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Impact of neuro-linguistic programming-based interventions on school triggers: A before and after intervention study on primary Schoolchildren

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ABSTRACT

Introduction: Neuro-linguistic programming (NLP) has been applied in different sectors, including education, to help students develop their skills and overcome academic, social, and behavioral triggers. Due to limited empirical studies and context-specific research, there are significant knowledge gaps in understanding how and to which extent NLP can identify and mitigate specific triggers for school difficulties, such as student engagement and learning outcomes.

Objective: This study aims to assess the impact of applying NLP on reducing academic, behavioral, social, and environmental triggers of primary schoolchildren in Lebanon.

Methods: A four-month research investigation was performed involving 128 participants aged 6–11 years. The T-test was used to examine outcomes before and after the NLP intervention, and the correlation between the features and the total score per group was performed.

Results: The NLP intervention reduced academic trigger scores from 3.91 to 3.54 and behavioral trigger scores from 4.48 to 3.9, specifically among children 9 years and above. However, social and environmental trigger scores were significantly reduced among all children post-NLP treatment ($p < 0.001$ and $p = 0.007$, respectively). The NLP intervention reduced stress across the different domains, including lower grades, interruptions, disagreements, noise, and bright lights. A negative correlation was identified between trigger scores and age (-0.408 , -0.343 , -0.448 for academic, behavioral, and social scores, respectively; $p < 0.001$), indicating a decrease in trigger scores with age. Nevertheless, NLP was more effective in males than females ($p < 0.05$). The most substantial correlations were observed between students' age and grade (-0.448 and -0.516 , respectively) and social trigger scores. Minimal correlations were found between parents' marital status, level of education, economic situation, working status of parents, and the total number of children with any trigger scores.

Conclusion: The NLP intervention significantly reduced academic and behavioral trigger scores, especially in children 9 and above. It also reduced social and environmental triggers across all ages. Older children showed greater improvement, and the intervention was more effective in males than females. While students' age and grade strongly correlated with social trigger scores, parental demographics had minimal impact on the results. Thus, NLP strategies prove to be effective in reducing learners' triggers across various dimensions.

1. Introduction

Neuro-linguistic programming (NLP) is a psychological approach that links neurology, language, and behavior patterns through experience (Alroudhan, 2018). It is a controversial and often pseudoscientific approach to personal development, communication, and psychotherapy. that target behavior modification to achieve a desired outcome (Rayati,

2021). NLP was developed in the 1970s by Richard Bandler, a mathematician, and John Grinder, a linguist (Kotera & Sweet, 2019), to provide a framework for understanding how people think, communicate, and change to improve personal and professional effectiveness (Kotera et al., 2019). NLP has been applied to address anxiety and emotional issues in different settings and has shown a positive impact as a complementary tool to traditional approaches (Nompo et al., 2021). Several

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training courses, personal development programs, and therapeutic and educational interventions are developed based on the principles of NLP (Drigas & Mitsea, 2021) since this approach can use a wide range of techniques and strategies that can be applied in various contexts, including personal growth, therapy, education, business, and coaching (Anjomshoa et al., 2020; Kotera et al., 2019; Sakalli & Kara, 2022).

Teachers at schools can consider NLP an assistive technology that can help them develop students' skills such as critical thinking, academic achievement, emotional intelligence, self-efficacy, and empathy (Anjomshoa et al., 2020). NLP methods and tools can be used in the classroom to create impressions about student relationships, actions, learning and performance, and teaching efficiency, strengthening students' school engagement (Alroudhan, 2018; Zhang et al., 2023). In schools, kids face normative stressors, including academic and social demands, and non-normative major life events, such as parental divorce or the death of loved ones (Fraser et al., 2021). Although much of the empirical literature on stress has focused on youth's experiences of major life events, normative stressors can occur more frequently and be associated with children's maladaptive behaviors and mental health problems (Morelli et al., 2021). NLP in schools can personalize a child's interpretation of an experience, which might be completely different from another in the same experience, with a vigorous focus on positive behaviors (Kotera & Sweet, 2019).

2. Literature review

The foundational idea behind NLP is that there is a connection between neurological processes, language, and modifiable behavioral patterns learned through experience to achieve specific goals (Begum et al., 2022; Edwards, 2021). In educational settings, NLP offers a range of techniques that have been positively received by some educators and students across various countries. While anecdotal evidence and initial studies suggest potential benefits in improving communication, motivation, and emotional intelligence, the lack of comprehensive, scientifically rigorous research remains a significant barrier to its widespread acceptance in schools (Suci, 2017).

In teaching methodologies and classroom management, NLP techniques are employed to improve the clarity and effectiveness of communication between teachers and students (Begum et al., 2022; Gran, 2021). Strategies for better rapport-building, active listening, and using language patterns to influence student behavior and motivation are common applications (Xiao et al., 2020). For example, using positive language and framing questions to encourage constructive responses can create a more engaging learning environment (Mhanna et al., 2024). NLP principles such as anchoring (associating a physical action with a positive state) and reframing (changing how situations are perceived) can significantly impact the learning environment. For instance, a teacher might use anchoring to help students associate a specific gesture with feelings of calmness and focus, thus improving concentration during exams or stressful situations. Regarding student performance and personal development, NLP emphasizes goal-setting and visualization techniques to help students set clear, achievable goals and maintain a positive mindset toward their studies (Fakehy, 2022; Sharif & Aziz, 2015). Visualization exercises, where students imagine successful outcomes, can enhance motivation and focus. Techniques like modeling (observing and replicating successful behaviors) and meta-model questioning (challenging limiting beliefs) support students in developing emotional intelligence and social skills (Rayati, 2021). These skills are crucial for success both inside and outside the classroom. For example, students can improve their interpersonal interactions and conflict-resolution skills by modeling effective communication behaviors.

Some efforts in several countries to implement NLP showed promising results. NLP has been integrated into some teacher training programs in the United Kingdom. Studies indicate that teachers trained in NLP report improved classroom management skills and better student

engagement (Carey et al., 2010; Kudliskis, 2013). However, there is criticism regarding the lack of empirical evidence supporting NLP's effectiveness in educational settings (Zeb et al., 2021). Some schools have adopted NLP techniques on an experimental basis, reporting improvements in student confidence and academic performance by overcoming test anxiety, leading to improved exam scores. In Australia, educators have explored NLP primarily through workshops and professional development courses (MEGUID, 2023; Ren, 2013). Teachers have used NLP to address student motivation, stress management, and conflict resolution issues (Drigas et al., 2022). Anecdotal evidence suggests benefits, but systematic research is required to establish efficacy. There has been growing interest in incorporating NLP into the educational curriculum in India. Workshops and teacher training sessions focus on applying NLP to improve teaching strategies and student outcomes (Keezhatta, 2019; Ramesh et al., 2023). Despite this, the adoption of NLP in Indian schools faces challenges such as limited resources, varying levels of teacher proficiency in NLP, and a lack of robust data supporting its long-term effectiveness due to the diversity of educational contexts. In the United States, NLP is used more experimentally, often as part of broader school initiatives to improve emotional and social learning (SEL) (Furduescu, 2019; Karunaratne, 2010). NLP techniques are sometimes included in programs designed to address bullying, enhance self-esteem, and support academic achievement (Sharif & Aziz, 2015).

NLP was also adopted in Lebanese schools and showed promising results in improving students' intellectual abilities and hyperactivity problems (Chehabeddine et al., 2023; Ghanem et al., 2024; Manana et al., 2023). Nevertheless, Lebanon has experienced multifaceted challenges that have slowed down and sometimes terminated the efforts and motivation of all stakeholders toward ensuring that the rights for education for all learners have been secured (Hatem et al., 2023). The Ministry of Education and Higher Education introduced an online educational platform to be accessed by all teachers and students in public schools. However, many families couldn't afford the tools needed for online learning, and many schools were not prepared for such a change, a fact which was intensified by the difficulty in accessing the internet and the problems of electricity connectivity (Awada et al., 2023; Hatem et al., 2023; Xu et al., 2022). During the pandemic, NLP can alleviate technical challenges by improving adaptability, communication, stress management, and motivation, offering a holistic approach to address psychological and behavioral issues associated with remote work, education, and digital engagement (Etuka et al., 2021; Soethama & Sumaryana, 2023). Accessible interventions such as NLP sessions can help students readapt and overcome the abovementioned stressors. The use of NLP in educational settings is not without controversy. Critics argue that NLP lacks a solid scientific foundation, indicating the need for more empirical research and peer-reviewed studies to substantiate its claims. Therefore, this study aims to assess the impact of NLP on the academic performance of primary schoolchildren in Lebanon.

3. Methods

3.1. Study design

A four-month before and after-intervention cohort study was carried out, starting in April and concluding in July 2023. This study involved the periods before and after the implementation of an intervention (NLP training workshop). The subjects were youngsters who were enrolled in a private school situated in an urban region of Lebanon. The general public can access the detailed study plan through the clinicaltrials.gov registry under the identifier NCT05870085. This comprehensive project is designed using standardized tools for primary school students, their parents or legal guardians, and teachers. Concerning the part addressed by students, two main hypotheses were developed to guide the research:

1. Can the NLP intervention mitigate school-related stressors in primary school children? This hypothesis aims to evaluate the effectiveness of NLP interventions in reducing stress triggers within the school environment.
2. Can the NLP Intervention enhance the intellectual abilities of primary schoolchildren? This hypothesis was previously explored and the corresponding findings were published (Manana et al., 2024).

The present study collects data at two different points in time, primarily focusing on the first hypothesis.

3.1.1. Study sample and sample size calculation

The study encompassed students ranging from grade 1 to grade 5, aged 6–11 years. These students had been enrolled in the mentioned school for at least one year before data collection was initiated. The necessary sample size was determined using G*Power software to assess the mean difference between two related data sets (matched pairs). A preliminary calculation, considering a 95% confidence level and 80% statistical power, resulted in a required sample size of 128 participants. This sample size was chosen to enable the detection of an effect size of at least 25%.

3.2. Study tool and data collection

A questionnaire (in English and Arabic, Supplementary material) was sent and filled out by the student’s parents/legal guardians. It included their reported information regarding the child’s general characteristics, such as age, sex at birth, and grade, and other specific questions regarding the family, such as their level of education, perceived economic situation, working, smoking, and marital status, with the total number of children. Another form was delivered and completed by the children to express their feelings and stress levels toward 54 questions covering behavioral, academic, environmental, and social triggers (See Fig. 1). They answered independently on a data collection sheet for an average time of 45 min. Fifty-four different situations were communicated to students, arranged at a table, to which they had to describe their feelings: 1 labeled as “does not bother me at all” with a happy face near it, 2 “makes me feel a little uncomfortable” with a lesser smiley face, 3 as “makes me feel stressed” with a neutral

emoji face, 4 as “this upset me” with a slightly angry face, and finally 5 “I’m going to explode” with a furious face colored in red. The pre-intervention was done in April and the post-intervention in July of the same academic year.

3.3. Description of the intervention

Two interventions were performed (for students and teachers). The first one targeted teachers, where an NLP expert and a trained member held the session. The teachers’ involvement in the study consisted of four distinct sessions, each lasting 30 min. These sessions covered various topics and interactive approaches, including a grounding exercise, an introduction to the application of NLP in educational settings, enhancing communication skills with students, exploring potential techniques such as meta-model, generalizations, and deletion, discussing the practical applications of methods such as reframing and anchoring, engaging in hands-on activities with children, practicing matching and mirroring exercises, teaching calming skills, implementing thermometer and breathing exercises, and, finally, encouraging the sharing and exchange of kind words. Following the first data collection, a series of activities were presented to students to help them overcome their school stressors and improve their academic performance. All activities were approved by an NLP expert, a psychologist, and the university’s scientific committee.

3.4. Ethical considerations

The research protocol underwent a thorough review and received approval from the institutional board of the Lebanese University Faculty of Pharmacy (reference: 3/23/D). Numerous meetings and deliberations occurred throughout the process, involving interactions among team members, the board, school teachers, and the research team. These discussions consistently led to mutual agreement and ethical authorization. Written informed consent was obtained from parents/legal guardians. Student information remains anonymous to ensure privacy and parental responses are treated as confidential. No coercion was exerted, and all answers were given voluntarily, with no potential harm to the participants.

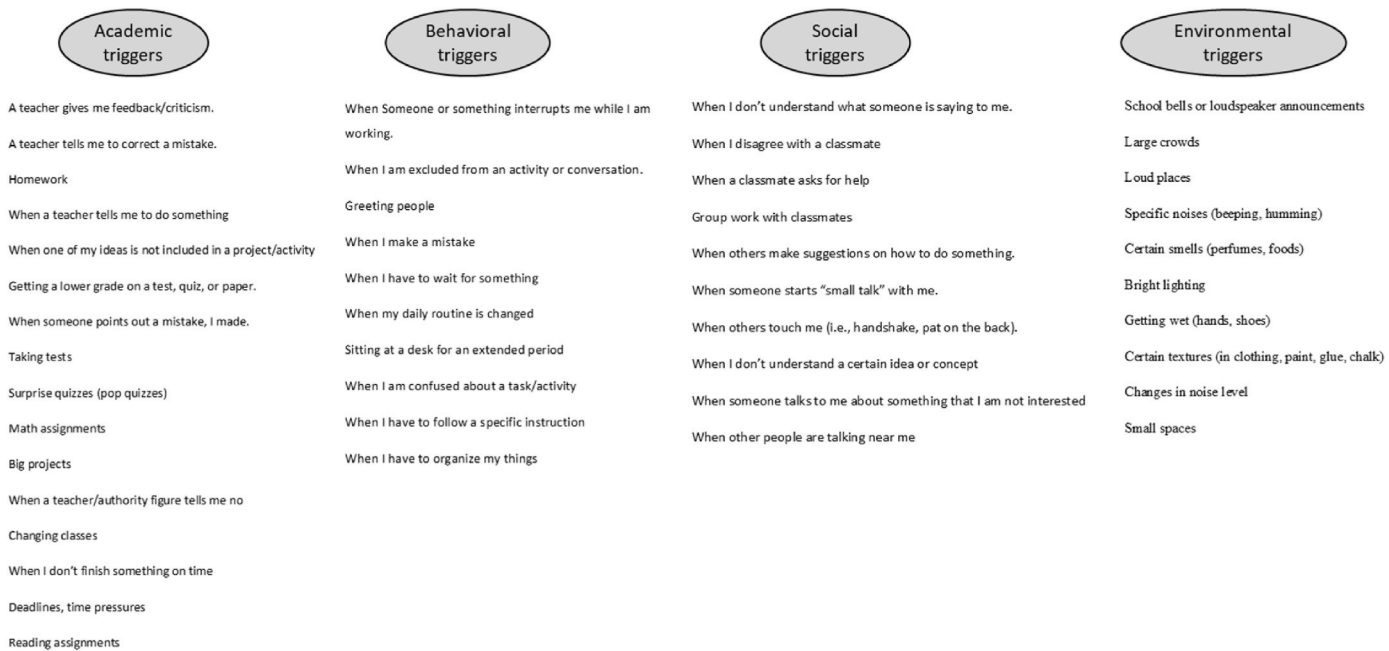


Fig. 1. Description of the questions asked for each type of trigger.

3.5. Statistical analysis

Statistical analyses were performed using Statistical Package for Social Sciences (SPSS Inc, Chicago, Illinois) Version 29. The total school trigger score, with a maximum possible score of 40, was computed by adding up the individual scores for the social, environmental, and behavioral triggers, while for the academic triggers, the score was multiplied by 0.625 before being included in the overall calculation. Frequencies and percentages represented categorical variables, while the ages and scores were presented as means and standard deviations. The paired sample T-test was used to examine differences in the features before and after the NLP intervention. The Pearson correlation between the features and the outcome of interest (total score per group) was performed since these relationships involved quantitative variables. One-way analysis of variance (ANOVA) was carried out to assess the relationship between the different school trigger scores and students' ages. Multivariate analyses were performed using linear regression models to assess how a combination of predictors influenced the various trigger dimensions. The confounding variables considered were those with significant p-values in the correlation analysis. All models were adjusted for the parents' economic situation and working status. Variables with p-values less than 0.05 were regarded as statistically significant.

Table 1
Differences in the baseline characteristics of students before and after the NLP intervention.

		Pre-intervention	Post-intervention	p-value
		Frequency (%)	Frequency (%)	
Sex at birth	Male	51 (39.5%)	52 (40.0%)	0.939
	Female	78 (60.5%)	78 (60.0%)	
Age of the student (years)	Mean ± SD	8.6 ± 1.5	8.8 ± 1.6	0.403
	≤9 years	80 (66.1%)	70 (62.5%)	
	>9 years	40 (33.9%)	42 (37.5%)	
Age of the parent (years)	Mean ± SD	39.7 ± 6.2	39.9 ± 6.1	0.939
Relationship with the student	Mother	100 (82.6%)	100 (82.0%)	0.890
	Father	21 (17.4%)	22 (18.0%)	
Grade	Grade 1	24 (19.8%)	20 (17.9%)	0.986
	Grade 2	17 (14.0%)	17 (15.2%)	
	Grade 3	27 (22.3%)	23 (20.5%)	
	Grade 4	28 (23.1%)	27 (24.1%)	
	Grade 5	25 (20.7%)	25 (22.3%)	
Marital status of the parents	Married	108 (90.0%)	98 (86.7%)	0.435
	Divorced/	12 (10.0%)	15 (13.3%)	
	Widowed			
The highest level of education of parents	Elementary school or less	16 (13.3%)	12 (10.9%)	0.847
	High school	50 (41.7%)	48 (43.6%)	
	University or more	54 (45.0%)	50 (45.5%)	
Perceived economic situation	Less than average	28 (23.5%)	30 (27.0%)	0.542
	Average or more	91 (76.5%)	81 (73.0%)	
Working status	Both parents work	38 (31.4%)	35 (31.5%)	0.980
	One parent works	74 (61.2%)	67 (60.4%)	
	Both parents don't work	9 (7.4%)	9 (8.1%)	
Total number of children	One	16 (13.2%)	14 (12.7%)	0.971
	Two	56 (46.3%)	48 (43.6%)	
	Three	38 (31.4%)	37 (33.6%)	
	4 or more	11 (9.1%)	11 (10.0%)	

Results are given in frequency (percentage) or mean ± standard deviation. p-values<0.05 are presented in bold and represent statistical significance.

4. Results

Table 1 illustrates the distinctions in the general characteristics of schoolchildren before (control group) and following (case group) the NLP intervention. The case group comprised a comparable proportion of females (60.0%) compared to the control group (60.5%; $p = 0.939$). A similar distribution of students across different grades was observed in both groups. After the intervention, both the students' ages (8.8 ± 1.6 ; $p = 0.403$) and their parents' ages (39.9 ± 6.1 ; $p = 0.939$) showed a slight increase, though these changes did not reach statistical significance ($p > 0.05$). The level of parental participation was comparable between cases (18% fathers and 82% mothers) and controls (17.4% fathers and 82.6% mothers) ($p = 0.895$). There was a lower percentage of married parents post-intervention (86.7% vs 90%), but this difference was not statistically significant ($p = 0.435$). Regarding their perceived economic status, 27% of the case group considered themselves below average, which was moderately higher than the control group (23.5%; $p = 0.542$). The employment status was described similarly in both cases and controls, with the majority having one parent working (60.4% and 61.2%, respectively; $p = 0.980$).

Table 2 compares the trigger scores in the different scores before and after the NLP intervention. This impact on academic triggers significantly varied by age group after the intervention ($p > 0.001$). It increased academic triggers for 6-year-olds (4.42 (1.20) vs. 5.95 (1.24)), slight increases for 7 and 8-year-olds, but decreases for 9, 10, and 11-year-olds. The decrease was most pronounced for the 11-year-old group (3.71 (1.76) vs. 3.01 (1.75)). Overall, the academic trigger scores decreased post-intervention with no statistically significant differences ($p = 0.517$) and an effect size of 6%. Regarding social triggers, significant differences were observed between age groups before and after intervention (p-values = 0.010 and < 0.001, respectively). All age

Table 2
Comparison of student trigger scores in the different factors before and after the neuro-linguistic programming intervention.

Age	Academic triggers		Social triggers	
	Pre-NLP intervention	Post-NLP intervention	Pre-NLP intervention	Post-NLP intervention
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
6 years	4.42 (1.20)	5.95 (1.24)	4.55 (1.18)	4.02 (1.33)
7 years	4.22 (1.16)	4.36 (1.49)	4.48 (1.27)	3.25 (1.34)
8 years	3.83 (1.70)	3.97 (1.73)	3.33 (1.65)	3.03 (1.46)
9 years	3.91 (1.55)	3.54 (1.96)	3.42 (1.65)	2.01 (1.65)
10 years	3.43 (1.44)	3.07 (1.49)	3.32 (1.62)	1.90 (1.51)
11 years	3.71 (1.76)	3.01 (1.75)	2.72 (1.11)	1.64 (1.07)
p-value	0.563	<0.001	0.010	<0.001
Overall	3.85 (1.53)	3.75 (1.83)	3.49 (1.56)	2.48 (1.61)
p-value	0.517		<0.001	
Effect size	0.060		0.627	
Age	Behavioral triggers		Environmental triggers	
	Pre-NLP intervention	Post-NLP intervention	Pre-NLP intervention	Post-NLP intervention
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
6 years	4.93 (1.53)	5.73 (1.41)	5.53 (1.58)	6.13 (1.65)
7 years	4.46 (1.59)	4.55 (1.19)	4.87 (1.80)	4.71 (1.42)
8 years	4.26 (1.89)	4.30 (2.04)	5.36 (2.04)	4.29 (1.85)
9 years	4.48 (1.92)	3.90 (2.19)	5.19 (2.05)	4.36 (1.98)
10 years	4.06 (1.49)	3.80 (1.15)	4.68 (1.92)	4.38 (2.28)
11 years	3.32 (1.33)	3.13 (1.41)	3.76 (1.77)	3.37 (2.40)
p-value	0.192	0.005	0.099	0.023
Overall	4.21 (1.71)	4.03 (1.74)	4.92 (1.95)	4.31 (2.07)
p-value	0.288		0.007	
Effect size	0.099		0.254	

groups reported a significant decrease in their social triggers, with an increased likelihood per age increase ($p < 0.001$) and an effect size of 62.7%. Students aged 6 years had a mean score decline from 4.55 (1.18) to 4.02 (1.33), those at 9 years from 3.42 (1.65) to 2.01 (1.65), and those at 11 years from 2.72 (1.11) to 1.64 (1.07). Concerning their behavioral triggers, students until 8 years old had higher scores post-intervention, while older ages reported fewer triggers, summing up to lower scores. Nevertheless, a minimal/non-significant effect size was noted (9.9%). Environmental trigger scores significantly decreased following the NLP intervention, especially for students above 7 years, with the highest impact on 8-year-old (5.36 (2.04) vs. 4.29 (1.85)) and 9-year-old students (5.19 (2.05) vs. 4.36 (1.98)). An overall significant reduction in the scores was observed ($p = 0.007$), with an effect size of 25.4%. When assessing individual academic triggers (results not shown), the highest impact of the NLP intervention was observed in stress related to receiving lower grades on tests or quizzes, pointing out students' mistakes, and facing deadlines and time pressures. For behavioral triggers, NLP significantly reduced stress associated with being excluded from activities or conversations and interruptions during study sessions. Regarding social triggers, NLP notably alleviated stress related to disagreements with classmates and difficulties in understanding others. Environmental triggers such as large crowds, loud places, noises like beeping and hammering, and bright lights showed significant stress reduction due to the NLP intervention.

The connectivity between the associated features and the scores in the different trigger subgroups is described by the correlation matrix displayed in Table 3. Before the intervention, positive correlations were found between the features and the scores, except for sex (-0.129 and -0.040 for the academic and behavioral groups, respectively), parents' age (-0.025 and -0.127 for the behavioral and social triggers), grade, relationship with the students, economic situation, working status and total number of children. After the intervention, students' ages and grades were significantly negatively affected by all the trigger scores, while sex substantially increased those scores ($p < 0.05$). The highest correlations were found between student's age and grade (-0.448 and -0.516 , respectively) and the social trigger scores. Contrarily, minimal/non-significant correlations were found between the parents' marital status, level of education, perceived economic situation, working status, and the total number of children with any trigger scores.

Table 4 presents the different linear regression models assessing the combined effect of the predictors affecting the school triggers' scores

before and after the NLP intervention. The variable inflation factor (VIF) is between one and five in all models, indicating that the variables have moderate multicollinearity. After adjusting for covariates, students with divorced or separated parents had significantly higher scores [$B = 0.96$ (0.01–1.92); $p = 0.042$]. In contrast, after the intervention, this was not significantly associated with the academic score ($p > 0.05$), but females had significantly higher scores than males [$B = 0.64$ (0.01–1.28); $p = 0.049$]. Before the intervention, the behavioral trigger score significantly decreased per grade increase [$B = -0.20$ (-0.43 – -0.05); $p = 0.016$], while after the intervention, females had higher scores [$B = 0.64$ (0.03–1.25); $p = 0.042$], and those having their fathers completing the survey had significantly lower scores [$B = -1.10$ (-1.90 to -0.30); $p = 0.007$]. Social trigger scores also significantly decreased per grade increase before [$B = -0.27$ (-0.48 to -0.06); $p = 0.013$], and those with only one working parent had significantly lower environmental trigger scores [$B = -0.66$ (-1.28 to -0.04); $p = 0.037$]. These findings were not observed after the NLP intervention, and no features significantly impacted social or environmental trigger scores.

5. Discussion

5.1. Impact of the NLP intervention on individual and overall school triggers

NLP is a systematic assistive approach that has been used in education to ameliorate students' responses to certain triggers, allowing better communication and control of negative emotions and anxiety. This study evaluated the impact of applying NLP techniques on their response to different triggers. No statistically significant differences in the general characteristics of the students before and after the NLP intervention, which can increase the validity of comparing control (before) and case (after the intervention) groups. Among individual stressors, the highest impact was observed in reducing stress related to receiving lower grades on tests or quizzes, pointing out students' mistakes, and managing deadlines and time pressures. This could be attributed to NLP's positive reframing and goal-setting strategies, which help students reframe their perception of failure and set realistic goals, thereby reducing the stress associated with unmet expectations (Edwards, 2021; Fakehy, 2022). Additionally, NLP's focus on constructive feedback and self-improvement likely helps students handle criticism more positively. The intervention also appeared to aid in time management and

Table 3
Correlation between study features and the trigger scores before and after the intervention.

Feature	Correlation	Academic	Behavioral	Social	Environmental
Age of the student	Pre-NLP	0.023	0.011	0.090	0.008
	Post-NLP	-0.408^b	-0.343^b	-0.448^b	-0.271^a
Sex at birth	Pre-NLP	-0.129	-0.040	0.004	0.010
	Post-NLP	0.246^a	0.250^a	0.180^a	0.216^a
Age of the parent	Pre-NLP	0.002	-0.025	-0.127	0.028
	Post-NLP	-0.105	-0.110	-0.077	-0.146
Relationship with the student	Pre-NLP	-0.218^a	-0.184	-0.134	-0.219
	Post-NLP	-0.120	-0.202^a	-0.023	-0.141
Grade	Pre-NLP	-0.202^a	-0.236^a	-0.319^a	-0.234^a
	Post-NLP	-0.419^b	-0.334^b	-0.516^b	-0.249^a
Marital status of the parents	Pre-NLP	0.204^a	0.022	0.196^*	-0.160
	Post-NLP	0.094	0.066	-0.023	0.053
Highest level of education	Pre-NLP	0.064	0.011	0.132	0.108
	Post-NLP	0.069	0.013	0.083	0.125
Economic situation	Pre-NLP	-0.081	-0.021	-0.019	-0.133
	Post-NLP	0.042	-0.124	-0.104	-0.016
Working status	Pre-NLP	-0.104	-0.049	-0.104	-0.170
	Post-NLP	0.008	0.168	0.047	0.016
Total number of children	Pre-NLP	-0.072	0.053	-0.026	-0.086
	Post-NLP	-0.080	-0.024	-0.081	-0.172

Significance was assessed through the Pearson correlation test.

^a $p < 0.05$.

^b $p < 0.001$.

Table 4

Linear regression associating features significant correlations and the trigger scores before and after the intervention.

Pre-NLP intervention	Academic	Behavioral	Social	Environmental
	B [95% CI]	B [95% CI]	B [95% CI]	B [95% CI]
Intercept	4.33 [1.99–6.66]	5.21 [2.98–7.44]	3.82 [1.49–6.14]	8.38 [5.91–10.86]
p-value	<0.001	<0.001	0.002	<0.001
Grade	–0.14 [–0.36–0.07]	–0.20 [–0.43 to –0.05]	–0.27 [–0.48 to –0.06]	–0.19 [–0.46–0.07]
p-value/VIF	0.177/1.008	0.016/1.006	0.013/1.008	0.143/1.006
Marital status of the parents	0.96 [0.01–1.92]		0.93 [–0.03–1.89]	
p-value/VIF	0.042/1.008		0.057/1.008	
Economic situation	–0.25 [–0.81–0.32]	–0.07 [–0.70–0.57]	–0.06 [–0.62–0.51]	–0.61 [–1.31–0.09]
p-value/VIF	0.388/1.054	0.839/1.047	0.843/1.054	0.087/1.047
Working status	–0.26 [–0.76–0.24]	–0.13 [–0.68–0.43]	–0.24 [–0.74–0.25]	–0.66 [–1.28 to –0.04]
p-value/VIF	0.303/1.051	0.658/1.044	0.337/1.051	0.037/1.044
R square (%)	7.3%	2.8%	10.3%	7.8%
Post-NLP intervention	B [95% CI]	B [95% CI]	B [95% CI]	B [95% CI]
Intercept	5.10 [1.68–8.53]	7.23 [3.69–10.77]	4.83 [1.95–7.70]	4.90 [0.80–8.99]
p-value/VIF	0.004	<0.001	0.001	0.020
Age (per increase of one year)	–0.25 [–0.65–0.16]	–0.16 [–0.54–0.23]	0.18 [–0.52–0.15]	–0.07 [–0.55–0.41]
p-value/VIF	0.227/3.758	0.426/3.768	0.282/3.758	0.765/3.758
Sex at birth	0.64 [0.01–1.28]	0.64 [0.03–1.25]	0.47 [–0.07–1.01]	0.67 [–0.09–1.44]
p-value/VIF	0.049/1.044	0.042/1.044	0.152/1.044	0.084/1.044
Grade	–0.28 [–0.71–0.15]	–0.27 [–0.68–0.14]	–0.35 [–0.71–0.01]	–0.29 [–0.80–0.23]
p-value/VIF	0.194/3.762	0.197/3.792	0.057/3.762	0.268/3.762
Parent involved		–1.10 [–1.90 to –0.30]		
p-value/VIF		0.007/1.012		
Economic situation	0.21 [–0.41–0.82]	–0.32 [–0.91–0.27]	–0.23 [–0.75–0.29]	–0.05 [–0.79–0.69]
p-value/VIF	0.514/1.055	0.287/1.056	0.379/1.055	0.901/1.055
Working status	0.07 [–0.47–0.62]	0.51 [–0.01–1.034]	0.13 [–0.33–0.59]	0.04 [–0.61–0.69]
p-value/VIF	0.793/1.035	0.055/1.038	0.571/1.035	0.906/1.035
R square (%)	20.8%	23.5%	26.1%	9.4%

Results are given in standardized beta with a 95% Confidence Interval (B [95%CI]). p-values <0.05 are presented in bold and are statistically significant. VIF: Variance Inflation Factor.

prioritization, enabling students to cope better with deadlines and reduce related stress (Skinner & Croft, 2009). NLP significantly alleviated stress associated with being excluded from activities or conversations and interruptions during study sessions. This is likely due to NLP techniques that enhance social skills and self-esteem, enabling students to feel more included and engage confidently in conversations (Mhanna et al., 2024). NLP notably alleviated stress related to disagreements with classmates and difficulties in understanding others, possibly attributed to conflict resolution and communication strategies, which help students navigate social conflicts more effectively and improve their interpersonal skills (Abdivarmazan & Sylabkhor, 2016; Mhanna et al., 2024). Moreover, NLP’s sensory acuity and relaxation techniques could help students manage sensory overload and their responses to sudden or annoying noises through desensitization and controlled breathing. Similarly, NLP might assist students in coping with bright lights by teaching them to manage their physiological and emotional responses to such stimuli (Kotera & Van Gordon, 2019).

At the academic and behavioral levels, the NLP intervention was significantly more effective for children older than 9, which could be explained by the fact that at this age, children start to develop critical thinking skills and ways of learning, reading, writing, and oral skills, and develop competitiveness (Hartati & Ginting, 2023; Manana et al., 2023). The methods of NLP, such as confirmation, visualization, securing, reframing, roleplaying, and part modeling, may positively affect learning advancement and behavioral adjustment (Zhang et al., 2023). Previous research found that children from 9 years of age had a similar extent of sequence learning as adults, whereas the learning at 4–8 years was substantially lower (Janacsek et al., 2012). In contrast, social and environmental triggers were reduced significantly in all age groups post-NLP intervention. This could be related to the role of NLP in fostering a more optimistic mindset among children, enhancing their self-awareness regarding thoughts and actions, bolstering social aptitude, communication proficiency, self-regulation, and overall mental well-being, ultimately aiding in mitigating social and environmental

stressors (Nompo et al., 2021). The current findings align with prior research, as evidenced by other studies that have consistently demonstrated the effectiveness of NLP interventions in ameliorating social anxiety, alleviating symptoms of depression, and reducing stress levels in children, underscoring its significance as a valuable tool for enhancing the psychological well-being of young children (Abdivarmazan & Sylabkhor, 2016; Fakehy, 2022). As children grow older and progress through various grade levels, the composite scores for triggers, encompassing academic, behavioral, social, and environmental factors, exhibited a noteworthy decrease. This decline coincides with their exposure to NLP sessions, suggesting that at this stage, children often exhibit behaviors driven by intrinsic motivation and display a generally incremental mindset (Cook & Artino Jr, 2016), rendering them receptive to the benefits of NLP interventions.

5.2. Factors affecting the impact of the NLP intervention in schoolchildren

Post-NLP intervention, girls had significantly higher trigger scores than boys. Most girls tend to use emotional regulation strategies when experiencing sadness, anxiety, and anger and when dealing with different triggers (Sanchis-Sanchis et al., 2020), thus reducing the efficiency of NLP. Besides, the increase in parents’ age decreased children’s triggers in all groups with no significant differences. With age, parental involvement and flexible parenting style were reported, resulting in higher reasoning and problem-solving abilities (Lin et al., 2023), increasing NLP techniques’ efficiency. Providing the right parental support can help minimize the risk of acquiring behaviors associated with anxiety and depression, which can impair children’s lives and their ability to behave well at home, at school, and in the community (National Academies of Sciences & Medicine, 2016). High paternal involvement is linked to higher levels of sociability, confidence, and self-control in children (Diniz et al., 2021), which can explain its positive effect on decreasing the different trigger scores. Parental involvement in children’s education, crucial for early school achievement, is influenced

by various factors. Risk factors like low socioeconomic status, single-parent households, language barriers, cultural differences, and parental mental health issues can hinder involvement (Blondal & Adalbjarnardottir, 2014; Chen et al., 2024). Conversely, protective factors such as higher socioeconomic status, two-parent households, effective communication, positive school climate, good parental mental health, and educational resources enhance engagement (Chen et al., 2024; Tan & Goldberg, 2009). Early indicators of school achievement include reading and numeracy skills, social-emotional development, attendance, and parental support (Tan & Goldberg, 2009). Higher income was associated with lower behavioral and social trigger scores. Low-income parents are most likely to work in stressful environments (low pay, little autonomy, inflexible hours, and few or no benefits), negatively affecting their children's behaviors (Isenberg et al., 2022). After the NLP interventions, no features were significantly associated with the academic and environmental triggers' scores. This finding may suggest a similar impact of NLP on the different subgroups since it can help students develop their academic skills, such as critical thinking, educational achievement, emotional intelligence, self-efficacy, and empathy, thus reducing the academic triggers they might face (Begum et al., 2022). In parallel, NLP also helps teachers strengthen the educational environment and conduct supportive and effective interactions with their students, thus improving their academic performance by creating a comfortable environment (Anjomshoa et al., 2020). At the behavioral level, trigger scores significantly decreased when asking the fathers to complete the survey. This could be explained by the fact that fathers can be less engaged in their children's lives due to other challenges, such as balancing professional and familial responsibilities, intense pressure to provide financial support for their families and time constraints. Social triggers' scores also significantly decreased per grade increase after the NLP interventions.

5.3. Limitations of the study

This research has some limitations. Variability in children's cognitive capabilities, language proficiency, and attention span is associated with their age. One significant limitation is the lack of capacity to generalize the results to other places, as the study was conducted without the use of weighting, meaning that the sample population may not accurately represent the broader demographic diversity of all educational settings. Differences in cultural and social norms could limit the generalizability of our results to other populations, as communication styles, educational values, and societal expectations differ widely between countries and even within regions of the same country. Furthermore, while we attempted to control for several key variables, many other factors could likely influence the outcomes of NLP interventions in educational settings that were not accounted for, potentially introducing bias into the study's findings. For instance, factors such as teacher experience, parents' involvement, and school resources were not comprehensively included in the analysis, which could skew the results. Response bias might be introduced as children might not consistently convey their thoughts accurately or could provide socially desirable answers. The limited availability of children during school hours due to time constraints could also impact their responses. Additionally, external factors, like life events or family circumstances, may have influenced their conduct and responses during the study. Despite these restrictions, this study imparts valuable insights into the impact of interventions on the challenges faced by children in schools. Further research with a more extensive and representative sample is strongly recommended.

6. Conclusion

This study shows that NLP techniques can benefit students by reducing triggers in various areas. The NLP intervention significantly reduced academic and behavioral trigger scores, particularly in children

9 and older. Additionally, it effectively lowered social and environmental trigger scores across all age groups. The study found a negative correlation between trigger scores and age, indicating that older children experienced greater benefits from the intervention. Notably, the intervention was more effective in males than in females. While there was a strong correlation between students' age and grade with social trigger scores, parental factors such as marital status, education level, economic situation, and employment status had minimal influence on the outcomes. These findings suggest that NLP may be a valuable tool for reducing various triggers in children and holds promise in improving students' well-being and academic performance across diverse groups.

Ethics approval and consent to participate

The study protocol, questionnaire, and consent form were reviewed and approved by the institutional review board of the Lebanese University faculty of pharmacy (reference: 3/23/D). Written informed consent was obtained from every participant's parent/legal guardian.

Consent for publication

Not applicable.

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CRediT authorship contribution statement

Diana Ghanem: Writing – original draft, Project administration, Investigation, Data curation. **Sarah Tarhini:** Writing – original draft, Investigation, Formal analysis, Data curation. **Marwa Manana:** Writing – original draft, Investigation, Formal analysis, Data curation. **Sanaa Awada:** Writing – review & editing, Validation, Conceptualization. **Roula Bou Assi:** Writing – review & editing, Visualization, Methodology, Conceptualization. **Lina Ismail:** Writing – review & editing, Investigation, Conceptualization. **Georges Hatem:** Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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