job of listening while in class. Our mind can be a great tool or it can distract us from the things going on around us. When students force themselves to take good notes, they put an extra effort in listening to the lecturer. This would usually have a profound effect on the students understanding after class
- Taking notes helps students organize the material and points out areas of weakness. This information provides students with the info. needed to organize their study time more effectively.

As pointed out, good note taking during class hours is an essential ingredient in a successful student learning experience in college. The preponderance of studies confirms that students recall more lecture material if they record it in

their notes [6]. However, note taking techniques would differ from one subject to another and challenges would arise if the students come from different educational backgrounds.

One specific sample of those students are the ELL (English Language Learners) students. ELLs are a highly heterogeneous and complex group of students, with diverse educational needs, backgrounds. They come mostly with moderate English Skills and are sometimes stigmatized for the way they speak English. Some ELL students may be high achievers in school while others struggle. They may excel in one content area and need lots of support in another. Some feel capable in school while others are alienated from schooling. More specifically, there are a number of challenges associated with ELL students' capability in taking notes during Mathematics Subjects [24]:

- Although Mathematics might be considered as a universal language however there are a number of unique vocabulary in Mathematics that might not easily be translated or even explained with proper educational background. These vocabulary might also include everyday vocabulary that has different meanings when used in mathematical contexts.
- Mathematics can be considered a symbolic language and students must learn to associate mathematical symbols with concepts and they would need to act fast when taking notes to express those concepts.
- Students are usually used to comprehending the active voice when reading or even listening. Mathematical texts on the other hand, tend to use the passive voice, a complex and difficult structure for many non -English speakers.

In this research, we investigate this challenging problem by introducing new teaching aids for ELL students to improve their note taking experience and affect their academic performance. More specifically, the following research questions would be investigated: How can teachers improve ELL students' listening and writing skills in Math classrooms? What are the implications of introducing pre-lecture written notes on the learning experience of ELLs in Math subjects?

The rest of this paper is divided as follows. In Section 2, we provide a literature review on existing research work. In Section 3, we provide our research framework. In Section 4, we provide our data collection details and analyze our results. We conclude this paper in Section 5.

## II. RELATED WORK

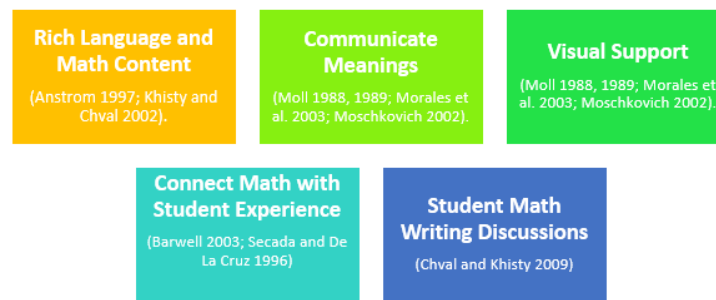
Peregoy& Boyle [26] discussed the importance of the four major components: writing, speaking, listening, and reading in the learning experience of any student during college and their implications on student performance. Those components have mutual effect on each other in the learning process. However, research in the field of teaching has been mainly based on reading, writing and speaking as the skills necessary for language acquisition and little focus was put on the listening component as it was considered a receptive skill in language learning [14]. Osada [25] discusses the importance of the listening process in learning pointing out the complexities associated with listening during class and transmuting those listened concepts into written notes.

Focusing more on the learning experience of ELL students in class, according to Ferris and Tagg [12] lack of note-taking skills and problems with note-taking as well as listening comprehension are troublesome areas most often reported by international students. Also, it is recommended to include note-taking materials as part of the classroom instruction to help students learn more about the subject matter under instruction [15]. There are a number of published

research work discussing the role that language plays in the Mathematics Education for ELL students [4, 22, and 31]. Brenner [7] discusses how ELL students are discouraged in mathematics classrooms and do not often participate or engage with the professor resulting in the lack of usage and experimentation with the language of mathematics. In general, teachers find difficulty in adapting mathematics curriculum to help ELL students comprehend the material and perform better [32]. According to Pimm [28], in order to cope in mathematics classrooms and comprehend the material, students need to understand the mathematical vocabulary. Teachers are therefore encouraged to prepare special notes for teaching ELL students since Mathematics utilizes a number of unique vocabulary with a passive symbolic way of presentation as discussed in Section 1. Taking notes for students in a Mathematics class is not an easy task as they have to be good at multitasking [8]. Students need to acquire a set of listening strategies necessary to efficiently process academic lectures in class while simultaneously taking notes. Teaching students how to take good notes in classrooms have a direct implication on their learning experience [15]. Al Khasawneh [2] discuss the problems faced by ELL students while taking notes especially the grammatical language barriers. Gur et al., [13] point out that taking notes is not simply writing down what students listen but it ignites their creativity in thinking and therefore would affect their learning process. Research conducted by Carrell [9] and Song [33] indicate that the recognition of the main ideas and detail information are the essential factors in order to comprehend the content of the lecture for ELLs. Being overwhelmed by the speed of lectures is a common feeling evident in ELL students and that can be solved by developing high listening proficiency skills [27].

A number of research work have proposed teaching strategies to provide a better learning experience for ELL students in Mathematics classrooms and thus improve their academic performance as summarized in Figure 1:

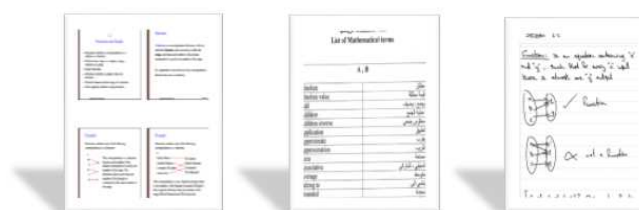
- Research work by Anstrom [3] and Khisty et. al [18] suggest that teachers should create classroom environments that are rich in language and mathematics content.
- Moll [19 and 20], Morales et al. [21] and Moschkovich [22] indicate that teachers should emphasize on the meaning of mathematical words and should encourage students to communicate meaning by using gestures, drawings, or their first language. This will enable students to ripen the target language and mathematics.
- The use of visual supports such as physical objects, videos, illustrations, and gestures in classroom conversations along with diagrams and visual graphs was discussed in Moschkovich [22] and Raborn [30].
- Teachers need to connect mathematics with students' life experiences and existing knowledge as summarized in Barwell [5] and Secada and De La Cruz [34].
- Teachers need to encourage students to discuss their writing in class or even after class to provide constructive feedback [10].



**Figure 1: Summary of Related Research Work on Mathematics Teaching Techniques for ELL Students**

### III. PROPOSED TEACHING METHODOLOGY

The research was conducted over the course of four consecutive semesters (Fall 2014 – Spring 2014, Fall 2015 – Spring 2015) at the American University of Sharjah, UAE in a Freshman Mathematics Subject for ELL students delivered by the same Mathematics Instructor. During the first two semesters, the ELL students were given lecture handouts at the start of each lecture which were printed digital power point presentation taken from the book companion Instructors manual. At the start, of the second semester, one of the students with a good handwriting was asked to use his tablet PC with an interactive digital pen stylus to take personal lecture notes during each lecture and save them afterwards to share with his instructor. The notes were mostly based on what the instructor wrote on the board and what the student had comprehended from the oral in-class discussions. During the last two semesters, the instructor decided to replace the book PowerPoint handouts that were given to the students at the start of each lecture with the written notes provided by the student at the end of the second semester. A sample of both handouts is shown in Figure 2(a) and 2(b). More importantly, students were asked to augment the notes with their personal notes as needed. Also, during the last two semesters, students were also given a handout tabular translation of major mathematical words from English to Arabic (their native language) as shown in Figure 2(c). Table 1 summarizes the teaching aids used during the different semesters.



**Figure 2: Three Different Set of Handouts Given to the ELL Students  
(PPT Notes, Math Terms Translation, and Written Notes)**

**Table 1: Different Teaching Aids Used**

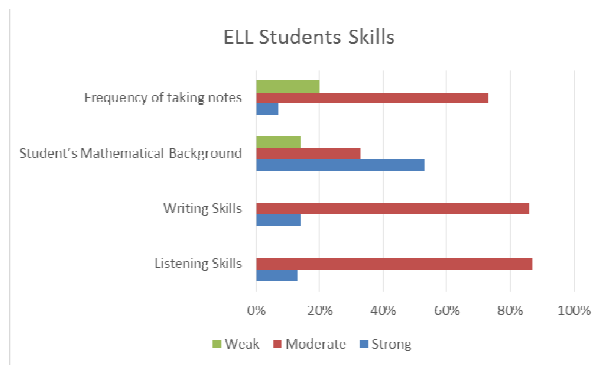
Semester	Class Size	Teaching Aid Used
Fall 2014	31	ELL students given book PowerPoint handouts at the start of each lecture.
Spring 2014	25	ELL students given book PowerPoint handouts at the start of each lecture.

**Table 1 – Cond.,**

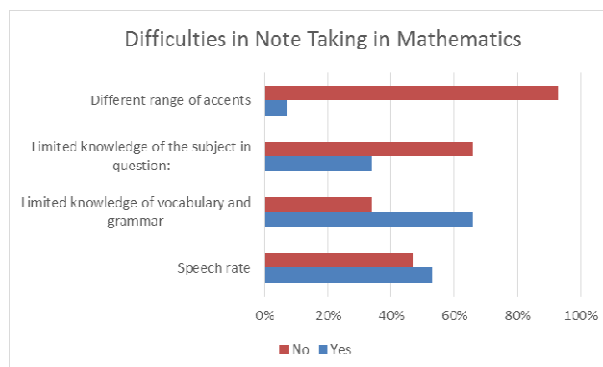
Fall 2015	30	ELL students given previous student written notes as handouts at the start of each lecture with mathematical concepts Translation table.
Spring 2015	21	ELL students given previous student written notes as handouts at the start of each lecture with mathematical concepts Translation table.

**IV. DATA COLLECTION AND ANALYSIS**

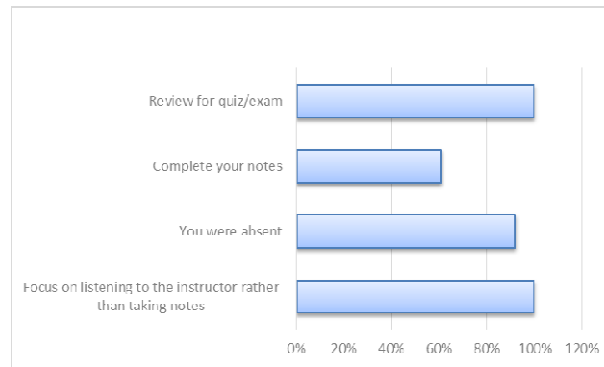
A mixed methods approach was employed, that is a qualitative and quantitative approach. The instrument was a survey given to the students. The quantitative approach was used in the first four questions. We wanted to analyze the ELLs adeptness in listening ranging from moderate to high as this will directly have implications on their ability to take good notes during the lectures. We also analyzed the ELLs proficiency in writing as this will have indicate if the ELL students can produce a grammatically correct English paragraphs focusing on the important concepts discussed in class. We also wanted to highlight an evident difficulties faced by the students during the lecture including speech rate, limited knowledge of the vocabulary and grammar, limited knowledge of mathematics concepts, and different ranges of accents in a lecture. The survey also highlights how frequently ELLs take notes in class ranging from always, sometimes and never. We also asked the students on their opinion on the effects of the introduced written notes on their performance in the subject.



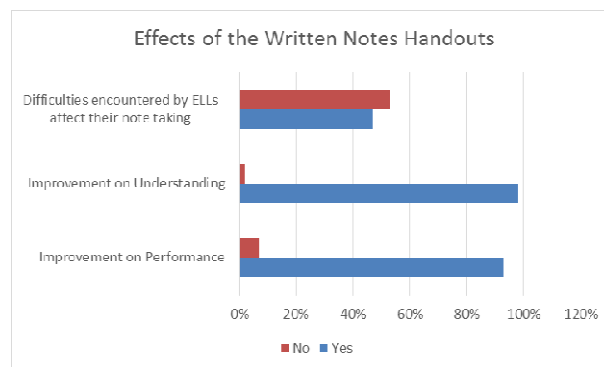
(a)



(b)



(c)



(d)

**Figure 3: Different Descriptive Statistical Graphs Resulting from the Survey**

The qualitative approach was employed in some open questions asking students what kind of difficulties they have when taking notes and what benefits does the introduction of the new teaching aids on their learning experience in the Mathematics subjects. A total of 51 non-native speakers of English students from the last two semesters were asked to participate in this study with a mix of males and females. The selected participants received an explanation of the nature of the study and their role in the study. It was explained that this study is aimed to analyze the implications of the introduction of the new teaching aids on their note taking experience in the subject as well as on their respective performance in the subject. The oral consent of each student was also acquired prior to completing the survey. A total of 48 students completed the survey successfully. Figure 3 summarizes the results collected from the survey as graphical descriptive statistics.

The first set of questions aimed to find out how students evaluate their listening skills, writing skills, mathematical background, and note taking frequency. The results are shown in Figure 3(a). As noted, most students evaluate their listening and writing skills as moderate compared to only very few evaluate it as strong. This is an interesting observation considering that the students are self-evaluating their listening skills compared to a teacher evaluating them which would probably lead to different results which might seem subjective however as discussed by Rahimi and Abendini [29], listening comprehension self-efficacy is significantly related to listening proficiency. The students' mathematical background is dispersed between the different levels showing that ELL students are indeed a heterogeneous group of students coming from different academic backgrounds as discussed in Section 1. Also, 73% of the students indicated that they usually take notes moderately. The second set of questions, focused on the reasons behind the evident difficulty in

good note taking in Mathematics. As shown in Figure 3(b), it can be noted that the different sets of unique vocabulary used in Mathematics classes represent a major burden to most students while other factors (such as lecturers accent, speech rate, background knowledge) do not represent a significant factor in good note taking. The third set of questions highlight the benefits of providing the students with written notes prior to class as perceived by the students. It can be noted from Figure 3(c), the major benefits agreed upon by all students is that the notes provided assist them to listen more to the lecturer and would usually help them to study for exams and quizzes. This is also an interesting point as the notes given to the students are written by an X-student of the same subject and are written in a way an ELL student would easily comprehend compared to static PowerPoint notes which would usually use a different style of presentation. The last set of questions highlight the immense positive effects of the notes on both performance and understanding as shown in Figure 3(d).

Students' comments on the open questions were quite interesting. Most students clearly indicated the usefulness of the written notes on their learning experience including its effects on time saving and allowing them to focus more during class hours. For example, one student commented: "I think that the written notes are very useful for several reasons. One reason is that it saves time so we don't have to write notes while the teacher is teaching the lesson so we can concentrate more and then refer to the notes if needed. Another reason is that it helped me in studying for the quizzes especially given that they were written by another student and were not simply copied from the textbook". Another student pointed out the benefits of the written notes in terms of clearer representation of the important concepts discussed in class and commented: "Since I am a student who studied Math in my high school years ago in Arabic, I faced some issues regarding understanding. However, the notes that you provide for us were useful in many ways.... The written notes were straight forward but the book had so many extra things that cannot be useful for us.

Overall, the results collected show promise to our proposed teaching enhancements in the form of pre-lecture written handouts and vocabulary tables for ELL students as evident by both the quantitative survey results and qualitative student responses to the open questions.

## V. CONCLUSIONS

Taking notes aids students to comprehend and understand lecture materials in Mathematics subjects. However, taking notes for ELL (English Language Learners) students is a very challenging task as ELL students are unable to communicate fluently or learn effectively in English. In this research paper, we first provided a comprehensive survey on the importance of note taking and the challenges associated with good note taking in Mathematics subjects for ELL students. We attempted to analyze the effects of augmenting Mathematics Lectures with pre-written handouts on the note taking of ELL. The introduction of the new teaching methodologies reflected positively on the students' and based on the conducted survey, the majority of the students indicated the positive impact of being exposed early in the lecture to written notes on their own note taking. We also made significant observations while analyzing our results. For example, previous research indicated that speech rate and different range of accents play an important role in understanding the explanation in class, allowing the students to better follow the content. However, our results showed insignificant correlation between accents and speed rates on good note taking. Also, it is suggested that teachers should consider some pauses during the lecture to allow students to discuss and rework their notes together.

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