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The National Institute for Research in
Behavioral Sciences

Research Evaluation of "Matific"

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Summary of Findings

Background

Matific offers a unique approach to the study of mathematics through the use of games and interactive activities involving technology for pre-school through sixth grade. The applications are designed for tablets and personal computers and are based on spiral, modular learning based on the students' progress.

The Szold Institute was asked to evaluate different components of Matific's program, as they are expressed in the attitudes of students and teachers who use the program. The evaluation aimed to examine how Matific's paradigm is actually implemented in schools. More, specifically, how and to what extent the program is used, the effects of the program on teaching and learning, and the main benefits and challenges associated with the use of the program.

Main Trends

How and to what extent is the program used?

1. Most of the teachers use the program once a week (43%) or twice a week (20%) and a majority of the teachers (52%) do not use the program for homework.
2. Fifty percent of the teachers use the program to the extent that suits them. In cases in which there are barriers to their use of the program, those barriers are mainly due to limited availability of technological devices (41%), technical problems faced in operating those devices (26%), and time constraints (22%).
3. Teachers mainly use Matific with the whole class at once (62%) and for independent study (61%). Teachers also reported using the program for one-on-one work with individual students (52%) and group work (25%). The use is mainly intended to provide an opportunity for practice (96%), review (75%), and enrichment (65%).
4. Approximately 14% of the teachers use the *Teacher's Manual* and 26% of the teachers use the student-performance reports produced by the system. Approximately 51% of the teachers are not familiar with the *Teacher's Manual* and 18% are not familiar with the possibility of receiving performance reports.
5. Approximately 95% of the teachers use textbooks in their math classes and approximately 76% use electronic material from other vendors in their math classes. In their math classes, approximately 59% of the students use websites or computer programs other than Matific.

Effects of the use of Matific on teaching:

The teachers reported that their use of Matific greatly benefitted their teaching, particularly in the following areas: relevance of the instruction to students (82%) and successful demonstration of material to students (77%). The teachers also saw the program as having strong effects on variety (95%), enjoyment (88%), and interest in instruction. The smallest effect of the program appears to be its effect on increasing the pace of teaching and the presentation of material (only 28% of teachers gave this a rating of *to a great extent*).

Effects of the use of Matific on learning:

1. The teachers reported that use of Matific affects the following *to a great extent*: students' enjoyment (98%), students' interest (95%), students' motivation (86%), and students' curiosity and cooperation (84%). It appears to have less of an effect on math anxiety (51%) and discipline issues (44%).
2. Attitudes of students toward math classes without Matific: In the absence of the program, 65% of the students reported that they wanted and liked math class *to a great extent*. In addition, 64% of the students are focused during math classes that involve the program and 61% feel they are successful during those math classes.
3. Attitudes of students toward math classes with Matific: The students reported that *to a great extent*, they were focused during program activities (84%), felt successful (78%), and enjoyed and wanted to study with the program (74%). Seventy-nine percent of the students want to continue to use Matific.
4. Students had more positive perceptions of learning with the program *to a great extent* in terms of the following: understanding the material (76% with the program and 66% without it), ease of learning (77% with the program and 50% without it), level of enjoyment (75% with the program and 51% without it), and level of interest (73% with the program and 40% without it). These differences were found to be statistically significant, with the exception of the difference regarding the importance of studying math.

Benefits and Challenges

1. According to the teachers, the unique aspects of Matific are mainly the enjoyable nature of the exercises (95%) and studying with the program (92%). The teachers also referred to the program's contribution to students' understanding of the material (78%), the program's attractive and user-friendly design (75% each), the opportunity for experiential learning (71%), and the interactive nature of the program (70%).
2. Most of the teachers did not have much difficulty using the program. The main difficulty mentioned by the teachers was the lack of awareness of the importance of the program among parents (25% gave this a rating of *to a great extent*). In response to an open-ended question, some of the teachers noted technical difficulties, including getting into the program with a password.

Conclusions

The findings indicate that the attitudes of the teachers and students toward the program are generally positive. Teachers and students noted the positive effects of the program in different areas such as enjoyment of the learning, understanding the material, and the students' level of interest, as well as variety and interest in instruction and the relevance of instruction for students. However, it appears that Matific is not used very frequently, mainly once every week or two. This is despite the fact that half of the teachers do not face any barriers to their use of the program. It also appears that a majority of teachers are not familiar with the *Teacher's Manual* and some are not familiar with the program's ability to generate performance reports. If the teachers were more familiar with these options, they might use the program more frequently and their students might derive greater benefit from the program.

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A. Background¹

Matific offers a unique approach to the study of mathematics through the use of games and interactive, technology-based activities for pre-school through sixth grade. The applications are designed for tablets and personal computers and are based on modular, spiral learning based on the student's progress.

The games for the students are accompanied by teaching aides for their teachers: a classroom-management system, a teacher's manual, recommendations as to how to organize lessons, and a *demo mode* that the teacher can use to demonstrate concepts in class.

The Company's Mission

- 1. To spread high-quality math education** and provide children around the world with rich applications for their math studies.
- 2. To strengthen teachers and parents** and offer a broad variety of colorful, interactive resources for math education.
- 3. To make math fascinating** and develop an appreciation of the beauty of mathematics and its relevance for everyday life among students of all ages.
- 4. To open doors to scientific thinking**, advance the ability to think analytically, and encourage the discovery of preliminary insights.

¹ Taken from summaries of discussions with company representatives and Matific website.

The company has a number of **pedagogical principles**:

- Emphasizing mathematical principles
- “Natural” math, as it is expressed in everyday life
- Providing numerous concrete experiences to serve as the basis for abstract abilities
- Variety of demonstration tools
- Problem-solving experience
- Learning through active trial-and-error
- Sophisticated use of technologies

The program is implemented according to a variety of methods and models (listed below), in keeping with the needs of the individual teacher, and there is no one method that is preferred or recommended:

1. Used by the whole class together during class time
2. Used during class, with one laptop/tablet per student
3. Used during class, with one laptop/tablet per group of students
4. Instruction of groups of struggling students (for example, as part of the Ofek Hadash program)
5. Supplemental study at home

B. Study Rationale

The Szold Institute was asked to evaluate different components of Matifics' program, as those components are expressed in the attitudes of the students and teachers who use the program. The evaluation aimed to examine the ways in which Matifics' paradigm is actually implemented in schools, specifically, how and to what extent the program is used, the effects of the program on teaching and learning, the benefits of the program, and the main challenges faced in its use.

C. Findings

Findings from questionnaires completed by teachers and students using Matific are presented below.²

² When the data permitted, we compared the attitudes of teachers with different amounts of experience working the program (teachers who had used the program for one year vs. teachers who had used the program for more than one year), the attitudes of teachers who teach children of different ages (teachers who teach first–third grade vs. teachers who teach fourth–sixth grade), the attitudes of students with different amounts of experience with the program (students in their first year of using the program vs. students who had used the program for more than one year), and the attitudes of students of different ages (first- through third-graders vs. fourth- through sixth-graders).

1. Background

Background information about the teachers

One hundred and twenty-seven teachers completed the questionnaire. On average, these teachers had 14 years of experience (standard deviation of 10.13) and mode level of experience was 4 years. Teachers' years of teaching experience ranged from 1 to 40 years.

Approximately 39% of the teachers ($n = 50$) first began to use Matific during the current school year, approximately 55% of the teachers ($n = 70$) began the previous year, and approximately 5% of the teachers ($n = 6$) began using the program two years ago.

Background information about the students

One hundred and fifty-five students completed the questionnaire. Approximately 77% of the students ($n = 95$) are in their first year of studying with the program, approximately 20% ($n = 25$) are in their second year, and approximately 3% ($n = 3$) are in their third year.

Table 1: Teachers and students by grade level

	Teachers (N = 127)		Students (N = 155)	
	Number of Respondents	Proportion of Responses (%)	Number of Respondents	Proportion of Responses (%)
First grade	52	41	9	6
Second grade	49	39	9	6
Third grade	41	32	24	17
Fourth grade	39	15	65	45
Fifth grade	40	15	36	25
Sixth grade	28	11	2	1
Special ed. classes	16	6	–	–

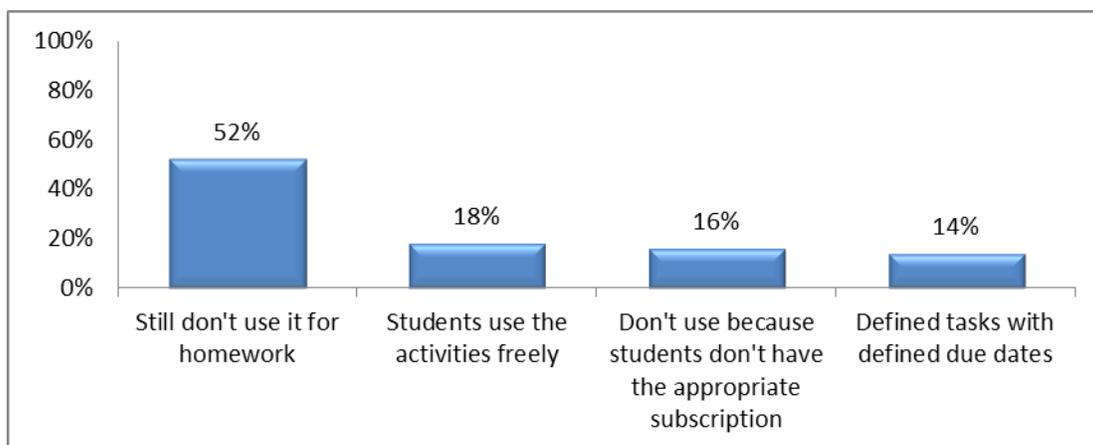
2. Frequency with which Matific was used

The teachers were asked how often they used Matific for classwork and/or homework. They were also asked if there were any factors that limited their use of the program.

Table 2: Frequency with which teachers use Matific ($N = 127$)

Frequency of Use	Frequency of This Response	Proportion of Responses (%)
Every class	14	11
Two or three times a week	11	9
Once a week	55	43
Once every two weeks	25	20
Once a month	11	9
Less than once a month	10	8

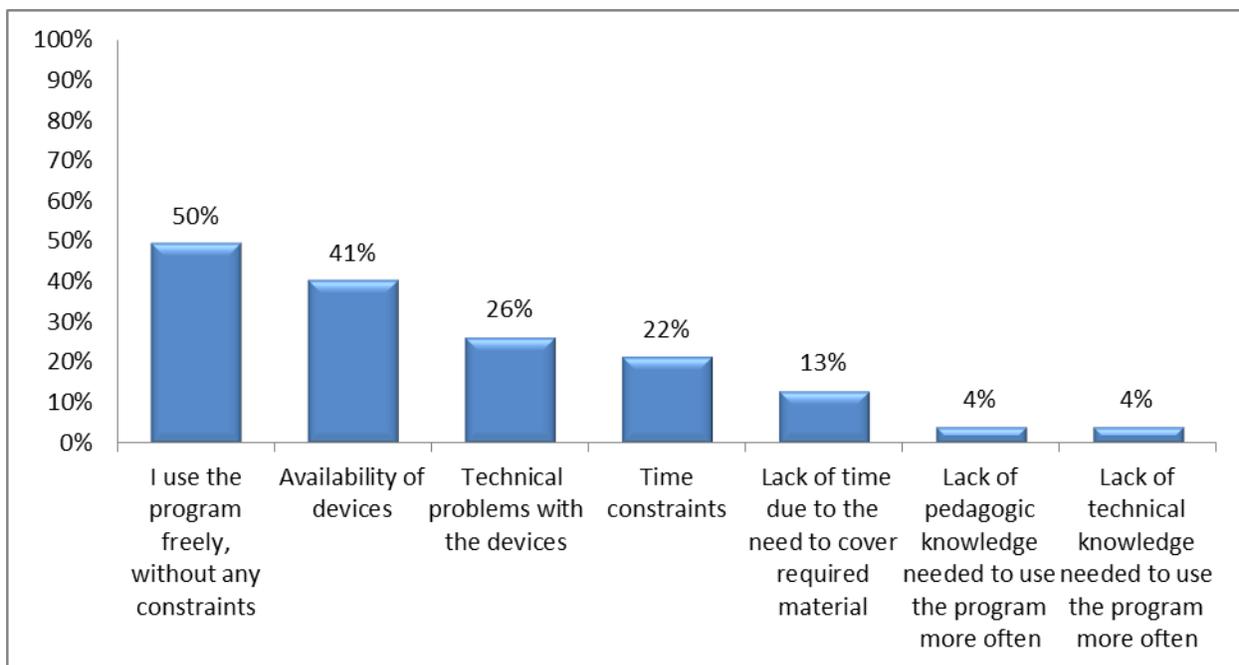
Figure 1: Use of Matific for homework according to teachers ($N = 127$)



Reports from the teachers indicate that Matific was most commonly used once a week (43%) or once every two weeks (20%). In addition, 52% of the teachers ($n = 64$) did not use the program for homework and some were unable to do so as their students did not have the necessary

homework subscription (16%, $n = 19$). Most of the teachers who did use the program for homework generally allowed their students to work freely on activities ($n = 22$, 18%) or gave assignments with set due dates ($n = 17$, 14%). No statistically significant differences in the frequency with which the program was used were found among teachers with different levels of experience working with the program or among teachers of different grades.

Figure 2: Barriers to use Matific according to teachers ($N = 127$)

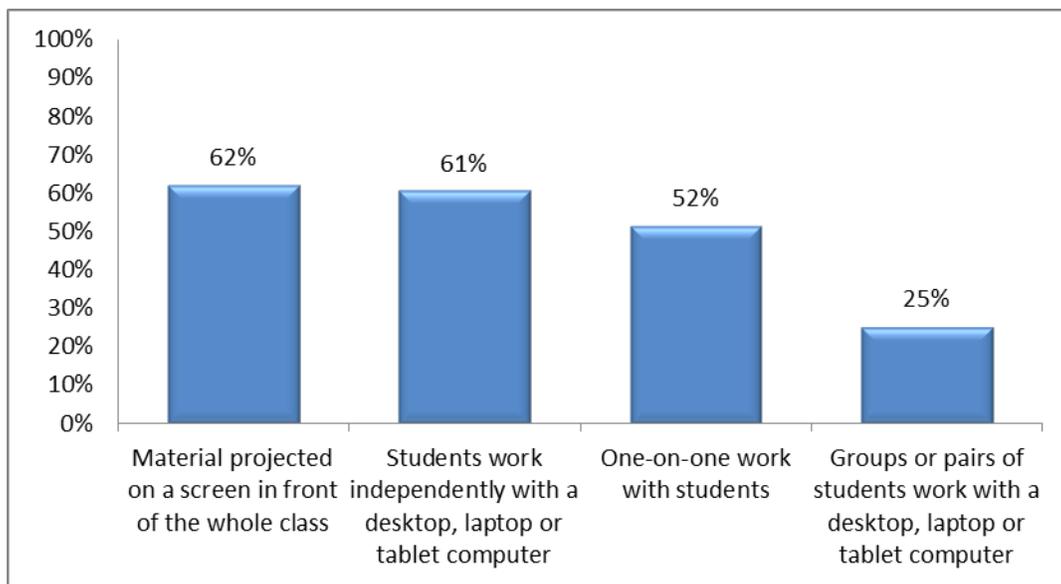


Fifty percent of the teachers who answered the question used Matific freely, to the extent that suited them, without any barriers or limitations. Among the teachers who did experience difficulties in their use of the program, those difficulties were mainly due to limited availability of technological devices ($n = 49$, 41%), technical problems operating those devices ($n = 3$, 26%), and time constraints ($n = 26$, 22%).

3. Manner in which Matific is used

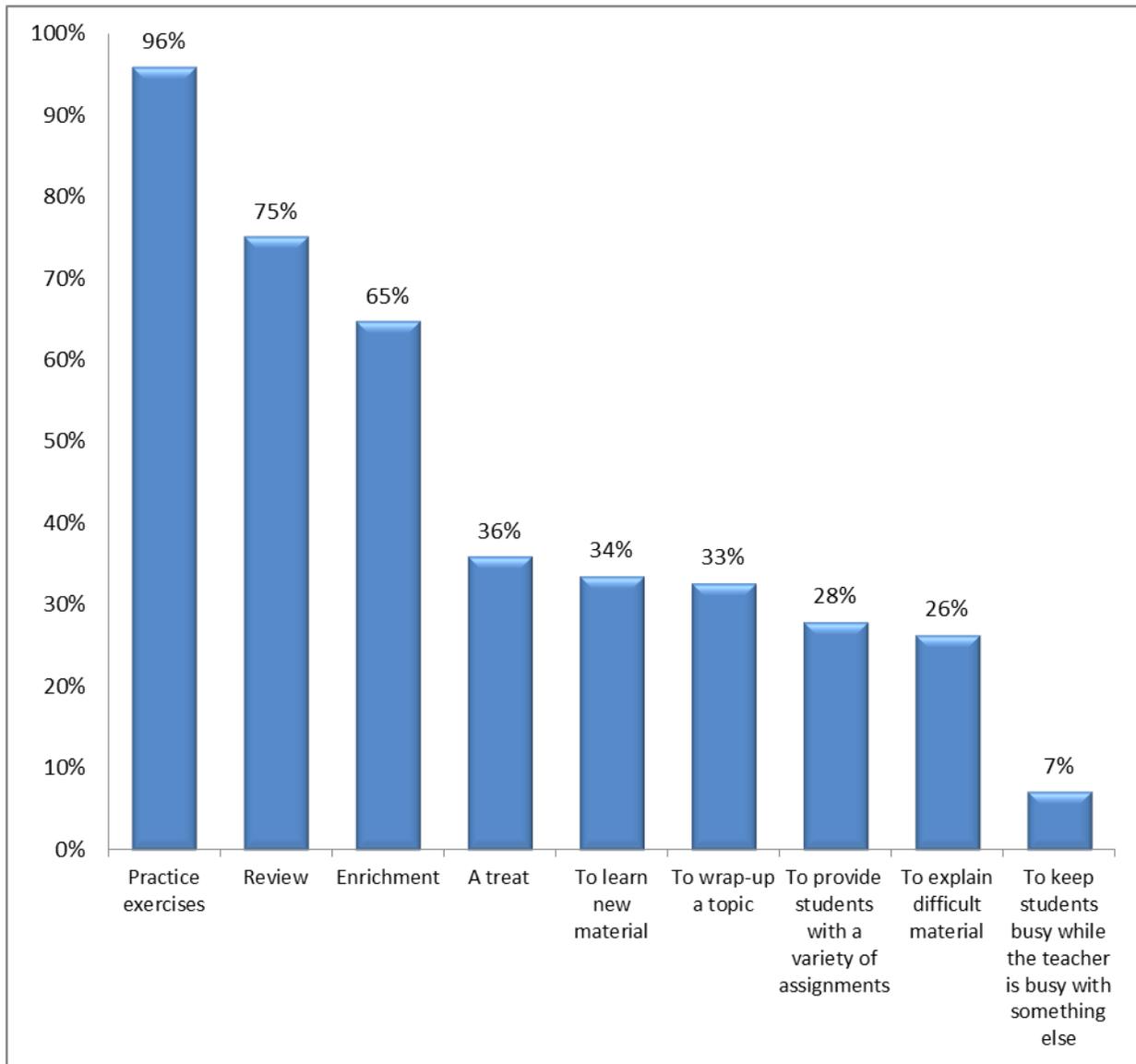
The teachers were asked how they used Matific and for what purposes they used it. Their answers are presented in the following figures.

Figure 3: How Matific is used according to teachers ($N = 127$)



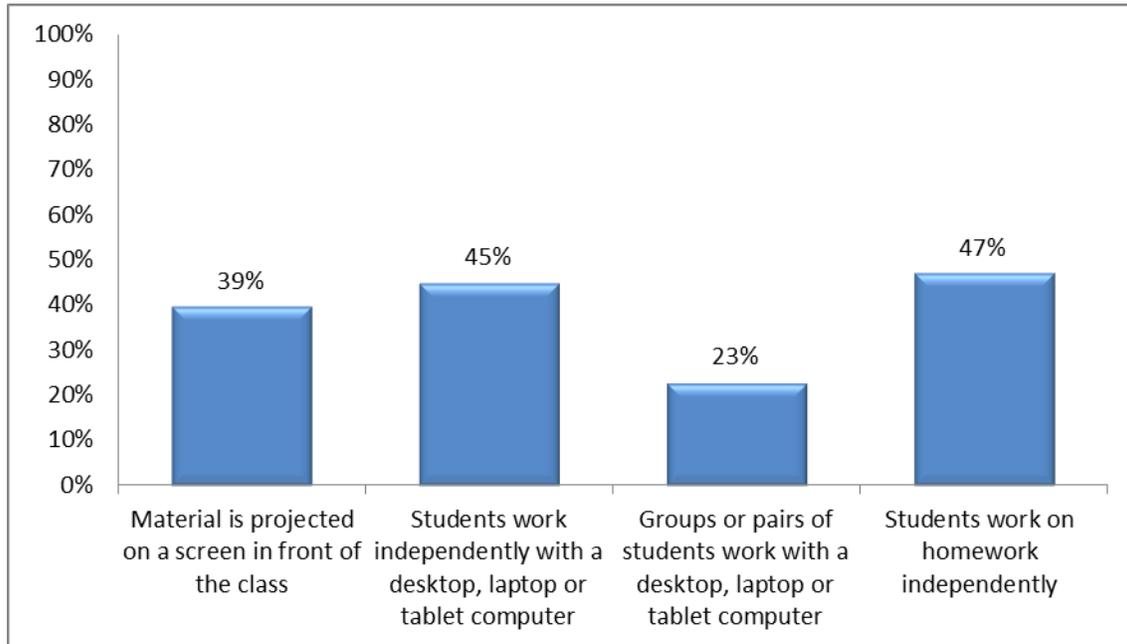
Most of the teachers used Matific with their whole class at once, by projecting the material on a screen so that all of the students could see it at the same time ($n = 76$, 62%) or had students use the program for independent work on a desktop, laptop, or tablet computer ($n = 74$, 61%). About half of the teachers used Matific for one-on-one work with individual students ($n = 63$, 52%). Twenty-five percent of the teachers ($n = 31$) also used the program for group work or work that students do in pairs.

Figure 4: Purposes for which teachers say they use Matific (N = 127)



The teachers reported that they mainly used Matific for practice exercises ($n = 120$, 96%), review of material ($n = 94$, 75%), and enrichment ($n = 81$, 65%).

Figure 5: Use of Matific, according to students (N = 155)



The students reported that, in their experience, Matific was mainly used for independent work carried out at home ($n = 64$, 7%) or during class ($n = 61$, 45%).

In addition to using Matific in their teaching, approximately 14% of the teachers ($n = 17$) reported that they used the *Matific Teacher's Manual*; whereas approximately 51% of the respondents ($n = 62$) reported that they were unfamiliar with the *Teacher's Manual*. Approximately 26% of the teachers ($n = 32$) used the student-performance reports generated by the program; whereas approximately 18% ($n = 22$) of the respondents did not know that such reports could be generated. In terms of these issues, no statistically significant differences were found between teachers who were new to the program and teachers who had more experience using the program, or between teachers of different grades.

The teachers were asked whether they used textbooks in their math classes. Approximately 95% of the teachers ($n = 116$) used textbooks in their math classes and approximately 76% of the

teachers ($n = 91$) used electronic material from other vendors in their math classes. Approximately 59% ($n = 70$) of the students used websites or programs other than Matific.

The teachers were asked an open-ended question about the additional study materials they used in class and 97 of the teachers responded to that question. Their answers were coded and are presented in the table below.

Table 3: Use of additional study materials, according to teachers ($N = 127$)

Study Material	No. of Teachers	Proportion of Teachers (%)
<i>Shvilim</i> – The Center for Educational Technology	27	28
<i>Ofek</i> website – The Center for Educational Technology	22	23
Textbook, unspecified	21	22
Demonstration materials	14	14
Materials the teacher prepares on his/her own	14	14
<i>Hashbacha</i> program	13	13
Games	13	13
<i>Pashut Heshbon</i> – Kinneret, Zmora – Biton, Dvir	10	10

Additional materials mentioned by fewer than 10% of the respondents: *Kesherim v'HeKsherim* – Unit of Math Education ($n = 9$, 9%), *Galim* website ($n = 5$, 5%), LNET ($n = 4$, 4%), *Et L'Daat* ($n = 3$, 3%), *Heshbon 10* – Lamda ($n = 2$, 2%), and *Sefereshet* ($n = 1$, 1%).

4. Effects of Matific on teaching and learning

The teachers were asked about how their use of Matific had influenced their teaching. They were given a list of items and asked to rate how their use of the program had affected the aspect of teaching mentioned in each item on a scale of 1 (*not at all*) to 5 (*a great deal*). The responses

were categorized according to three levels of agreement: *very little* (1–2), *to some extent* (3), and *to a great extent* (4–5). The results of this analysis are presented in the following figures.

Figure 6: Effect of Matific on teaching according to teachers (N = 127)

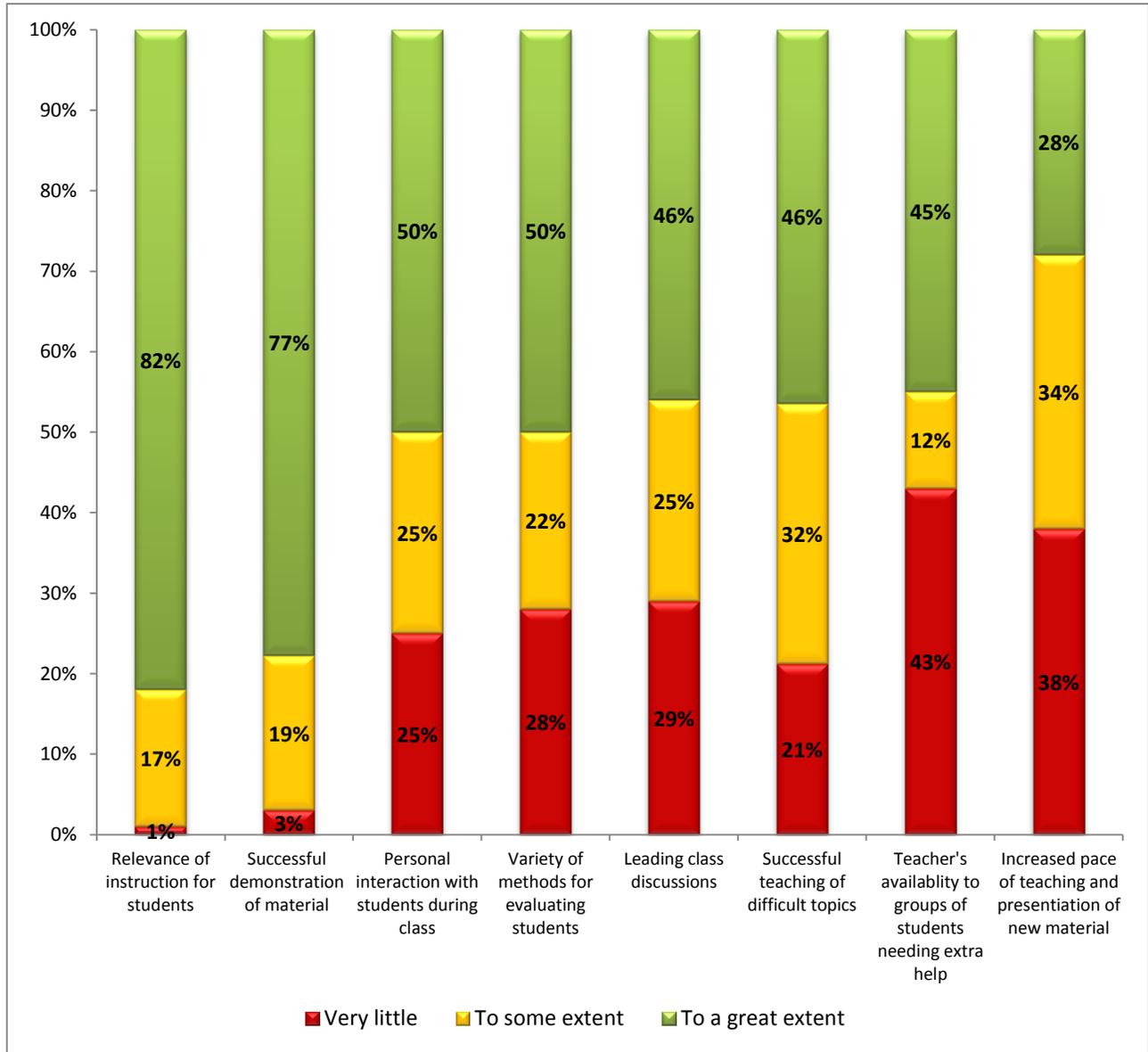
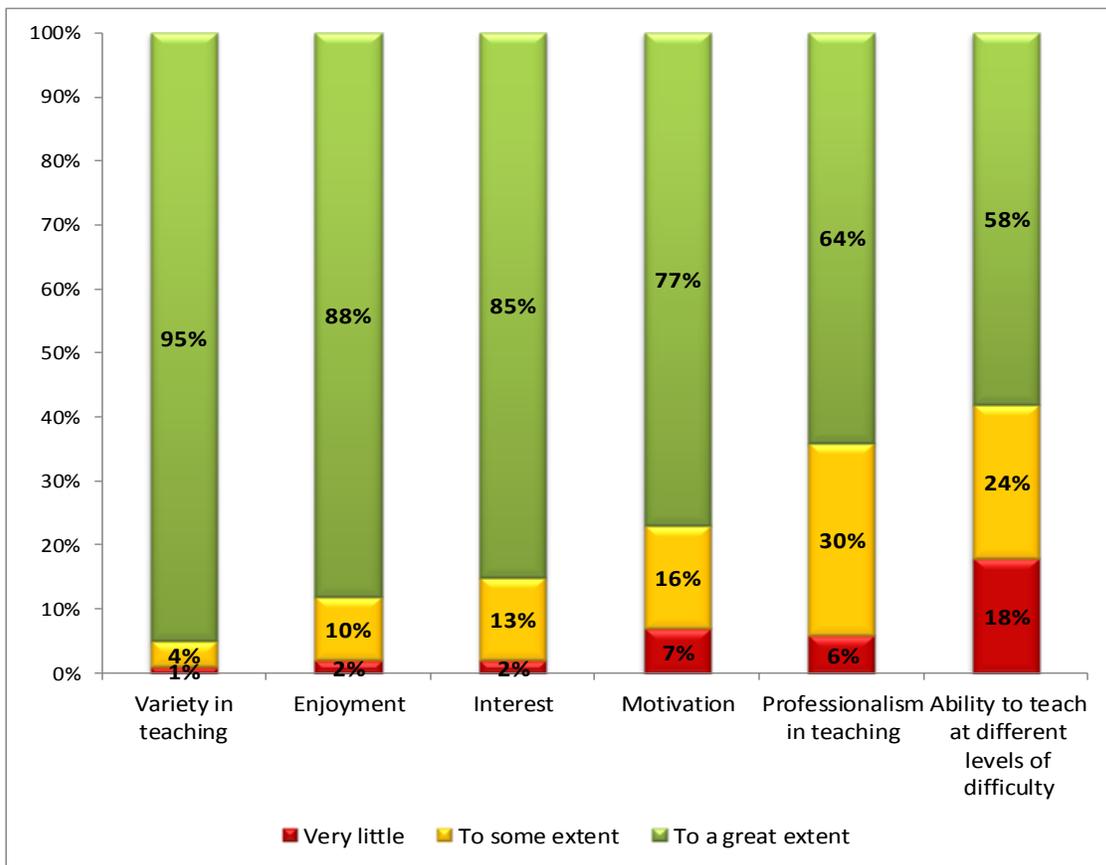


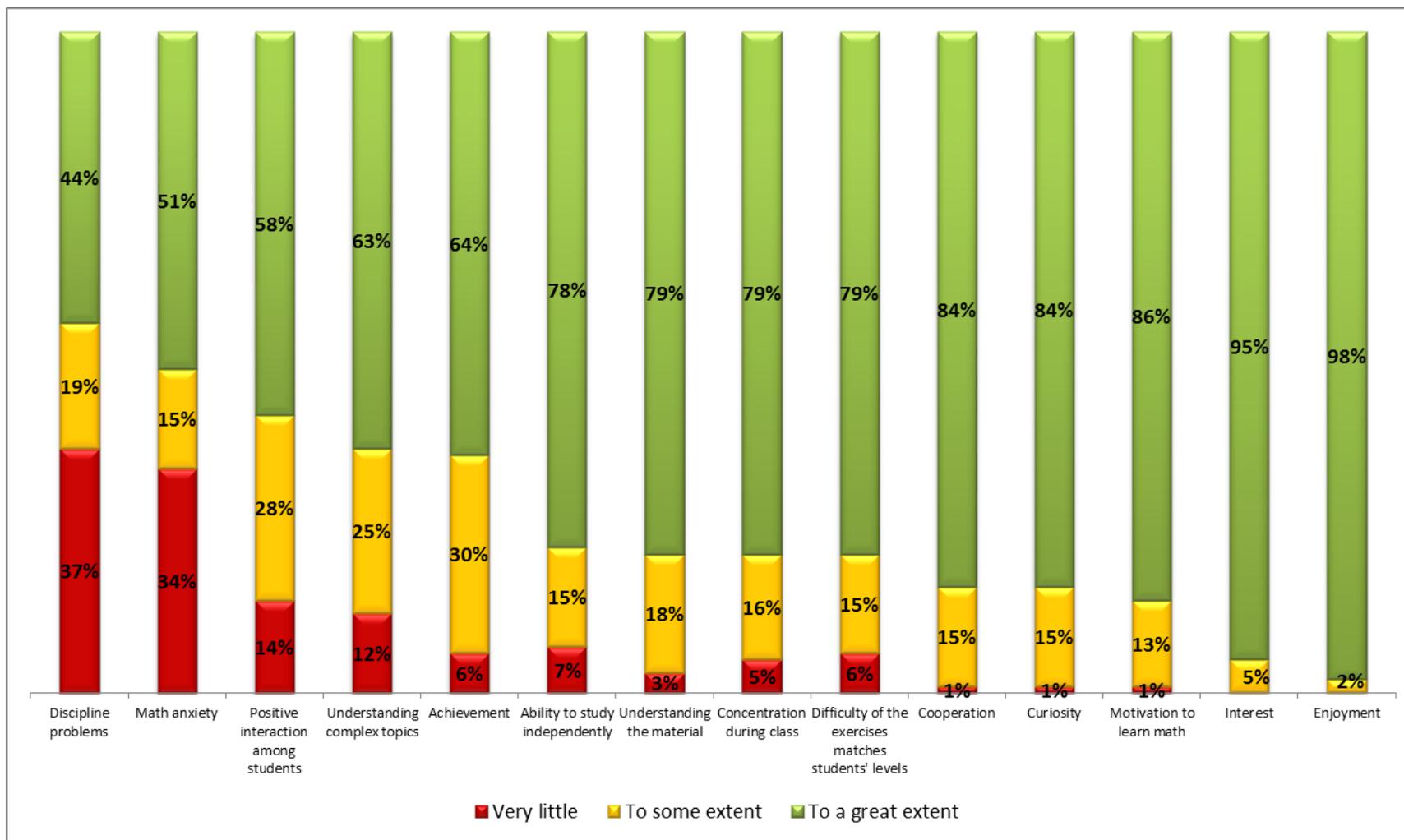
Figure 7: Effects of Matific on different aspects of teaching according to teachers ($N = 127$)



It appears that the teachers felt that their use of Matific benefited the following *to a great extent*: relevance of teaching for students ($n = 95, 82\%$) and the demonstration of course material for students ($n = 91, 77\%$). The teachers also saw the program as affecting the following aspects of their teaching *to a great extent*: variety in teaching ($n = 112, 95\%$), enjoyment from teaching ($n = 104, 88\%$), and interest in teaching ($n = 101, 85\%$). Use of the program appears to have had its smallest effect on the (increased) pace of teaching and the presentation of material [only 28% of the teachers ($n = 33$) gave this item a rating of *to a great extent*].

The teachers were also asked about the effect of the use of Matific on their students.

Figure 8: Effect of the use of Matific on learning according to teachers (N = 127)



The teachers perceived the program as affecting the following aspects of learning *to a great extent*: enjoyment ($n = 122$, 98%), interest ($n = 115$, 95%), motivation ($n = 106$, 86%), and curiosity and cooperation ($n = 102$, 84%). The program appeared to have less of an effect on math anxiety ($n = 56$, 51%) and discipline problems ($n = 50$, 44%).

With regard to running class discussions, teachers with more than one year of experience working in the program had a statistically significant advantage over the other teachers. Statistically significant differences favoring teachers of younger students (grades 1–3) were noted in the following areas: effect of the program on positive interaction with students, managing class discussions, and teachers' motivation, interest, and enjoyment of instruction.

Students were asked about their attitudes toward studying math with and without the Matific. They were presented with a list of items related to math classes and asked to rate each item on a scale of 1 (*not at all*) to 5 (*to a very great extent*). Their responses were categorized into three levels of agreement: *very little* (1–2), *to some extent* (3), and *to a great extent* (4–5). The results of this analysis are presented in the figures below.

Table 4: Students’ attitudes toward studying math without Matific ($N = 155$)

Math Classes Without Matific	Very Little Agreement (1–2)	Some Agreement (3)	A Great Deal of Agreement (4–5)	Average Score	Standard Deviation
I want to study math.	19%	16%	65%	3.87	1.34
I like the activities we do in math class.	23%	13%	65%	3.71	1.47
I concentrate during math class.	16%	20%	64%	3.81	1.25
I’m usually good at math.	22%	17%	61%	3.73	1.35
I like math.	29%	12%	59%	3.52	1.54
There’s a pleasant atmosphere in the room during math class.	24%	23%	53%	3.51	1.35
I can study on my own from the book during math class.	32%	18%	50%	3.35	1.49
I’m more stressed before math tests than I am before tests in other subjects.	50%	17%	33%	2.74	1.56
I’d prefer not to study math.	75%	8%	17%	1.95	1.41
I find math class stressful.	73%	12%	15%	1.95	1.37

Sixty-five percent of the students ($n = 98$) noted that, *to a great extent*, they wanted to study math and enjoyed studying math without Matific. Sixty-four percent of the students ($n = 94$) reported that they concentrated during math classes that did not involve Matific and 61% of the students ($n = 91$) felt that they are generally good at math during classes that do not involve Matific. A comparison of students of different ages (first through third grade vs. fourth through sixth grade) revealed that the younger students had more positive attitudes regarding the statements concerning the atmosphere in the room during math class, being good at math, and liking math.

Table 5: Students' attitudes toward studying math with Matific ($N = 155$)

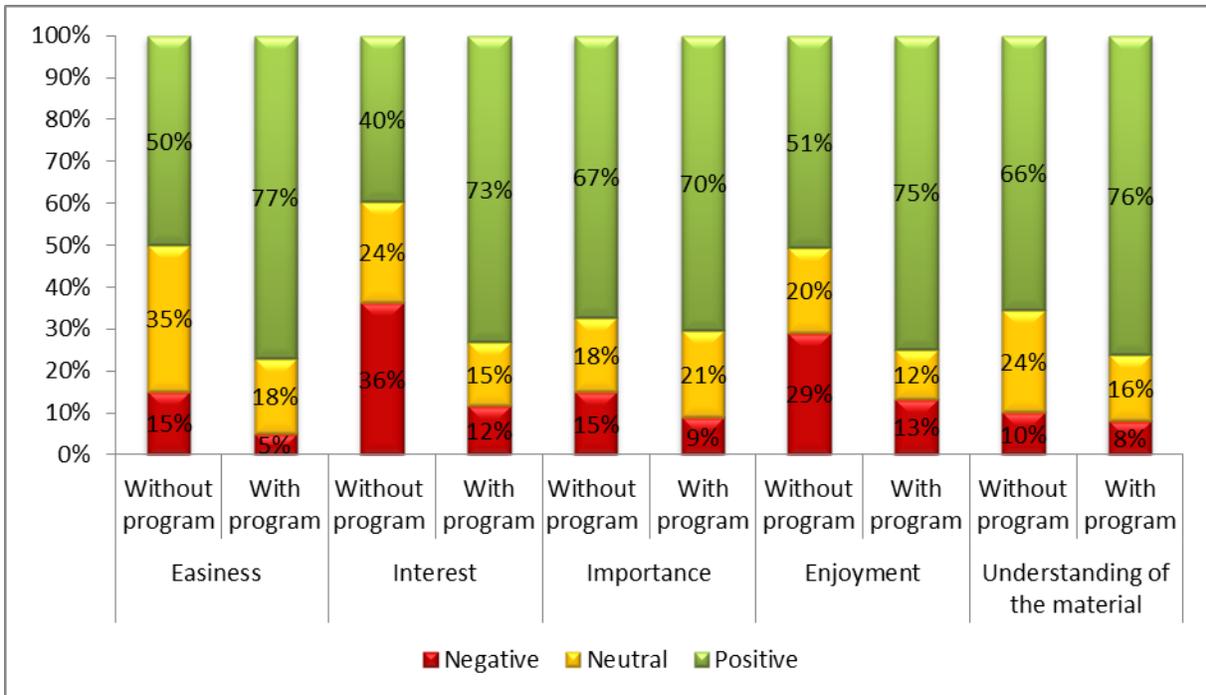
Math Classes With Matific	Very Little Agreement (1–2)	Some Agreement (3)	A Great Deal of Agreement (4–5)	Average Score	Standard Deviation
I concentrate during Matific activities.	9%	7%	84%	4.36	1.05
I generally do well at the Matific tasks.	9%	13%	78%	4.21	1.13
With Matific, I can study on my own.	11%	14%	75%	4.16	1.22
I want to study with Matific.	13%	13%	74%	4.24	1.23
I like the Matifics' activities.	14%	12%	74%	4.13	1.25
There's a pleasant atmosphere in the room during math classes that involve Matific.	17%	14%	68%	3.87	1.33
I'd prefer not to use Matific.	74%	9%	17%	1.86	1.44
I find studying with Matific to be stressful.	90%	4%	7%	1.39	1.02

As shown in Table 5, a majority of students reported that, *to a great extent*, they concentrated during program activities ($n = 113$, 84%), they felt like they were doing well ($n = 105$, 78%), they felt capable of studying independently ($n = 101$, 75%), and they enjoyed and wanted to use the program ($n = 100$, 74%). It appears that for the most part, students' attitudes toward studying math with Matific were more positive than their general attitudes toward studying math.

In response to another question, 79% of the students ($n = 109$) wanted to continue to use Matific and 15% of the students who answered the question ($n = 21$) indicated that they did not know whether they wanted to continue to use the program.

Students were presented with different statements (e.g., easy vs. difficult, interesting vs. boring) and asked to rate each item on a scale of 1 to 5 for studying math with Matific and for studying math without it.

Figure 9: Studying with Matific vs. studying without the program, according to students
(N = 155)



For all of the aspects assessed, the students’ attitudes toward studying with Matific were more positive than their attitudes toward studying without it. This included: understanding the material being taught (76% to a great extent with the program vs. 66% to a great extent without it), easiness of the material (77% with the program vs. 50% without it), level of enjoyment (75% with the program vs. 51% without it), and level of interest (73% with the program vs. 40% without it). According to *t*-tests conducted to compare the average ratings, these differences were all statistically significant, with the exception of the difference concerning the perceived importance of studying math with or without the program.

When math was taught without Matific, younger students (grades 1–3) had more positive attitudes toward the importance of studying math and more positive attitudes toward their level of understanding of the subject, as compared to students in grades 4–6. These differences were statistically significant.

5. Benefits and challenges

1. Unique aspects of the program

The teachers were presented with a list of different aspects and asked to choose which of those aspects were unique to Matific.

Table 6: Unique Aspects of the Program According to Teachers ($N = 127$)

	Number of Responses for This Item	Proportion of the Respondents (%)
Makes exercises fun	114	95
It's easy and fun to study math this way	110	92
Contributes to students' understanding of the material	93	78
Attractive design that encourages use	90	75
User-friendly (for teachers and students)	90	75
Allows students to learn through experience	85	71
Interactive nature of the program	84	70
Allows for material to be practiced in a new way	83	69
Relevance to the children's lives	80	67
Reduces math anxiety	76	63
Allows for feedback regarding students' learning in a way that doesn't involve a grade (program awards stars)	66	55

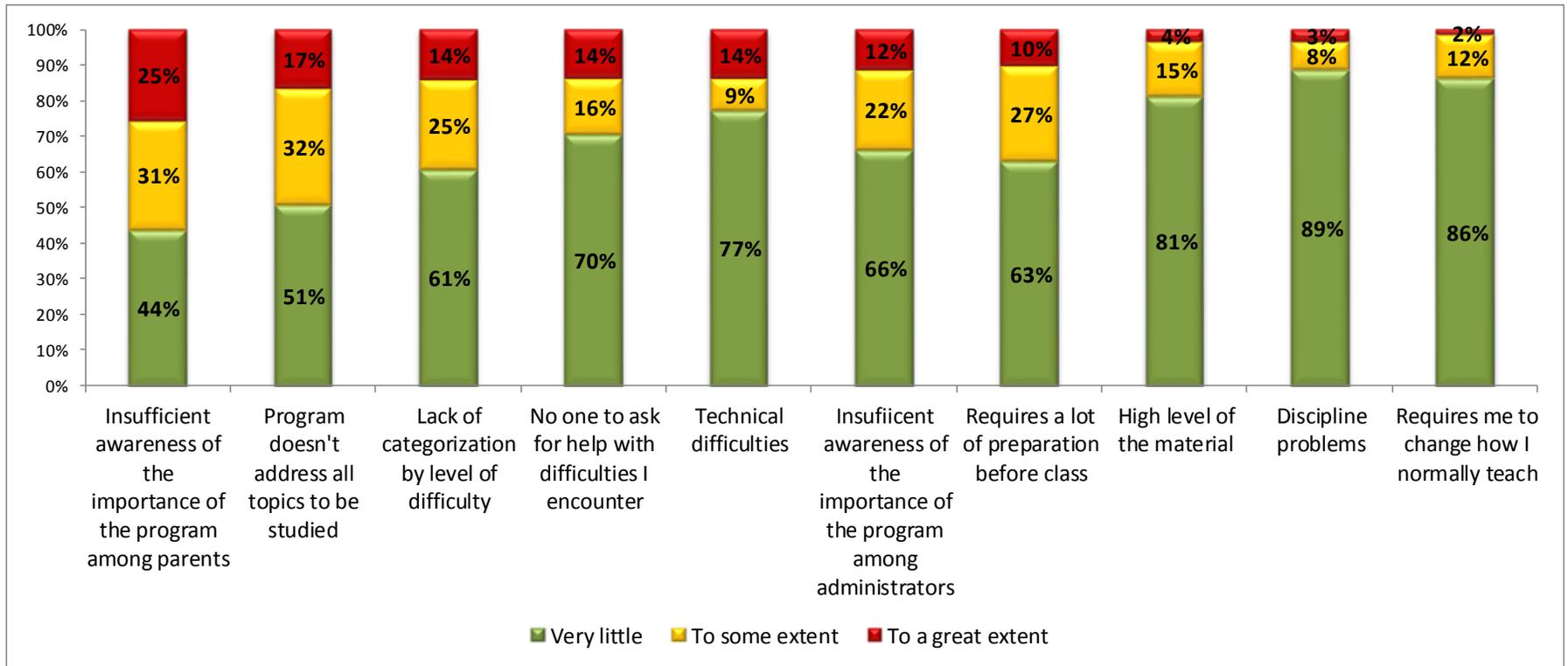
	Number of Responses for This Item	Proportion of the Respondents (%)
The website and computer program are in Hebrew	59	49
Contributes to improvements in student performance	53	44
Helps teachers to teach topics that are considered difficult to teach	38	32
Allows for problems to be solved in more than one way	26	22
Availability of support for teachers from the program staff	20	17

The teachers' responses indicated that the main unique aspects of the program were that it made doing exercises and learning fun (95% and 92%, respectively). Teachers also referred to the following as unique aspects of the program: its contribution to students' understanding of the material being taught (78%), its attractive and user-friendly design (75% each), the opportunity for students to learn through experience (71%), and the interactive nature of the program (70%). Three teachers addressed aspects related to special education and stated that they felt the program was suitable for struggling students and allowed them to learn, too.

2. Difficulties and challenges

The teachers were presented with a list of potential difficulties that might be encountered in the use of the program and were asked to note which of those difficulties they had encountered in their own work.

Figure 10: Difficulties in the use of Matific according to teachers (N = 127)



The responses from the teachers indicate that most of them did not encounter many difficulties in their use of the program. The main difficulty, which was noted as present *to a great extent* by 25% of the respondents, was that parents were not sufficiently aware of the importance of the program. A statistically significant difference was found between the teachers with different levels of experience. The teachers who were in their first year of using the program gave ratings of *to a great extent* to difficulties related to the (too) high level of the material and the lack of categorization by level of difficulty more often than the more experienced teachers.

In response to an open-ended question, some of the teachers mentioned technical difficulties, such as difficulty entering the program with a password and creating user profiles (8 teachers). The teachers also noted areas for improvement, mainly: increasing the variety of practice material, evaluation tasks, games, and topics (10 teachers) and adapting practice exercises and evaluations to students' different levels (9 teachers).

Conclusion

The findings of this evaluation indicate that the attitudes of teachers and students toward Matific are generally positive and also show the benefits of Matific, including its contribution to students' enjoyment of their studies, their comprehension of the material, and their level of interest, as well as variety, enjoyment, and interest in teaching, and the relevance of the instruction for students. However, it appears that Matific is not used in classrooms very frequently, but rather only once every week or two. This is despite the fact that half of the teachers did not face any barriers to their use of the program. In addition, it appears that a majority of the teachers were not familiar with the *Teacher's Manual* and some were not aware of how they could use performance reports generated by the program. If teachers were more familiar with the *Teacher's Manual* and the program's performance reports, they might use the program more often and that knowledge may also allow them and their students to further enjoy the benefits of this program.