The Effect of Magicschool.ai on Dyslexic Student's Achievement in Science

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Résumé

La dyslexie est un trouble qui provoque des difficultés dans la lecture et le traitement du langage. Les élèves dyslexiques obtiennent des scores plus bas que leurs pairs aux tests de réussite et en plus aux tests de sciences en raison de leurs difficultés de lecture et de traitement du langage. Des études ont montré que l'utilisation d'outils d'IA peut aider les élèves dyslexiques à simplifier le langage du texte à leur niveau et à obtenir de meilleurs résultats en sciences. Dans cette étude, une approche expérimentale a été utilisée en choisissant un seul groupe de 10 élèves dyslexiques de troisième année. Les élèves ont fait un test de sciences avec et sans l'utilisation de Magicschool.ai. Ce dernier a été utilisé pour simplifier le langage dans le test et fournir des définitions pour les mots complexes. L'objectif de l'étude était d'évaluer l'effet de l'utilisation de cet outil pour simplifier le langage sur la réussite des élèves dyslexiques en sciences. L'échantillon de l'étude était de 10 élèves de troisième année atteints de dyslexie provenant de trois écoles publiques différentes de Beyrouth. Pour mesurer l'effet de cet outil, un test a été administré aux élèves sans l'utilisation de Magicschool.ai, puis le test a été répété en utilisant l'application. Les résultats ont été analysés à l'aide de SPSS et ont montré que l'utilisation de cet outil d'IA a aidé à augmenter le degré de la réussite des élèves. Ainsi, on suggère d'utiliser les outils d'IA pour améliorer la réussite des élèves dyslexiques en sciences.

Mots-clés

Éducation inclusive, dyslexie, outils d'IA, enseignement primaire.

Abstract

Dyslexia is a disorder that causes difficulties in reading and processing language. Students who don't understand the language score lower than their peers on achievement tests. Moreover, dyslexic students score lower on science tests due to their reading and processing language difficulties. Studies have shown that using AI tools can help students with dyslexia simplify the language in the text to their level and score better in science. In this study an experimental approach was used using a single group of 10 dyslexic grade 3 students. The students took a science test with and without the use of an AI tool; Magicschool.ai. Magicschool.ai was used to simplify language in the test and provide definitions for complex words. The study's aim was to assess the effect of using this tool to simplify the language on the achievement of dyslexic students in science. The sample of the study was 10 grade 3 students with dyslexia from three different public schools in Beirut. To measure the effect of this tool, a test was administered to the students without the use of Magicschool.ai then the test was repeated using magicschool.ai. The results were analysed using SPSS and showed that using this AI tool helped increase the achievement of the students. Thus, suggesting that using AI tools can improve dyslexic students' achievement in science.

Key words

inclusive education, dyslexia, AI tools, primary education.

مستخلص

عسر القراءة والكتابة هو اضطراب يسبب صعوبات في القراءة ومعالجة اللغة. الطلاب الذين لا يفهمون اللغة يحصلون على درجات أقل من أقرانهم في الاختبارات التحصيلية. بالإضافة إلى ذلك، يحصل الطلاب الذين يعانون من عسر القراءة والكتابة على درجات أقل في اختبارات العلوم بسبب الصعوبات التي يعانون منها في القراءة ومعالجة اللغة. أظهرت الدراسات أن استخدام أدوات الذكاء الاصطناعي يمكن أن يساعد الطلاب الذين يعانون من عسر القراءة والكتابة في تبسيط اللغة في النص إلى مستواهم والحصول على درجات أفضل في العلوم. في هذه الدراسة، تم استخدام منهج تجريبي باستخدام مجموعة واحدة من 10 طلاب يعانون من عسر القراءة والكتابة في الصف الثالث. خضع الطلاب لاختبار في العلوم مع وبدون استخدام أداة الذكاء الاصطناعي ماجيك

سكول.اي. تم استخدام ماجيك سكول.اي لتبسيط اللغة في الاختبار وتوفير تعريفات للكلمات المعقدة. كان هدف الدراسة تقييم تأثير استخدام هذه الأداة لتبسيط اللغة على تحصيل الطلاب الذين يعانون من عسر القراءة والكتابة في العلوم. كانت عينة الدراسة 10 طلاب من الصف الثالث يعانون من عسر القراءة والكتابة من ثلاث مدارس رسمية في بيروت. لقياس تأثير هذه الأداة، تم إجراء اختبار للطلاب بدون استخدام ماجيك سكول.اي ثم تكرار الاختبار باستخدام ماجيك سكول.اي. تم تحليل النتائج باستخدام SPSS وأظهرت أن استخدام أداة الذكاء الاصطناعي هذه ساعد في زيادة تحصيل الطلاب. وبالتالي، توحي بأن استخدام أدوات الذكاء الاصطناعي يمكن أن يحسن تحصيل الطلاب الذين يعانون من عسر القراءة والكتابة في العلوم.

الكلمات المفتاحية

التعلم المدمج، الديسلكسيا، أدوات الذكاء الاصطناعي، التعليم الابتدائي

1. Introduction

Background

Inclusive education can be defined as education that takes into consideration all the students' needs. It is also a process that aims at integrating children with learning difficulties and disabilities into all schools without discrimination (Akbarovna, 2022). Science for all is a movement that branched out of inclusive education. Science for all means that science literacy should be achieved for all students regardless of their abilities and aspirations (Abels, 2014).

However, when science is taught in a second language it makes it harder for the learner to understand science. Students who don't understand the language score lower than their peers on achievement tests (Akbasli, Sahin, & Yaykiran, 2016). Add to that the fact that science books are written with two or three levels higher than the actual level of the students. This makes it harder for students with learning difficulties to understand science and thus score highly on science tests (Abels, 2014).

Dyslexia is a learning disorder that causes difficulties in reading and processing language (Learning Disabilities Association of America, 2018). Dyslexic students have difficulties learning science due to science being highly reliant on language in instruction (Tiril & Okumus, 2022). This raises the need for a tool that helps the students understand language taught in science at their level. Some AI tools help students simplify the language in the text to their level. One of these tools is called magicschool.ai. Teachers can use this tool to provide definitions for many words that can be challenging in the text. They can also copy the text and paste it then ask the tool to simplify the text so that the students can understand it. The problem at hand is that dyslexic students, find it hard to comprehend the language and thus understand science. Using an AI tool that can simplify the language can help the students understand the language and thus increase their achievement in science.

Literature review

The number of articles on the specific topic of this study is very limited. This is one of the reasons as to why this study is of great addition to the literature. In this section of the introduction a review of studies that are closely related to the topic at hand will be discussed.

Language in Science Education

The PISA is the program for International Student Assessment. PISA results show that there is a strong correlation between achievement in reading comprehension and science and math achievement (Akbasli, Sahin, & Yaykiran, 2016). In this study, data was gathered from multiple countries, where countries that scored higher on the reading comprehension also scored high on math and science. In their study Francisco and their colleagues found results that align with the previous study. Even though many factors play a role in science learning, low level of reading comprehension negatively affects science learning (Cano, Garcia, Berben, & Justicia, 2014). A third study found that the higher the word count the lower weak readers achieved on their tests (Neri, Guill, & Retelsdorf, 2021).

Even though not a lot of studies have been conducted on the effect of reading comprehension on science learning (Cano, Garcia, Berben, & Justicia, 2014). The results of all three of these studies

are in alignment and suggest that the level of reading comprehension is closely related to achievement in science.

AI applications in language education

To begin with some articles were written on the effect of AI tools on reading comprehension. A study by Srinivasan and Murthy, using an AI multi-sensory technology caused the increase in the learning outcomes up to 40% in reading comprehension (Srinivasan & Murthy, 2021). Moreover, a recent paper reviewed multiple data bases on the AI uses in language teaching and learning. In this paper, (Ali, 2020) found that AI uses were not only beneficial for the teachers but also for the learners. AI use improves the language skills of the learners specifically reading and writing. This study is of great relevance to the current study as dyslexic students have difficulties with reading and writing (Learning Disabilities Association of America, 2018). Finally, (Sharadgah & Sa'di, 2022) conducted a review of 200 articles on the effects of AI uses on language teaching. In their paper, they found that AI uses can improve language skills. All three of these studies show the same results which are that using AI in language teaching can lead to improvement in language skills such as reading and writing.

AI applications for dyslexic students

AI applications have proven to be very effective for students with dyslexia (Wang, Muthu , & Sivaparthipan, 2022). New studies are being conducted to find the most effective uses of AI in the classroom for students with dyslexia. In 2022 Wang and her colleagues developed a model using AI that enhances cognitive skills for students with AI. The name of the model is the Augmentative and alternative communication model. This model was developed to supplement speech and writing for students with disabilities. The model was enhanced using AI in the study. The results showed that the effectiveness of the model increased from 36% to 66% (Wang, Muthu , & Sivaparthipan, 2022). Another study by Gilbert et al. (2023) developed an AI tool that interprets font’s readability by students with dyslexia and create fonts that more readable for them. This study showed that this AI tool was able to improve the student’s reading ability from the font alone (Gilbert, et al., 2023). Another AI language learning model was used to test if can improve the language skills of students with dyslexia. The model works by providing feedback and

personalized instructions for students. Evaluations of this AI model shows promising results in assisting and improving educational outcomes of students with dyslexia (Alqahtani, Alzahrani, & Ramzan, 2023). These studies along with many others show that the right AI tools can enhance the learning outcomes of students with dyslexia.

Conclusion

All of the previous studies provide ground for this study. This study tackles multiple issues discussed in the studies mentioned in the literature. Language is a very fundamental part of teaching science. The literature shows that AI can be a helpful tool in teaching language and in teaching students with dyslexia. However, there is little literature on AI tools in teaching language in science. Thus, comes the importance of this study.

Research question:

What is the effect of using magicschool.ai to simplify the language on the achievement of dyslexic students?

Hypothesis:

Using magicschool.ai to simplify the level of the language will increase the achievement of dyslexic students.

Research objective

This study aims to explore the effect of using an AI tool (magicschool.ai) to simplify the language in science on the achievement of dyslexic students.

1. Methodology

Design

This study is a quantitative experimental study using one group. An exam was used to test the achievement of the students in science where no AI tools was used to help them whilst taking the examination. Then the same exam was repeated where the AI tool was used. The AI tool used here is called magicschool.ai Teachers used the tool to make the text simpler according to their level. Then the data of the results of the examination was collected and analysed. The experimental design was chosen to test for the presence of a correlation between using this AI tool and the achievement of dyslexic students in science. One group was chosen due to the small sample size and to achieve better results.

Settings

The study took place at three inclusive schools in Beirut area. The schools were chosen due to convenience. The researcher chose these schools as they are the closest in distance and they were the first to agree to participate in the study. One school has two shifts; a morning shift for Lebanese and non-refugee students and an afternoon shift for Syrian refugee students. The learners from the sample were chosen from the morning shift. The intervention was from the beginning of February till the beginning of March. Preliminary steps took two weeks and the intervention itself was over two weeks too. Thus, 4 weeks were needed to complete the intervention.

Sample

The sample of this study is 10 grade three students with dyslexia. The sample was chosen from 3 public inclusive schools in Beirut. The sample was chosen by convenience as the researcher is based in Beirut and the principals of these 3 schools agreed to be a part of the study. All the students with dyslexia received a consent form however only 10 of their parents signed it. The sample consisted of 6 boys and 4 girls of similar age. With the oldest being 10 and the youngest being 8 at the time of conducting the study. All the participants were of Lebanese nationality. The students had been diagnosed with dyslexia by a professional for more than a year. All the students were

being monitored by specialists in the school as per the inclusive policy for students with special needs in public schools.

Tools

A science test was used as a tool in this study. The same test was done twice. The first time the test was done without the AI tool. The second time the AI tool was used to simplify the language and provide definitions for advanced words. This test is a science examination with a slight focus on the language to meet the objective of this study. The test was on the topic of the digestive system. The topic was chosen according to the chapter the teacher had reached in the academic year. The researcher was advised to use this topic by the specialist since the students were a little bit familiar with the content but had not finished learning about the digestive system yet. The test contains three exercises. In the first exercise, students must read a small passage about the process of digestion. Then they must pick out from the passage the names of the digestive organs. In the second exercise, they must read sentences about the function of an organ then name the organ. In the final exercise they must write the steps in the process of the digestion.

The test was reviewed by the science coordinator in the schools as well as the special needs specialists.

Validity and reliability

First the test was reviewed by the coordinator and the specialists in the schools. The test was also repeated on the same group of students after a week to see if there is consistency of the results. When the test was repeated, it was repeated using the adapted version of the test. The exam was also corrected by the researcher and the coordinator and reviewed by the principal and the specialist.

Ethics

Conducting an experiment or any study in a public school needs an approval from the ministry of education. The head of the directorate of elementary education read the proposal for this study to make sure that it adheres to the ethical measures needed. The head of the directorate of elementary

education then signed the approval and the researcher was allowed to conduct the study in the selected schools. On the other hand, the researcher took verbal approval from the subjects under the study personally so that they don't participate in the study based only on their parent's decision. All the participants' parents also signed a consent form to participate in the study. The names of the participants and the schools will remain confidential and anonymous. Each participant received a number and they wrote their number on their test papers so that there is no evidence of their identity.

Procedure

Step one: Selecting the schools and the sample

After getting a confirmation from the ministry of education to conduct the study. The researcher selected 3 schools which were the closest and agreed to be a part of the study. Then two weeks prior to the intervention the researcher met with the specialists in each school in order to identify the learners with dyslexia. After receiving a list of the learners with dyslexia the researcher met with these learners. During their meeting the researcher explained to the learners the purpose behind the study and the procedure. The researcher then got verbal consent from the learners. At this point the sample size was 16 learners. After that the learners received a consent form which they took to their parents to sign. 6 families didn't want their child to participate in the study which decreased the sample size to 10 students only.

Step two: Preparing the assessment

One week later the researcher prepared the test. The science coordinators in the schools reviewed the test as well as the special needs specialists. The test was then piloted on three dyslexic students from a private school. These students where also in grade three. The results of their tests were between 5 and 6 over 10 which is to be expected as they didn't receive a test adapted using magicschool.ai.

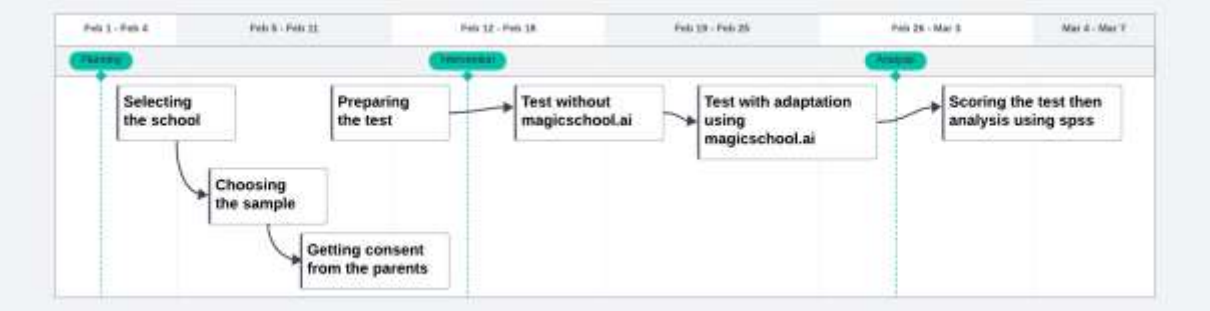
Step three: The intervention

The intervention took place at the schools during the art session. The principals preferred that the students don't miss the science sessions and chose the art session to do the intervention in. During the first week of the intervention the learners took the test without adapting it using magicschool.ai.

During the second week of the intervention, the learners took the test but this time the researcher used magicschool.ai to simplify the language and provide definition for the scientific and complex words. In order to provide definitions the option of "text scaffolder" was used. This option provides 3 to 7 scaffolding questions to simplify the text as well as 5 to 7 definitions of complex words in the text. Only the definitions provided by the AI were used. For example, some of the words that the AI tool provided definitions for are: Chewed: When food is crushed into smaller pieces by the action of teeth. Esophagus: The tube in the body that carries food from the throat to the stomach. Nutrients: Substances in food that provide nourishment for the body. Excreted: To expel waste material from the body through the anus. The second option that was used in called a "text leveler". Using this option a text is typed into the application and a grade level is selected. For this study the grade level selected was grade 2 since most of the learners were a grade 2 level in reading as assessed by the specialist. Some of the words that were modified to simplify the text by the AI were "liquid pulp" which was turned into a "watery substance". The word "nutrients" was replaced by "good things for our body". Finally the tests were collected scored and analyzed.

The following chart shows the timeline of the steps:

Figure 1. Timeline of intervention chart



Data Analysis

After data collection, a rubric to score the tests was created. The rubric was created by the researcher and reviewed by the coordinator and the specialist. To ensure that the linguistic aspect of the rubric was valid a 3rd grade English teacher reviewed the rubric as well. Then, the researcher scored the tests, and the results were reviewed by the coordinators and the specialists. Also, to

ensure that the results are reliable another researcher who is a colleague of the author of this study scored the tests. The results of both researchers were in alignment.

Since this is a quantitative study SPSS was used in data analysis. This is an experimental study with one group which underwent a test with and without adaptation using an AI tool. Thus, using one sample T-test is the right option. This test was used to compare between the results of the test with and without the adaptation using an AI tool. Descriptive statistics of each test results were also provided.

Limitations

This study includes only 3 schools form the governorate of Beirut. Thus, it doesn't represent the characteristics of the population in Lebanon as it only represents 1 of 8 governorates. Moreover, the sample is a very small sample of only 10 students. This is due to the study being on a specific learning difficulty in an specific grade level.

As for the limitations of intervention, due to lack of time the researcher had to limit the study with one test. Which decreases the reliability of the study since having more than one test on different scientific subjects where it produces the same results is more reliable. It is also possible that using the same test with and without the adaptation of the language using AI could have affected the results. A study using two different test where one uses the AI tool and the other doesn't could prove if this is true.

Finally, having only one test without other triangulation of tools method could have affected the results of the study. Adding a quantitative tool could have enriched and enhanced the study much more effectively.

2. Results

Results of the test without using magicschool.ai:

The descriptive statistics and frequencies of the test results without adapting the test using magicschool.ai are presented in the tables below:

Table 1. Table showing the frequencies of the results of the test without magicschool.ai adaptation.

testwithoutai

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	10.0	10.0	10.0
	3	1	10.0	10.0	20.0
	4	3	30.0	30.0	50.0
	5	3	30.0	30.0	80.0
	6	1	10.0	10.0	90.0
	7	1	10.0	10.0	100.0
	Total	10	100.0	100.0	

After observing the table we can conclude that 50% of the participants got a grade less than 5. Taking into account that the total grade is 10. This indicates that half the participants failed the test without using magicschool.ai to adapt the language. Only two students got a grade above 5.

Table 2. Descriptive statistics of the results of the test without AI adaptation.

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation
testwithoutai	10	5	2	7	4.50	1.434
Valid N (listwise)	10					

From the table we can see that the minimum is 2 and the maximum is 7 with a mean of 4.5. taking into account that the results are over 10 this means that the mean value is a failing result.

Results of the test with magicschool.ai adaptation:

The descriptive statistics and frequencies of the test after adapting the language with magicschool.ai are presented in the tables below:

Table 3. Table showing the results of the test after being adapted with magicschool.ai

testwithlai

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5	4	40.0	40.0	40.0
	6	3	30.0	30.0	70.0
	7	2	20.0	20.0	90.0
	9	1	10.0	10.0	100.0
	Total	10	100.0	100.0	

From table 3 we can infer that none of the students got a grade lower than 5 over 10. This means that none of the students failed the test after the language was adapted using magicschool.ai. 40% of the students got a passing grade of 5 with the rest getting 6 and above.

Table 4. Descriptive statistics of the results of the adapted test

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation
testwithlai	10	4	5	9	6.10	1.287
Valid N (listwise)	10					

Table 4 shows that the mean for the adapted test is 6.1 which is a passing grade. The minimum is 5 and the maximum is 9. The mean increased from 4.5 in the test without the language adaptaation using ai to 6.1 for the adapted test. The minimum also increased from 2 to 5 and the maximum also increased from 7 to 9.

Comparison between the tests

One sample T- test was performed. The results are presented in the following table:

Table 5. One sample t-test results

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
testwithoutai	9.925	9	.000	4.500	3.47	5.53
testwithlai	14.992	9	.000	6.100	5.18	7.02

Going back to the hypotheses of this study, the null hypothesis is:

There is no statistically significant difference between the means of the results of the two tests.

While the alternative hypothesis is:

There is a statistical difference between the means of the results of the two tests.

Since the significance level is at 0.05 and the t-value indicated by table 5 is 0.000 this means that there is a statistical difference between the means of the results of the two tests. Thus, the null hypothesis is rejected, and the alternative hypothesis is confirmed.

3. Discussion

The results presented above show that using the AI tool magicschool.ai to adapt the language in the science tests improved the achievement of students with dyslexia.

The outcomes of this study are in alignment with the previous literature. They also enrich the previous studies.

First and foremost, the collected data showed that before the adaptation of the tests 50% of the dyslexic students failed the test. Which is in alignment with the studies on the effect of low language proficiency and achievement in science. This study reflects the same results provided by (Cano, Garcia, Berben, & Justicia, 2014); low levels of reading comprehension negatively affect achievement in science.

This study focuses on an AI language adaptation tool for students with dyslexia. The results of the study are coherent with the previous studies. (Srinivasan & Murthy, 2021) used an AI technology and found that it increased the achievement of students in language. Meanwhile, the results of the current study deemed the AI language adaptation tool to be effective in enhancing the achievement of dyslexic students in language based science tests. Which is also in alignment with studies on AI tools used with dyslexic students only. One of these studies is the one by (Wang, Muthu , & Sivaparthipan, 2022) that used an AI model for students with dyslexia which improved the results

of the model without the adaptation with AI. This also aligns with the current study since the AI tool led to the increase in achievement of dyslexic students.

The studies mentioned and many others laid the groundwork for the current study. The results of this study on the other hand validated these studies. This serves as a rationale to use AI assistance for students with dyslexia in schools, and calls for more studies to be conducted on the issue at hand.

4. Conclusion

Many studies can be found on the effectiveness of AI in language teaching or the effectiveness of AI tools in teaching students with dyslexia. But not much is written on using AI tools with dyslexic students. That is why this study is a great addition to the literature.

The findings of this study encourage science teachers and principals to use AI tools in teaching dyslexic students. That is because this study found that using AI tools to adapt science tests can increase the achievement of students with dyslexia.

However, many studies need to be conducted on teaching language in science for students with dyslexia in order to support this study. Dyslexia is a problem for many students, this difficulty is not addressed in language in science. Teaching science to students with dyslexia can be a challenge and using AI tools can be a great improvement for them as this study showed.

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