iejee

International Electronic Journal of Elementary Education
March 2024, Volume 16, Issue 3

Enhancing Grapheme-Phoneme Correspondence Learning: A Single-Case Study Using Picture Mnemonics

Matthias Grünke[a,*], Isabel Gürcay[b], Janine Bracht[c], Alina Jochims[d], Matthias Schulden[e], Anne Barwasser[f], Ellen Duchaine[g]

Received : 21 January 2024
Revised : 18 March 2024
Accepted : 28 March 2024
DOI : 10.26822/iejee.2024.342

[a,*] **Corresponding Author:** Matthias Grünke, Department of Special Education & Rehabilitation, University of Cologne, Germany.
E-mail: matthias.gruenke@uni-koeln.de
ORCID: https://orcid.org/0000-0003-4249-6035

[b] Isabel Gürcay, Department of Special Education & Rehabilitation, University of Cologne, Germany.
E-mail: isabel.guercay@uni-koeln.de
ORCID: https://orcid.org/0000-0002-7321-4830

[c] Janine Bracht, Department of Special Education & Rehabilitation, University of Cologne, Germany.
E-mail: janine.bracht@uni-koeln.de
ORCID: https://orcid.org/0000-0002-2683-4084

[d] Alina Jochims, Department of Special Education & Rehabilitation, University of Cologne, Germany.
E-mail: alina.jochims@uni-koeln.de

[e] Matthias Schulden, Department of Special Education & Rehabilitation, University of Cologne, Germany.
E-mail: matthias.schulden@uni-koeln.de
ORCID: https://orcid.org/0000-0002-6176-2047

[f] Anne Barwasser, Department of Special Education & Rehabilitation, University of Cologne, Germany.
E-mail: anne.barwasser@uni-koeln.de
ORCID: https://orcid.org/0000-0002-8124-6429

[g] Ellen Duchaine, Department of Curriculum and Instruction, Texas State University, USA.
E-mail: ellenduchaine@txstate.edu
ORCID: https://orcid.org/0000-0002-3071-2215

Abstract

The ability to recognize and name the sounds of alphabet letters is a crucial prerequisite for students as they embark on their journey to learn how to read. Regrettably, some children face significant challenges in this area. In this single-case multiple baseline study, we utilized mnemonic pictures to facilitate the memorization of the grapheme-phoneme correspondence of ten target letters. Our aim was to empower four struggling first-grade students to quickly and confidently retrieve this information. The results reveal that the students significantly benefited from the intervention. Furthermore, the approach was perceived as attractive and helpful by both the four children and their teacher. The study concludes by reflecting on its limitations and discussing potential implications and future avenues of research.

Keywords:

Early Reading Skills, Grapheme Phoneme Correspondence, First Graders, Picture Mnemonics, Multiple Baseline Design

Introduction

Reading is a crucial skill, both academically and beyond. To develop proficient decoding abilities, letter recognition and knowledge of letter sounds form the building blocks for future success. According to the National Early Literacy Panel (NELP, 2008), they are the key predictors of later literacy skills and fundamental components of phonics development. Without the ability to identify letters and their corresponding sounds, words on a page remain a mystery (Ehri, 2005).

While children naturally learn to speak, connecting spoken to written language often requires explicit instruction (Vaughn & Fletcher, 2022). Difficulties in letter recognition and knowledge of letter sounds can persist into the school-age years if effective strategies are not implemented during early education. These deficits become more apparent as students enter school and can significantly impact their reading abilities (Clayton et al., 2020). However, mastering letter recognition and knowledge of letter sounds empowers children to decipher the reading code. Therefore, early intervention for students struggling with these skills is imperative (Bowman & Treiman, 2004).

Most studies on teaching letter recognition and letter sound knowledge have focused on English-speaking students. The writing system in this language is more complex and variable than in many other widely spoken languages like Spanish, Italian, or German. It is relatively difficult to learn because children will have problems figuring out the system on their own (Ehri, 2003). Systematic phonics instruction seems to be the ideal approach for laying the groundwork for future literacy skills (Ehri, 2020). However, evidence-based and highly effective programs for teaching prerequisite competencies in languages other than English are scarce. This is unfortunate, especially for countries where the proportion of children with language difficulties is particularly high, such as Germany, for example. There, more refugees were received since the so-called "long summer of migration" than in any other Western nation (Jacobi, 2021; Ward-Glenton, 2023). This means that in this country, there are now relatively many children who are not proficient in the national language. In the most populous federal state (North Rhine-Westphalia), the proportion of students with a migration background is over 40%. The rate is especially high in the entry classes (Landesbetrieb IT.NRW, 2022). There is a great need for effective and easily applicable interventions that are feasible under the conditions of everyday school life.

However, in their widely received meta-analysis, Wolf, Schroeders, and Kriegbaum (2016) point out: "Overall, the meta-analytical training effects of the German programs were lower than in the international meta-analyses" (p. 9). This indicates a significant need to address the risk posed by the presence of many young students with different language barriers in Germany and to attend to their needs to help them establish a strong foundation for successful literacy development.

One set of approaches that consistently shows very high effect sizes in relevant primary research and meta-analyses are mnemonic techniques. These strategies have been used for centuries to enhance memory, and numerous studies have explored their effectiveness (e.g. Fontana et al., 2007; Mastropieri & Scruggs, 1998; Mastropieri et al., 2000; Scruggs & Mastropieri, 2000). Mnemonic techniques, such as the keyword method, pegword method, letter method, and reconstructive elaboration, involve associating unfamiliar information with familiar knowledge to strengthen memory retention and recall. Their use improves memory for concrete verbal information, particularly when paired with imagery. While mnemonics should not replace comprehensive instruction, they can supplement teaching to enhance memory. The Dual Coding Theory supports the effectiveness of mnemonic strategies by emphasizing the importance of integrating verbal and nonverbal information, which enhances memory encoding and retrieval (Paivio, 1991).

In the context of helping struggling students acquire letter recognition and letter sound knowledge, embedded picture mnemonics appear to be a very promising option. In this approach, a letter is embedded in a mnemonic picture representing the corresponding initial letter and sound (e.g., the letter 's' embedded in a picture of a snake), which can strengthen the connection between letter shapes, names, sounds, and familiar images (Ehri, 2022). Previous studies have demonstrated the efficacy of embedded letter and mnemonic picture cards in teaching letter recognition and letter sound knowledge across diverse student populations (Argramonte & Belfiore, 2002; Ehri, Deffner & Wilce, 1984; Sener & Belfiore, 2005).

However, research on students at the beginning of school is limited. An electronic search of five databases (Academic Search Complete, Education Full Text, ERIC, Psychology and Behavioral Sciences Collection, and PsycINFO) using the keyword "picture mnemo*" in the title, conducted on October 1, 2023, yielded 16 hits. Among these, only three were empirical studies that focused on teaching basic letter recognition and letter sound knowledge to early readers.

The first study was conducted by Fulk et al. (1997). It found that using integrated picture mnemonics effectively improved letter-sound acquisition and recognition in three first-grade students with special needs. The positive effects were sustained over time, as confirmed by follow-up data collected at two-week and four-week intervals. The second study was by Shmidman and Ehri (2010). It tested whether embedded mnemonics help preschoolers learn 10 Hebrew letter-sound relations. Children using embedded mnemonics mastered letters faster, made fewer mistakes, and showed better retention after a week. The last study was carried out by Dilorenzo et al. in 2011 and tested the effectiveness of "Itchy's Alphabet", a multisensory program that stresses letter-sound patterns, sound-symbol relationships, and logical letter formations. It not only uses pictures as a mnemonic but also plush figures and board games. The authors tested the approach in three kindergarten classrooms and found that it significantly improved sub-lexical skills for all children, including those at risk and receiving special education services.

The current evaluations on this topic are indeed promising. However, their quantity is very limited. Moreover, all of them were conducted more than 10 years ago. Hence, the objective of this research was to test the benefits of using picture mnemonics to aid struggling beginning readers in acquiring letter recognition and letter sound knowledge with a novel focus on the German context, given its unique linguistic challenges and high need for such interventions:

1. Does a simple short-term picture mnemonic intervention lead to an improved ability to rapidly and correctly name letters?

2. How do the students and their teacher perceive the treatment?

Methods

Participants and Setting

Participants consisted of four children attending their first year of formal education at an inclusive elementary school located in a major metropolitan city in Western Germany. These students, having completed three months of preliminary reading instruction before the study began, struggled significantly with letter recognition, unlike their peers who could identify all alphabet letters. They had three months of initial reading instruction but struggled significantly with letter recognition, unlike their peers who could identify all alphabet letters. To be eligible for the study, the children had to fulfil the following criteria: (1) low phonological awareness, (2) inability to name more than 15 of the 25 most commonly used letters of the German language, (3) close to perfect attendance over the last three months, (4) sufficient motivation to participate in the study.

The classroom teacher of the four participants first suggested ten students that met criterion 3, which she viewed as having low literacy skills. We conducted an informal phonological awareness test with them (available from the first author) in which they were shown pictures of different objects. They were then asked to pronounce the initial sounds of the things they saw. The objects either started with a long vowel, a short vowel, an isolated long consonant, an isolated short consonant, or a consonant cluster. According to Born and Oheler (2017), it is progressively more difficult to identify these initial sounds in this order. Students who were not able to recognize consonant or consonant clusters were viewed as potential candidates of the study.

Moreover, we presented the children with an 8.30x11.70-inch chart containing the 25 most commonly used letters of the German language printed on it: E, N, I, S, R, A, T, D, H, U, L, C, G, M, O, B, W, F, K, Z, V, P, Ü, Ä, and Ö (Plume & Schneider, 2004). We determined which letters they were not familiar with. Children who could not name 10 or more of these letters were included in the closer selection. There were four students remaining. It turned out that among all the letters the participants were unable to name, the letters B, D, F, G, H, K, R, S, U, and W were always among them. Thus, these constituted our target letters. We asked the students if they were interested in working with us and becoming familiar with some of the letters they still had trouble with. All of them expressed their willingness to engage in our training. Subsequently, informed consent was obtained from the parents or guardians of the children.

The four students who were ultimately selected for the study were Amir, Brianna, Cedric, and Daniel (names were changed to ensure confidentiality). Amir was an 8-year-old boy of Turkish descent, and his parents mostly spoke Turkish at home. Brianna was 7 years old at the time of the study, and her parents had immigrated from Jamaica when she was a toddler. Cedric, who was 6 years old, did not have an immigrant background. However, according to his class teacher, he came from a socially disadvantaged home with very little learning stimulation. As a result, his language development was far below the normal level. Although Cedric grew up speaking German, he was not clearly advantaged in language compared to the other three students. Daniel, also 6 years old, was born to Polish guest workers. According to their teacher, all of them experienced considerable difficulty in learning new information and skills. Despite diligently attending almost every early reading instruction lesson since they started school, they were unable to keep up with the rest of the class.

Interventionist

A 25-year-old female graduate student in special education served as the interventionist. She had practicum experience working with special needs students and received four 1-hour online training sessions from the first author on conducting the training. Additionally, she was provided with a detailed five-page script to guide the session conduct (available upon request from the first author).

Experimental Design

The study used a multiple baseline design across students to determine the effectiveness of the intervention (Ledford & Gast, 2018). We planned for 17 daily probes with the first participant starting out with 3, the second with 4, the third with 5, and the fourth with 6 baseline measurements. The order in which the four students began with the intervention was determined by chance.

Dependent Variable

The relative number of correctly named capital letters per minute served as dependent variable. For each probe, we designed an individual 8.30x11.70-inch chart on which the 10 target letters for each child were printed eight times in random order (with the limitation that each of the letters had to be mentioned once in each line) (see Figure 1 for an example).

Figure 1

Letter Naming Chart

R	G	U	B	K	S	W	H	D	F
B	W	H	R	F	G	U	K	S	D
K	G	R	D	S	W	H	F	U	B
S	B	W	U	F	G	D	K	H	R
U	H	D	F	K	R	W	G	B	S
D	K	F	R	U	S	G	B	H	W
G	S	D	F	W	B	K	R	U	H
W	U	K	G	R	H	F	B	S	D

At each measurement point, the students were asked to name the letters line by line. Even though they were not corrected when making a mistake, they hardly ever misnamed a letter. After a minute, it was determined and recorded how many letters they went through altogether. At the beginning, they were often only able to name one correctly and read it whenever it came up, while skipping the rest. For example, if they made it to the end of the third row in Figure 1 and only named the B's, they looked at 30 letters, but got only 3 of them right. The ratio of correctly read letters thus equaled 3/30 = 0.10. We calculated the relative performance of the participants by multiplying the absolute number of accurately named letters by the given ratio. In our example, the product would be 3 x 0.10 = 0.30. Towards the end of the intervention, the students hardly committed any mistakes. If they again made it to the end of the third row, but this time got every single letter right, the index would be (30/30 = 1) x 30 = 30.

This approach is fundamentally akin to that employed by the well-known d2 Test of Attention by Brickenkamp (2002). This instrument displays d and p letters in 14 rows, each with 57 characters marked with one to four dashes. Participants must cross out as many ds with two dashes as they can within 20 seconds per row, minimizing omissions and errors. Performance is judged by the number of correctly crossed-out ds relative to the total letters presented.

To estimate the interrater-reliability, the relative number of correctly named capital letters per minute was determined independently by the interventionist and the first author. Both calculated the respective indices on the basis of the charts where it was recorded, how many letters a participant went through and how many she or he got right. Ultimately, the interrater agreement turned out to be 100%.

Procedures

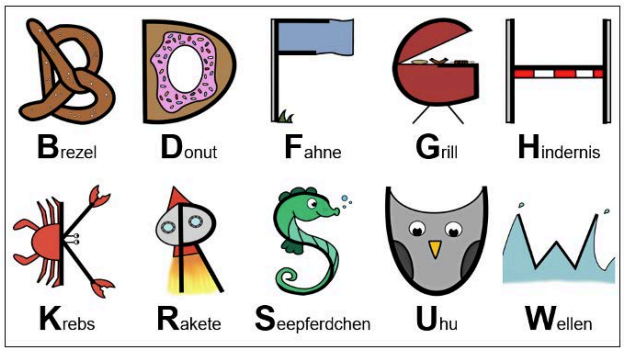
During the baseline phase, the interventionist took the participants consecutively to a resource room in the school, providing a quiet and undisturbed environment for their work. The order in which they received their daily lessons varied. At the beginning of each session, the interventionist played the game "Crazy Eights" with the children to control for any potential attention bias. After 20 minutes, she administered the performance test. Subsequently, the students returned to their classroom.

During the intervention phase, the game was replaced with the treatment. To ensure proper implementation of the training, the aforementioned script was used; it contained all the steps and instructions crucial to the training. This was done to enhance treatment fidelity. Each session started with the presentation of an 8.27 x 11.69-inch line diagram depicting a particular student's progress in terms of the relative number of correctly named capital letters per minute over the course of the study. Participants were praised for any improvements and reminded that enhancements were due to their effort in applying the mnemonic strategy. If there was no increase in performance compared to the previous session, the interventionist provided feedback, encouraging the idea that everyone can have a bad day and that the following day would be better.

In line with Paivio's Dual Coding Theory (1991), it is recommended to integrate verbal expressions, such as the letters in our study, with visual representations, specifically, pictorial depictions that correspond to the initial letters of associated words. This integration of verbal and non-verbal modalities is suggested to deepen cognitive processing, thus enhancing the learning effect. With this approach, the ten target letters and their associated picture mnemonics were introduced sequentially, following their order in the alphabet. For this purpose, 5.83 x 8.27-inch cards with each symbol depicted in Figure 2 were presented. For example, when introducing the letter 'S', the brief script used to instruct each letter sound read as follows: "This is the letter 's'. 'S' makes the sound in 'seahorse'. Look at the letter 's' in this picture of a seahorse. What is the letter? What sound does it make?" The student was asked to look at the integrated picture mnemonic and repeat the information. Prompts were provided, if needed, to facilitate a student response. The first lesson provided enough time to go over the ten letters at least three times, and it ended with the performance measurement following the procedures during baseline.

Figure 2

Mnemonic Pictures for the 10 Target Letters



As indicated, each subsequent session began with the presentation of a line diagram showing the performance curve up to that point and ended with a test of the student's knowledge on letter sound-correspondence. During the second lessons, the interventionist went through the mnemonic pictures once more, scaffolding the memorization and retrieval process, and prompting the participants to name the corresponding graphemes. As indicated, each subsequent session began with the presentation of a line diagram showing the performance curve up to that point and ended with a test of the student's knowledge on letter-sound correspondence. During the second lessons, the interventionist revisited the mnemonic pictures, scaffolding the memorization and retrieval process, and prompting the participants to name the corresponding graphemes. However, the order was now varied randomly. The children were praised for correct responses, and immediate corrections were provided for any mistakes. Throughout the following sessions, efforts were made to increase the students' retrieval speed to achieve automation. Starting from the fifth session, the interventionist gradually introduced 5.83 x 8.27-inch cards without mnemonic pictures, depicting only one of the ten target letters each. In cases where the children made errors, immediate corrections were made, and the corresponding mnemonic picture was referred to.

The classroom teacher was thoroughly briefed about the entire undertaking and was acquainted with all the materials. Furthermore, the interventionist provided daily updates at the end of each school day, allowing the teacher to stay abreast of the proceedings. Additionally, the classroom teacher had the opportunity to observe the progress made by the participants during her lessons, which ensured a well-informed understanding of the developments at hand.

Social Validity

To assess the social validity of the study, the interventionist conducted a survey with the students and their classroom teacher after the final session to ascertain their reception of the training. The primary focus was on discerning the perceived benefits of the treatment for the participants and determining whether they found the experience enjoyable. The interventionist personally interviewed each student and the teacher, asking the following questions:

1. Did you like the picture mnemonics?
2. Do you think that the picture mnemonics were beneficial?
3. Would you recommend the picture mnemonics to other students?

Naturally, the wording of the questions was adjusted during the interview with the teacher. For example, "Did you like the picture mnemonics?" was modified to inquire if she believed the students enjoyed the picture mnemonics. The responses were audio-recorded and later transcribed.

Results

Figure 3 displays the relative number of correctly named capital letters per minute during baseline and intervention. Unfortunately, Amir, Brianna and Cedric missed a couple of sessions due to illness. However, examining the graphs, it becomes obvious that all four students in this study showed an increase in performance over the course of the intervention. The scores towards the end of the treatment were considerably higher than at the beginning or during baseline.

Figure 3

Ratio of Correctly Read Letters in 1 Minute for the Participants

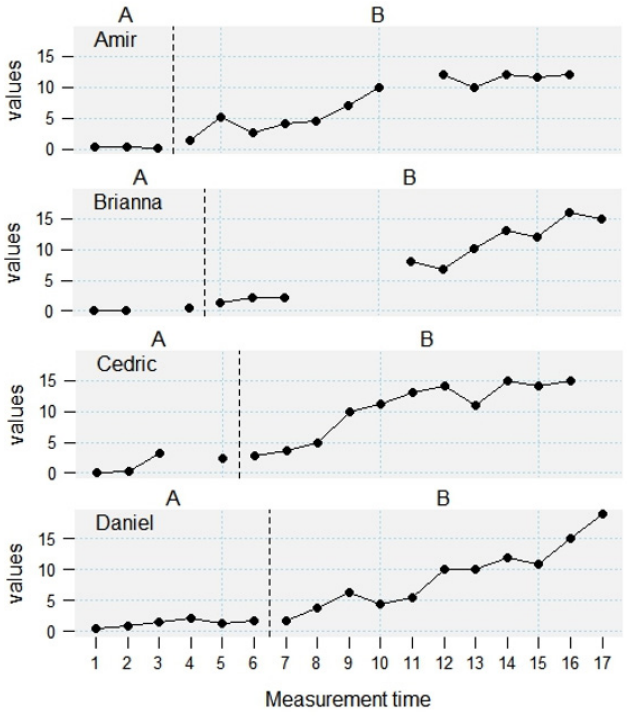


Table 1 provides an overview over some descriptive data.

Table 1.
Descriptive statistics for the three participants

		Baseline	Intervention
Amir	*N* (Probes)	3	14
	N (Missing)	0	2
	M	0.30	17.70
	SD	0.11	4.00
	Range	0.20–0.42	1.33-12.00
Brianna	*N* (Probes)	4	13
	N (Missing)	1	3
	M	0.21	8.69
	SD	0.26	5.43
	Range	0.00–0.50	1.33–16.00
Cedric	*N* (Probes)	5	12
	N (Missing)	1	1
	M	1.51	10.41
	SD	1.60	4.57
	Range	0.00–3.27	2.88–15.00
Daniel	*N* (Probes)	6	11
	N (Missing)	0	0
	M	1.34	8.98
	SD	0.61	5.21
	Range	0.44-2.12	1.79–19.00

We calculated three overlap indices to acquire further information on the benefits of the intervention beyond the descriptive analysis. For this, we used the Non-overlap of All Pairs (NAP; Parker et al., 2011), the Percentage of Non-overlapping Data (PND; Scruggs et al., 1987) and Tau-U (Parker et al., 2011). The p-value for the NAP and the PND were calculated on the basis of two web tools, retrievable under http://singlecaseresearch.org/ and https://ktarlow.com/stats/pnd/ respectively. For the Tau-U, we used the SCAN Package by Wilbert (2021) and applied the formula that takes an A phase trend into account (A vs. B + trendB – trendA). Strong and significant effects were identified for all overlap indices ($p < .001$) across all students.

Table 2.
Overlap indices for the dependent variable across all participants

Name	NAP	*p*	PND	*p*	Tau-U	*p*
Amir	100	<.001	100	<.001	0.86	<.001
Brianna	100	<.001	100	<.001	0.85	<.001
Cedric	98	<.001	91	<.001	0.80	<.001
Daniel	97	<.001	91	<.001	0.75	<.001

Note. NAP = Non-overlap of all pairs; PND = Percentage of Non-overlapping Data

To finalize the visual and quantitative analyses, we explored the possibility of integrating a hierarchical piecewise linear regression model, which incorporates data from all participants - this is referred to as a level 2 analysis. This approach was proposed to potentially identify shifts in the rate of performance improvement between phase A and phase B. While ratios, specifically the relative count of correctly identified capital letters per minute, were used as our dependent variable, we applied this statistical method with an awareness of its limitations. A crucial point to consider is our inability to confirm definitively that the data follows a normal distribution, which necessitates a cautious approach when interpreting the results of our analysis.

There was a notable baseline trend and a statistically significant slope-effect ($p < .01$) with an average increase of 0.71 scale points per intervention session.

Table 3.
Piecewise regression model for the dependent variable across all participants

	B	*SE*	*df*	*t*	*p*
Intercept	-0.52	0.87	54	-0.60	.55
Trend	0.43	0.19	54	2.25	.03*
Slope	0.71	0.22	54	3.18	<.01**

Note: *significant at the .05 level; **significant at the .01 level

The outcomes of the social validity inquiry, conducted with students and their teacher regarding the utilization of picture mnemonics, yielded uniformly positive responses. All participants held a favorable opinion of the picture mnemonics, finding them helpful and advocating their adoption for use by other students. All three questions were answered affirmatively and with conviction. Children shared their enjoyment experienced during the sessions. The classroom teacher closely monitored the students' progress and unequivocally observed that participation in the interventions not only led to a noticeable improvement in performance but also triggered a significant increase in motivation. These findings support the promising potential of incorporating picture mnemonics as an effective educational tool in teaching environments.

Discussion

Main Findings

The purpose of this study was to assess the impact of a picture mnemonics intervention on the ability of four struggling first graders to rapidly and accurately name letters. We selected 10 target graphemes that the participants were unfamiliar with before the treatment. The results indicate that the training had a significant impact on the students' skill level, as all of them showed remarkable improvements.

During the baseline phase, the mean relative number of correctly named capital letters per minute for the participants was 0.30, 0.21, 1.51, and 1.34, respectively. In the treatment phase, the average performance increased significantly to 17.70, 8.69, 10.41, and 8.98, indicating a steep rise of 5,800.00%, 4,038.10%, 589.40%, and 570.15%, respectively. The four participants exhibited large to very large effect sizes (NAP, PND, and TAU-U), representing positive changes in the dependent variable over the course of the training. An overall piecewise regression analysis revealed a significant slope effect, indicating considerable

performance improvement at the beginning of the treatment.

The measures across phases suggest that all students benefited from using picture mnemonics to link verbal and non-verbal representations as suggested by the Dual Code Theory (Paivio, 1991). Moreover, both the teacher and the children reported viewing the training as extremely positive.

Limitations

This study acknowledges several limitations that must be considered. Initially, the intervention involved only four students from a single classroom, which constrains the broader applicability of our conclusions. Subsequent research should aim to validate or challenge our findings across diverse demographics. Furthermore, the absence of follow-up data collection due to time constraints precludes the determination of the intervention's enduring effects. Later studies should include long-term follow-ups to evaluate the sustained impact of the intervention.

Another constraint arises from the individualized nature of the training, which differs from the more common group instruction setting in classrooms, thus potentially affecting the experiment's real-world applicability. It would be beneficial for future research to examine the effectiveness of our approach in typical classroom environments, where one teacher manages a group of students.

A notable limitation that must also be addressed is the significant amount of absenteeism: Brianna missed 4 of the 17 sessions due to illness, while Amir and Cedric were each absent twice. Although their absences were within reasonable limits, such missed sessions undoubtedly detract from the study's quality.

It is also important to critically acknowledge that a university graduate student facilitated all sessions in this study. Although appropriate for our experimental framework, future applications would benefit from engaging a more diverse cohort of educators proficient in the picture mnemonics strategy.

The potential for bias in the social validity interviews is also present, as they were conducted by the same individual who administered the treatment, possibly eliciting responses aimed at pleasing the interventionist rather than providing candid feedback. It might be challenging for participants to express criticisms directly to the person responsible for the training. Future research should involve impartial third parties to gather feedback on the treatment procedures.

Practical Implications and Conclusion

In light of the constraints noted, this research still establishes the value of the picture mnemonics strategy in enhancing the association between graphemes and phonemes for four young students experiencing challenges. Mastery in recognizing the alphabet's letters swiftly, without mistakes, and with ease is critical for the development of decoding skills. Thus, implementing powerful teaching strategies for learners struggling with these foundational areas is essential. Picture mnemonics can be effectively employed in individualized instruction or incorporated into classroom activities, such as group recitation. The initial effort required by educators to prepare for this method is reasonable, and its principles can be applied consistently, facilitating its integration into daily educational routines.

Current trends indicate that difficulties with reading foundational skills are prevalent among first-year elementary school students. Teachers need strategies that are straightforward to implement to support those who fall behind. Picture mnemonics fulfill this need. It is the hope of the academic community that further research will expand our understanding of how to effectively employ this approach and that evidence-based recommendations on the most effective practices will permeate numerous classrooms. We can no longer afford to let so many students fall behind at the very start of their educational journey.

References

Argramonte, V., Belfiore, P. J. (2002). Using mnemonics to increase early literacy skills in urban kindergarten students. *Journal of Behavioral Education, 11*(3), 181–190. https://doi.org/10.1023/A:1020178020059

Born, A., & Oehler, C. (2017) *Lernen mit Grundschulkindern: Praktische Hilfe und erfolgreiche Fördermethoden für Eltern und Lehrer* [Teaching with elementary school children: Practical Assistance and successful support methods for parents and teachers]. Kohlhammer.

Bowman, M., & Treiman, R. (2004). Stepping stones to reading. *Theory Into Practice, 43*(4), 295–303.

Brickenkamp, R. (2002). *d2 Test of Attention*. Hogerefe.

Clark, J. M., & Paivio, A. (1991). Dual coding theory and education. *Educational Psychology Review*, *3*(3), 149–210. https://doi.org/10.1007/BF01320076

Clayton, F. J., West, G., Sears, C., Hulme, C., & Lervåg, A. (2020). A longitudinal study of early reading development: Letter-sound knowledge, phoneme awareness and RAN, but not letter-sound integration, predict variations in reading development. *Scientific Studies of Reading, 24*(2), 91–107. https://doi.org/10.1080/10888438.2019.1622546

Dilorenzo, K. E., Rody, C. A., Bucholz, J. L., & Brady, M. P. (2011). Teaching letter sound connections with picture mnemonics: Itchy's alphabet and early decoding. *Preventing School Failure, 55*(1), 28–34.

Ehri, L. C. (2003). Systematic phonics instruction: Findings of the National Reading Panel. Department for Education and Skills. http://www.standards.dfes.gov.uk/pdf/literacy/lehri_phonics.pdf

Ehri, L. C. (2005). Development of sight word reading: Phases and findings. In M. Snowling & C. Hulme (Eds.), *The science of reading* (pp. 135–154). Blackwell.

Ehri, L. C. (2020). The science of learning to read words: A case for systematic phonics instruction. *Reading Research Quarterly, 55*(1), 45–60. https://doi.org/10.1002/rrq.33

Ehri, L. C. (2022). What teachers need to know and do to teach letter-sounds, phonemic awareness, word reading, and phonics. *The Reading Teacher, 76*(1), 53–61. https://doi.org/ 10.1002/trtr.2095

Ehri, L. C., Deffner, N. D., & Wilce, L. S. (1984). Pictorial mnemonics for phonics. *Journal of Educational Psychology, 76*(5), 880–893. https://doi.org/10.1037/0022-0663.76.5.880

Fontana, J. L., Scruggs, T., & Mastropieri, M. A. (2007). Mnemonic Strategy Instruction in Inclusive Secondary Social Studies Classes. *Remedial and Special Education, 28*(6), 345–355. https://doi.org/10.1177/07419325070280060401

Fulk, B. M., Lohman, D., & Belfiore, P. J. (1997). Effects of integrated picture mnemonics on the letter recognition and letter-sound acquisition of transitional first-grade students with special needs. *Learning Disability Quarterly, 20*(1), 33–42. https://doi.org/10.2307/1511091

Jacobi, M. (2021). *How the political participation of refugees is shaped on the local level*. Deutsches Institut für Entwicklungspolitik.

Landesbetrieb IT.NRW (2022, August 1). *40,0 Prozent der Schülerinnen und Schüler in NRW hatten im Schuljahr 2021/22 eine Zuwanderungsgeschichte* [40.0 percent of students in North Rhine-Westphalia had an immigration background in the 2021/22 school year]. Information und Technik Nordrhein-Westfalen. https://www.it.nrw/400-prozent-der-schuelerinnen-und-schueler-nrw-hatten-im-schuljahr-202122-eine-18029

Ledford, J. R. & Gast, D. L. (2018). *Single case research methodology: Applications in special education and behavioral sciences*. Routledge.

Mastropieri, M. A., & Scruggs, T. E. (1998). Constructing more meaningful relationships in the classroom: Mnemonic research into practice. *Learning Disabilities Research and Practice, 13*(3), 138–145.

Mastropieri, M. A., Sweda, J., Scruggs, T. E. (2000). Putting mnemonic strategies to work in an inclusive classroom. *Learning Disabilities Research & Practice, 15*(1), 69–74. https://doi.org/10.1207/SLDRP1502_2

National Early Literacy Panel (2008). *Developing early literacy: Report of the National Early Literacy Panel*. Washington, DC: National Institute for Literacy. Available at http://www.nifl.gov/earlychildhood/NELP/NELPreport.html

Paivio, A. (1991). Dual coding theory: Retrospect and current status. *Canadian Journal of Psychology, 45*(3), 255–287. https://doi.org/10.1037/h0084295

Parker, R. I., Vannest, K. J., & Davis, J. L. (2011). Effect size in single-case research: A review of nine nonoverlap techniques. *Behavior Modification, 35*(4), 303–322. https://doi.org/10.1177/0145445511399147

Plume, E. & Schneider, W. (2004). *Hören, Lauschen, Lernen 2: Sprachspiele mit Buchstaben und Lauten für Kinder im Vorschulalter* [Listening, eavesdropping, learning 2: Language games with letters and sounds for preschool-age children]. Vandenhoeck & Ruprecht.

Scruggs, T. E., & Mastropieri, M. A. (2000). The effectiveness of mnemonic instruction for students with learning and behavior problems: An update and research synthesis. *Journal of Behavioral Education, 10*(2-3), 163–173. https://doi.org/10.1023/A:1016640214368

Scruggs, T. E., Mastropieri, M. A., & Casto, G. (1987). The quantitative synthesis of single-subject research: Methodology and validation. *Remedial and Special Education, 8*(2), 24–33. https://doi.org/10.1177/074193258700800206

Sener, U., & Belfiore, P. J. (2005). Mnemonic strategy development: Improving alphabetic understanding in Turkish students, at risk for failure in EFL settings. *Journal of Behavioral Education, 14*(2), 105–115. https://doi.org/ 10.1007/s10864-005-2705-x

Shmidman, A., & Ehri, L. (2010). Embedded picture mnemonics to learn letters. *Scientific Studies of Reading, 14*(2), 159–182. https://doi.org/10.1080/10888430903117492

Vaughn, S., & Fletcher, J. (2022). Explicit instruction as the essential tool for executing the science of reading. *The Reading League Journal, 2*(2), 4–11.

Ward-Glenton, H. (2023, August 1). *Refugees could help Germany's labor market, but Ukraine's skilled workers are needed at home*. CNBC. https://www.cnbc.com/2023/02/24/ukrainian-refugees-could-help-germanys-labor-market-but-not-for-long-theyre-ready-to-go-home.html

Wilbert, J. (2021). *Analyzing single-case data with R and Scan*. Available at: https://jazznbass.github.io/scan-Book/ (Accessed August 1, 2023).

Wolf, K. M., Schroeders, U., & Kriegbaum, K. (2016): Metaanalyse zur Wirksamkeit einer Förderung der phonologischen Bewusstheit in der deutschen Sprache [Meta-analysis on the effectiveness of phonological awareness intervention in the German language]. *Zeitschrift für Pädagogische Psychologie, 30*(1), 9–33. https://doi.org/10.1024/1010-0652/a000165