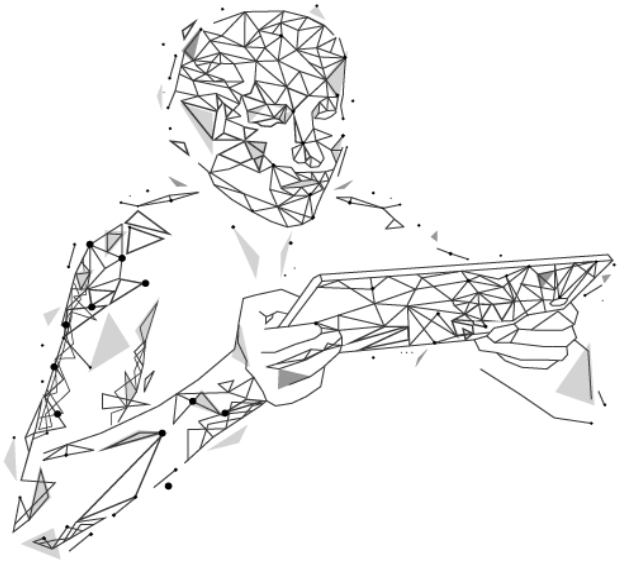
ARETE Pilot Study · Pilot 2

Country Report

Greece



The ARETE project has received funding from the European Union's H2020 research and innovation programme under Grant agreement N. 856533. Content provided and information within this report is the sole responsibility of the ARETE Consortium and does not necessarily represent the views expressed by the European Commission or its services.

About ARETE project

ARETE is an EU funded project which aims to support the pan-European interactive technologies effort both in industry and academia. It is carried out by a consortium made of the following partners: University College Dublin (UCD), CleverBooks, Words Worth Learning (WWL), Vrije Universiteit Amsterdam, European Schoolnet (EUN), Consiglio Nazionale delle Ricerche (CNR), University of Wurzburg (UNW), Vicomtech, The Open University (OU) and Durham University (UDUR).

ARETE was launched in November 2019 and will end in April 2023. During its lifetime 4 pilot studies have been carried out to achieve the below main objectives:

- Develop and evaluate the effectiveness of an interactive AR content toolkit;
- Apply human-centred interaction design for ARETE ecosystem;
- Pilot and evaluate the effectiveness of AR interactive technologies;
- Pilot and evaluate the effectiveness of AR interactive technologies.

In charge of the deployment of Pilot 1, 2 and 4, European Schoolnet supported the establishment of pilots' requirements, recruited teachers for the studies, and supported them along the entire deployment of the research: from pre-testing to post-testing.

About Pilot 2

Within ARETE, Pilot 2 focused on STEM: its aim was to study the effects of Cleverbooks (CLB) interactive Augmented Reality (AR) solutions to teaching and learning Mathematics and Science with primary school students typically underperforming in Mathematics and Science tests.

Within it, European Schoolnet supported the definition of the requirements for the study, mediating between the needs for a sound research methodology and the reality of classroom implementation. It recruited teachers, trained them to conduct the study and coordinated all teachers' activities linked to Pilot 2 deployment during the 2021-2022 school year.

To measure the efficiency of the Augmented Reality (AR) solutions under analysis, teachers were divided into two groups i.e., an intervention group, which employed the AR solutions, and a control group which did not.

Country report

In the following pages, you will find the reports briefly presenting the results of Pilot 2 per teacher/class for your country. The reports are anonymous, given that the study was conducted according to strict ethical criteria, and teachers as well as students are only presented using codes. The research and data analysis were conducted by the University of Wurzburg, with reference to the pedagogical aspects of the AR solution proposed, and by the University of Durham concerning the elements of human interaction.

Summary

In total, 62 math teachers and 52 science teachers took part to Pilot 2: teachers and their students were distributed among the following eleven countries: Croatia, Greece, Italy, Poland, Portugal, Republic of Moldova, Romania, Serbia, Spain, Sweden and Turkey.

In Greece, 29 teachers from the below list of schools were involved in the study:

- 4th Primary School of Voula, Voula (Mathematics)
- 9th Primary School of Komotini, Komotini (Mathematics)
- 4th Primary School of Agios Ioannis Rentis, Athens (Science)
- 2nd Primary School of Lamia, Lamia (Mathematics)
- Ralleia Experimental Primary Schools, Piraeus (Science)
- 1st Experimental Primary School of the University of Thessaloniki, Thessaloniki (Mathematics)
- Minority school of Dokos, Komotini (Science)
- Argiri Laimou School, Gerakas (Mathematics)
- 4o Primary school of Pefki, Athens (Science)
- 3rd Primary school of Rhodes, Rhodes (Mathematics)
- 14th Primary School of Aigaleo, Athens (Science)
- Anatolia College Elementary School, Thessaloniki (Mathematics)
- 1st Primary School of Paiania, Paiania (Science)
- 15th Primary School of Nea Ionia, Nea Ionia (Mathematics)
- University of the Aegean Dep. of Primary Education (linked to the 1st Experimental Primary School of Rhodes), Rhodes (Science)

For more information on the pilots, please contact Giuseppe Mossuti, the ARETE Project Manager on behalf of European Schoolnet (giuseppe.mossuti@eun.org).

For more information on the research conducted, please contact Dr. Jennifer Tiede from the University of Wuerzburg, Germany (jennifer.tiede@uni-wuerzburg.de).

ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for:
2T131

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate mathematics teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

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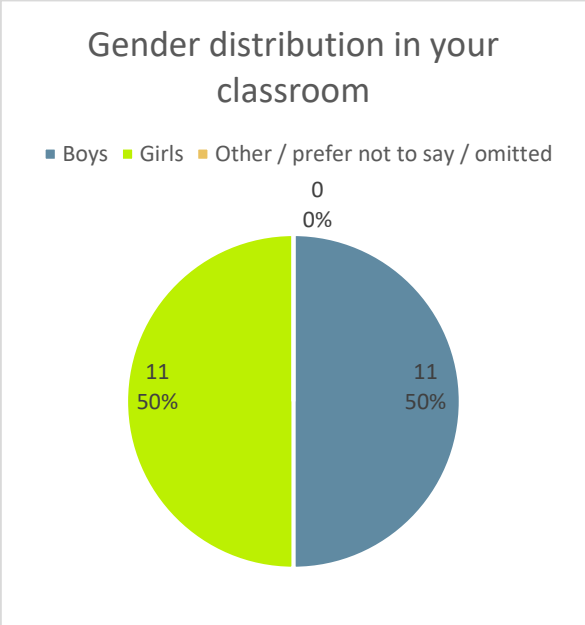

Figure 1: Gender distribution in your classroom

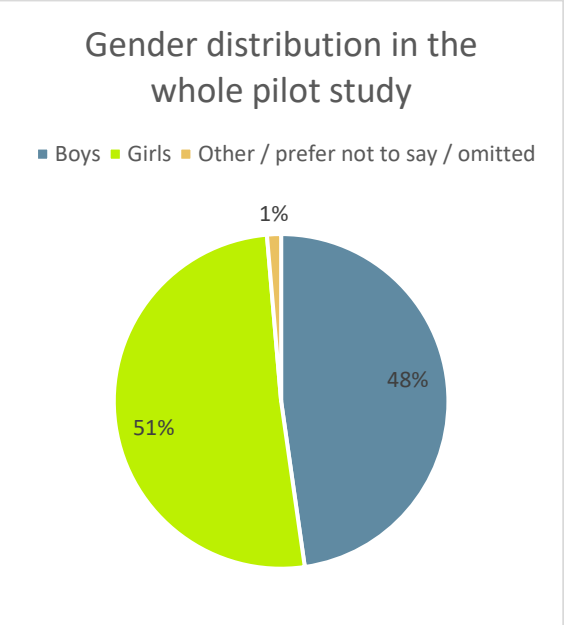

Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 27 of the 58 participating countries show no gender gap in mathematics performance? Only in 4 countries did girls outperform the boys (Mullis et al., 2020).

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' mathematical performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in mathematics on average. The 5% of students who "never" speak the test language at home scored the lowest in mathematics (ibid.). To learn more about the correlation between the children's language prerequisites and their mathematics performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).

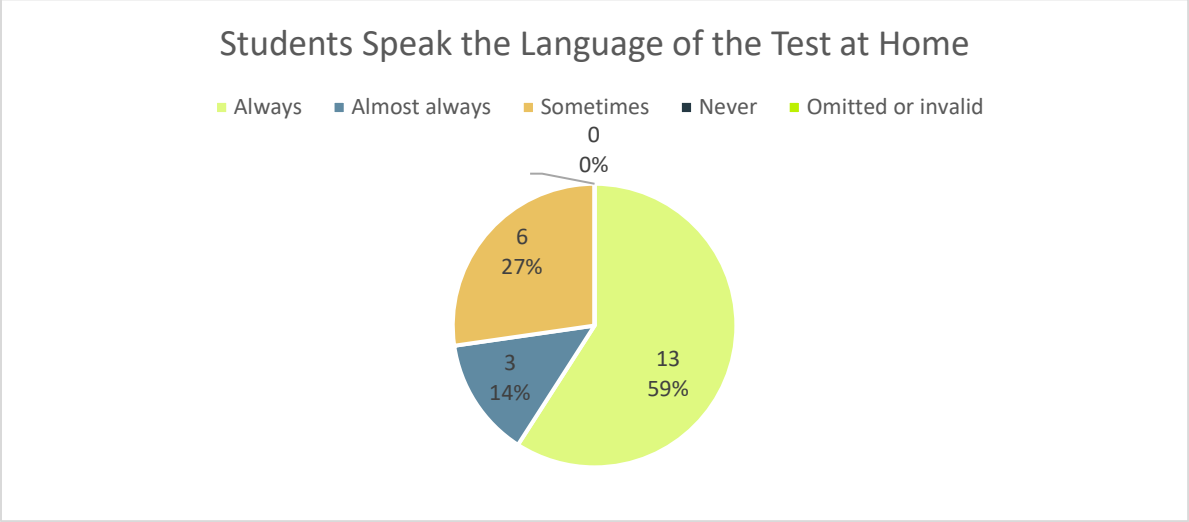

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

Research has shown that the motivation to learn on the part of the students can contribute quite decisively to learning success. Conversely, a lack of motivation can contribute to significantly poorer performance (Deci & Ryan 2009). Motivation also plays an essential role in the formation of an attitude towards a school subject (Mata et al. 2012). We asked your students about their attitudes towards mathematics as a subject.
The items, where students could agree on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I enjoy learning mathematics
- I wish I did not have to study mathematics (reverse)
- Mathematics is boring (reverse)
- I learn many interesting things in mathematics

- I like mathematics
- I like any schoolwork that involves numbers
- I like to solve mathematics problems
- I look forward to mathematics lessons
- Mathematics is one of my favorite subjects

In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

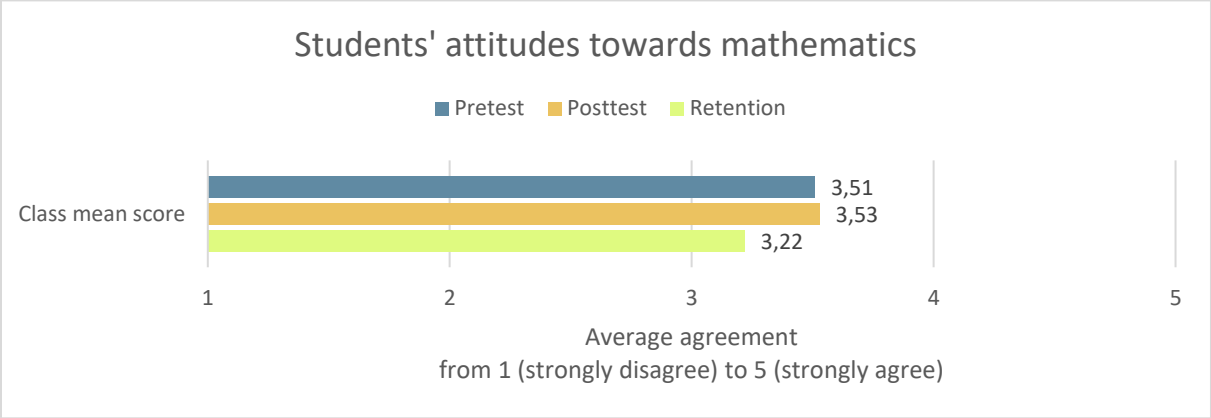

Figure 4: Students' attitudes towards mathematics (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their mathematics lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
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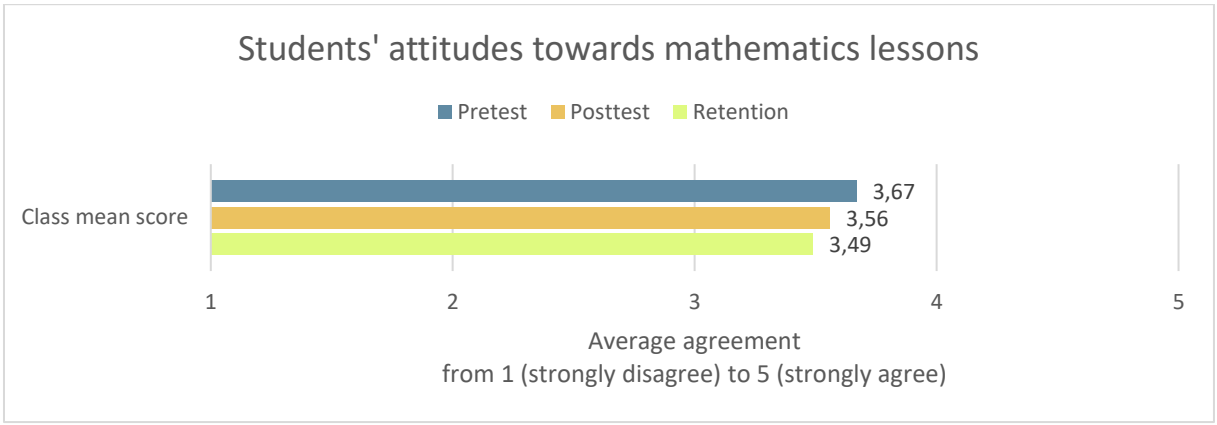

Figure 5: Students' attitudes about their mathematics lessons (pre test, post test & retention test data)

Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
The items for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree) were:

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- I am just not good at mathematics (reverse)
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- Mathematics makes me nervous (reverse)
- I am good at working out difficult mathematics problems
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- Mathematics is harder for me than any other subject (reverse)
- Mathematics makes me confused (reverse)

Are you surprised by the results? Which factors could have promoted or inhibited development?

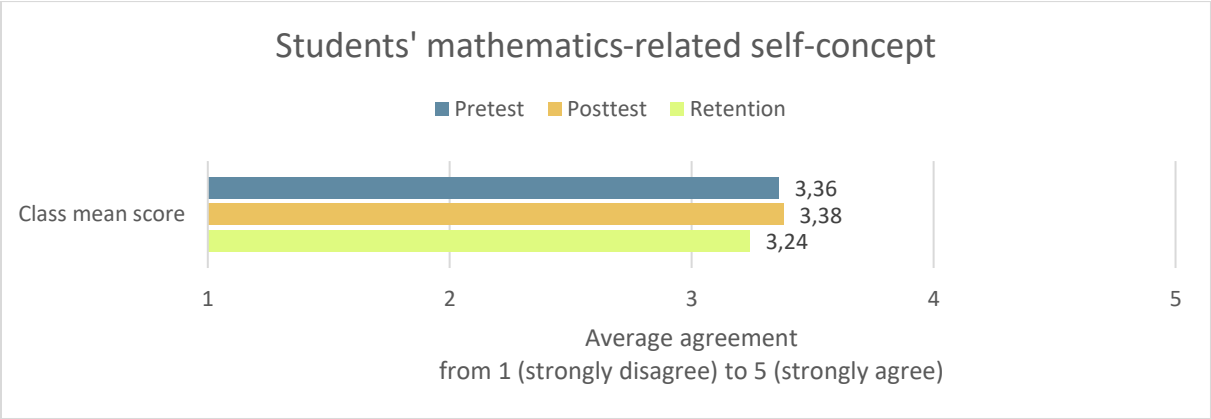

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 22 students[1])

In the pre test, the average score in your class is 45,45 % of correct answers.

In the post test, your students scored an average of 83,86 % of correct answers.

In the retention test, your class average is 89,84 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

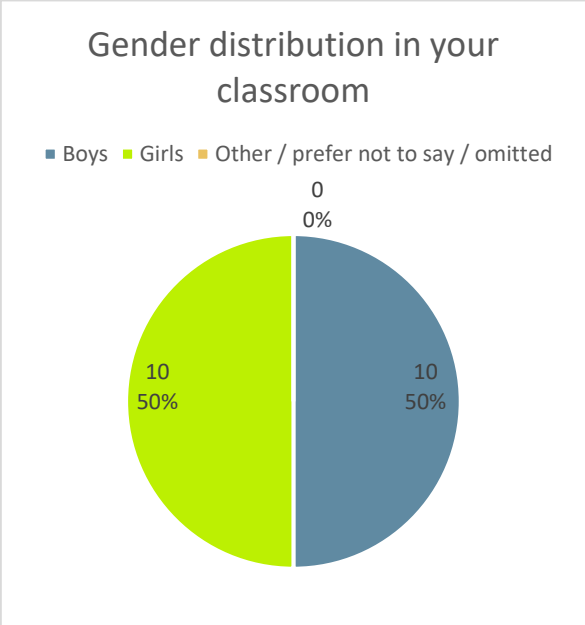
Individual Teacher Feedback for:
2T132

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate mathematics teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.



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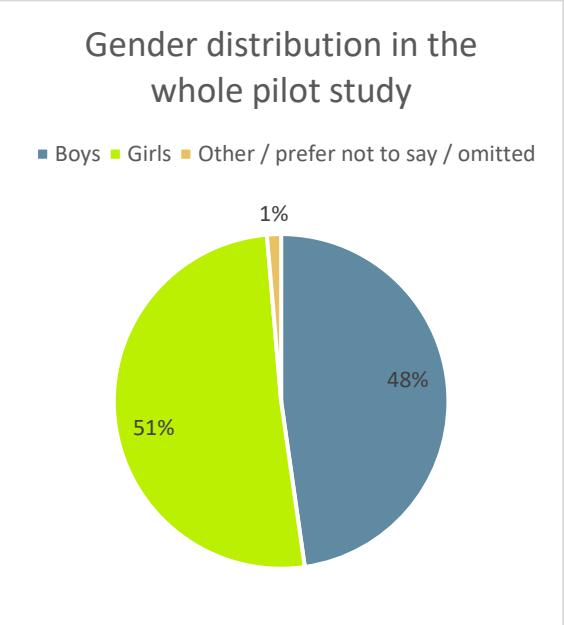


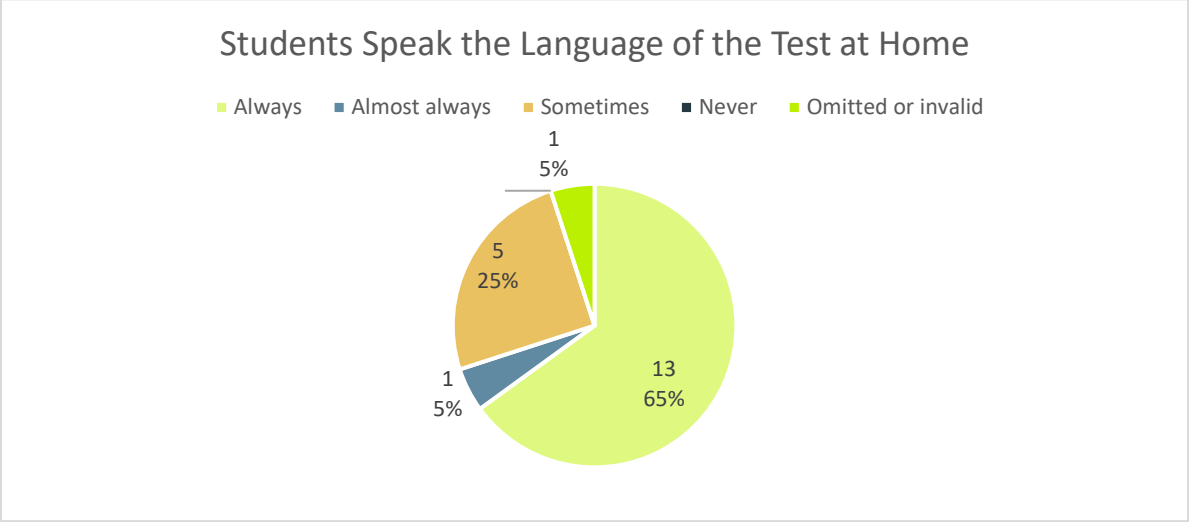
Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 27 of the 58 participating countries show no gender gap in mathematics performance? Only in 4 countries did girls outperform the boys (Mullis et al., 2020).

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' mathematical performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in mathematics on average. The 5% of students who "never" speak the test language at home scored the lowest in mathematics (ibid.). To learn more about the correlation between the children's language prerequisites and their mathematics performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).



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In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

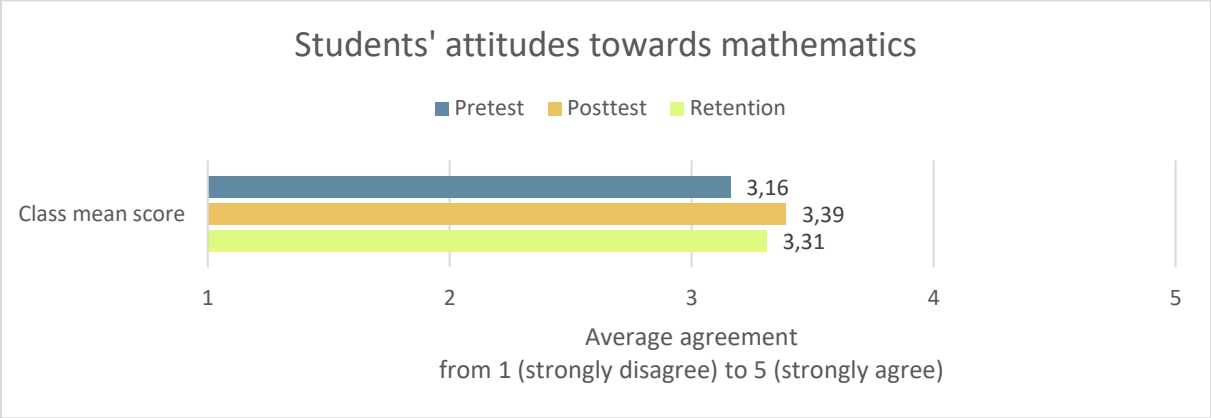

Figure 4: Students' attitudes towards mathematics (pre test, post test & retention test data)

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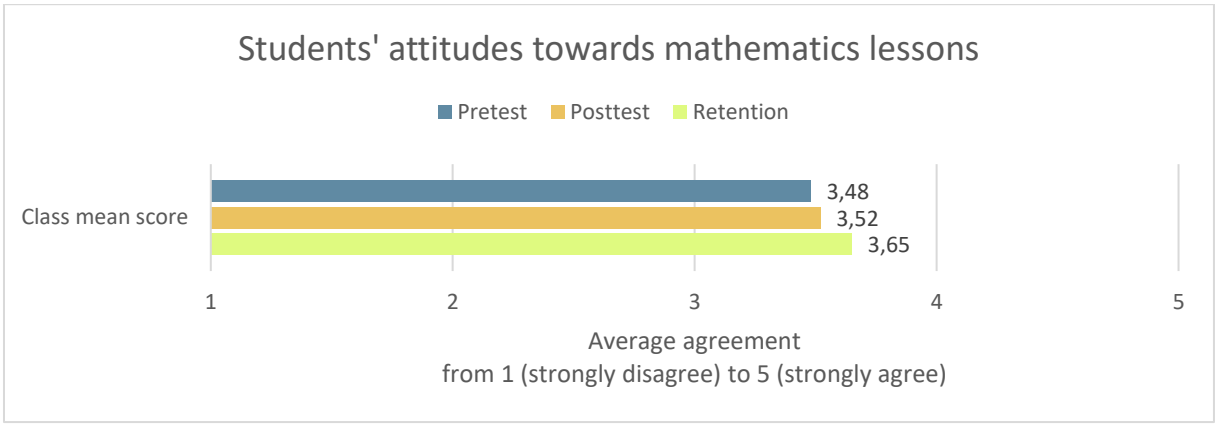

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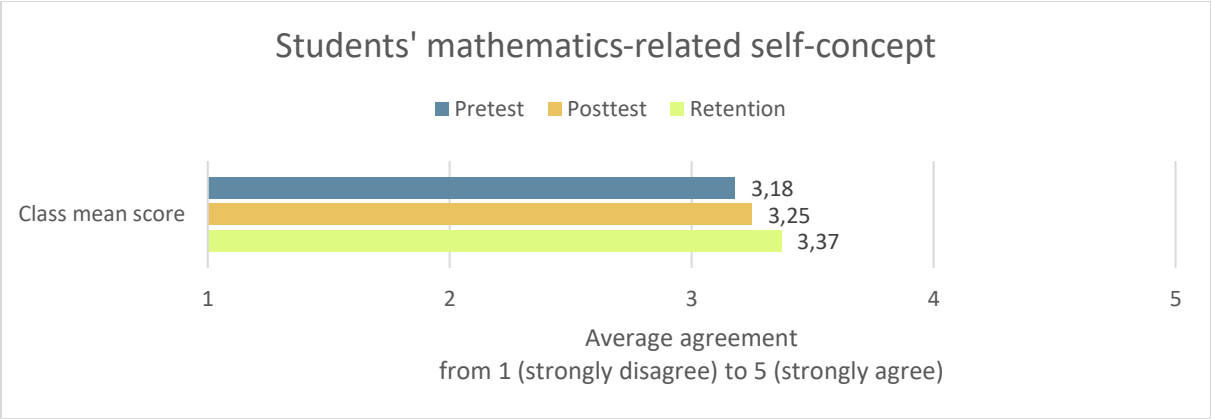

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Mean Performance of Your Class in the knowledge test (data from 19-20 students[1])

In the pre test, the average score in your class is 42,73 % of correct answers.

In the post test, your students scored an average of 54,55 % of correct answers.

In the retention test, your class average is 59,33 % of correct answers.

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

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2T141

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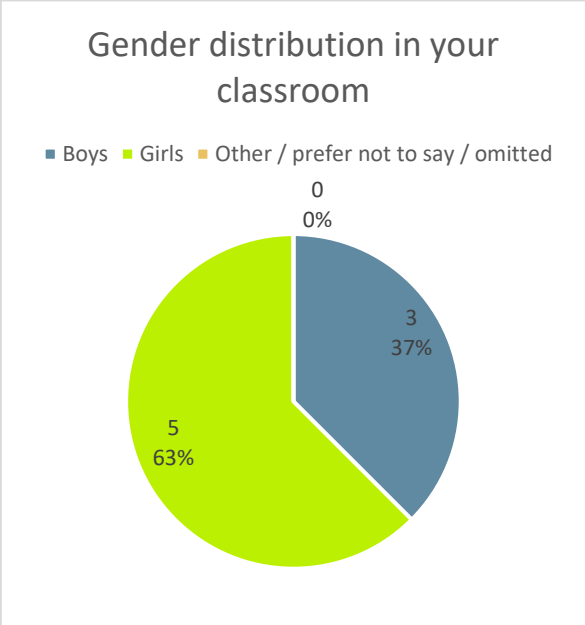

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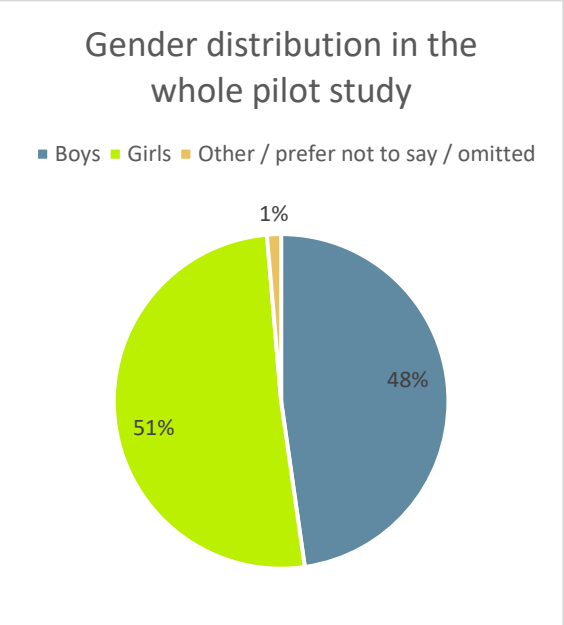

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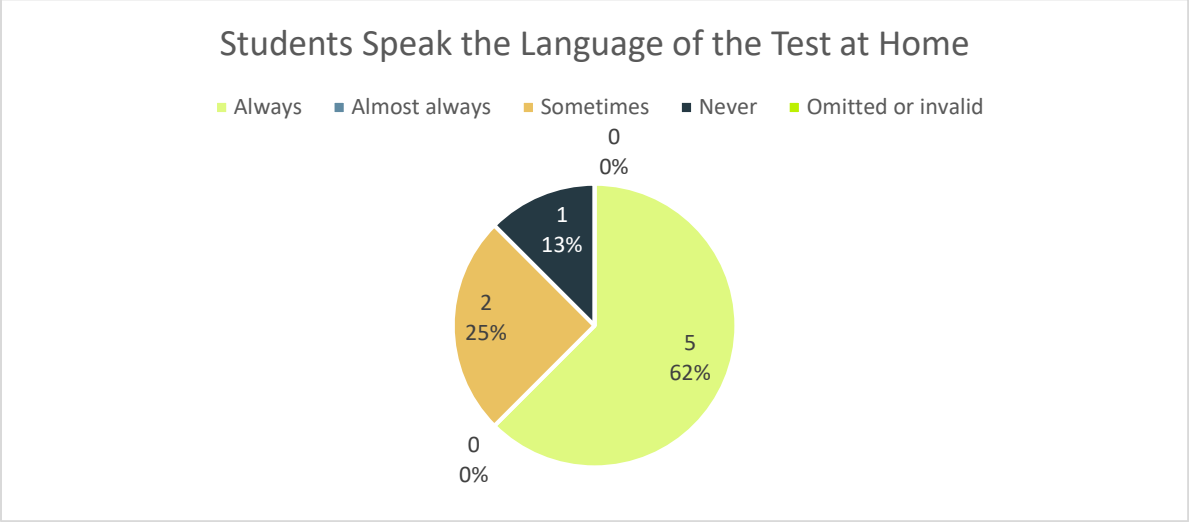

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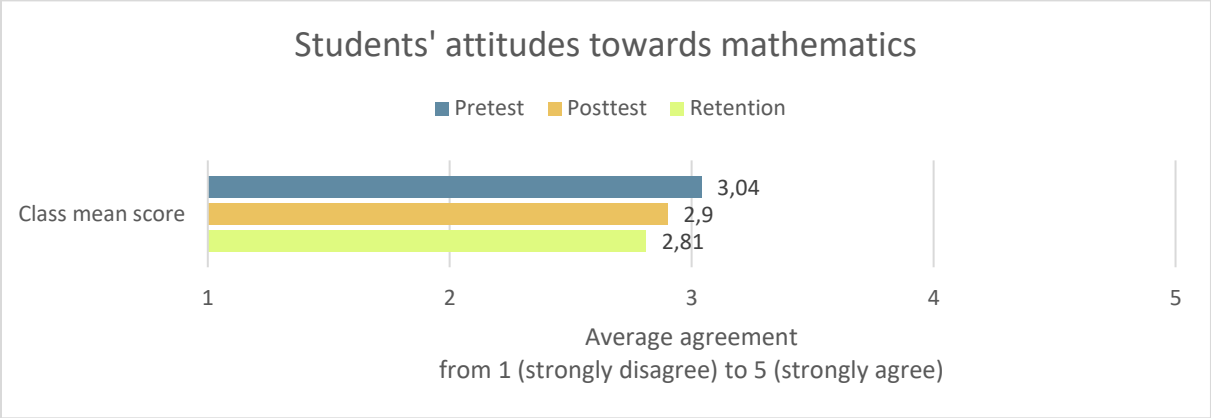

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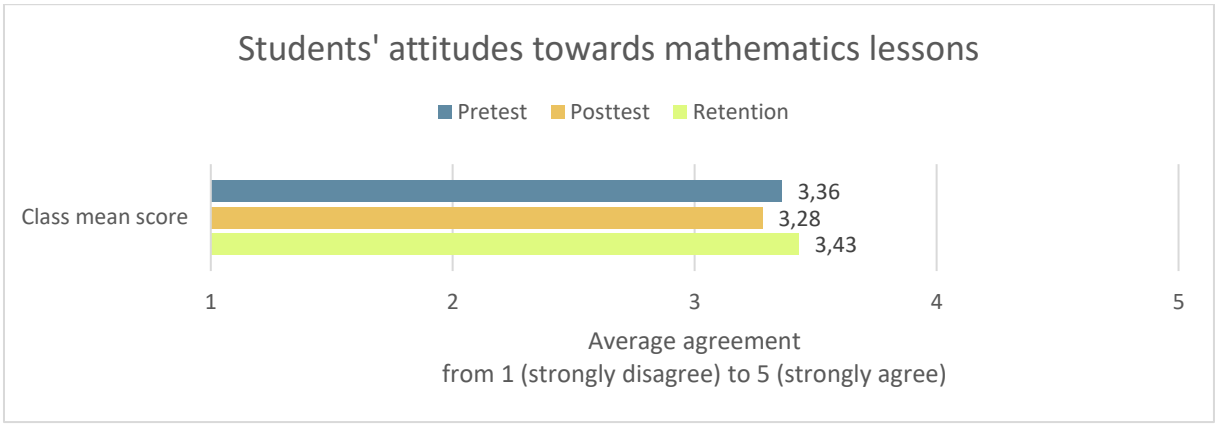

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Are you surprised by the results? Which factors could have promoted or inhibited development?

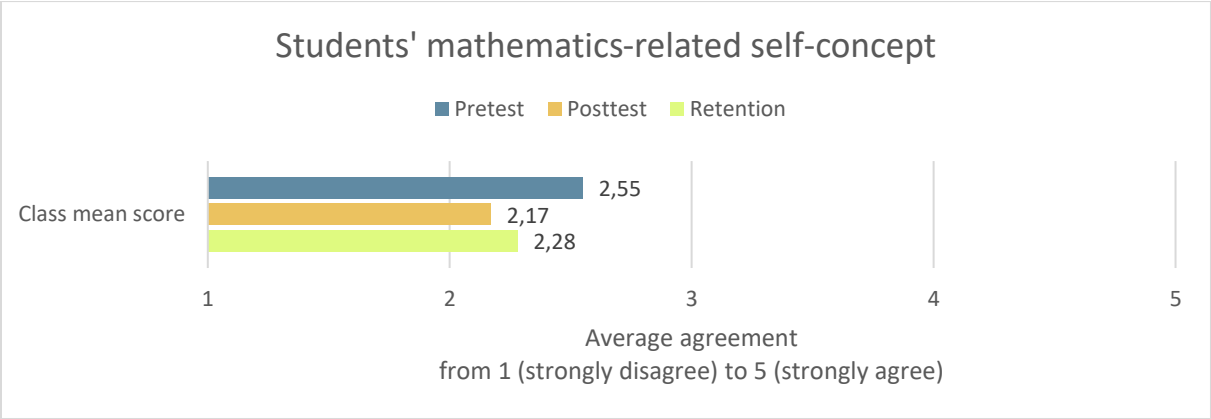

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 8 students[1])

In the pre test, the average score in your class is 55,68 % of correct answers.

In the post test, your students scored an average of 92,05 % of correct answers.

In the retention test, your class average is 92,05 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for:
2T142

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate mathematics teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.

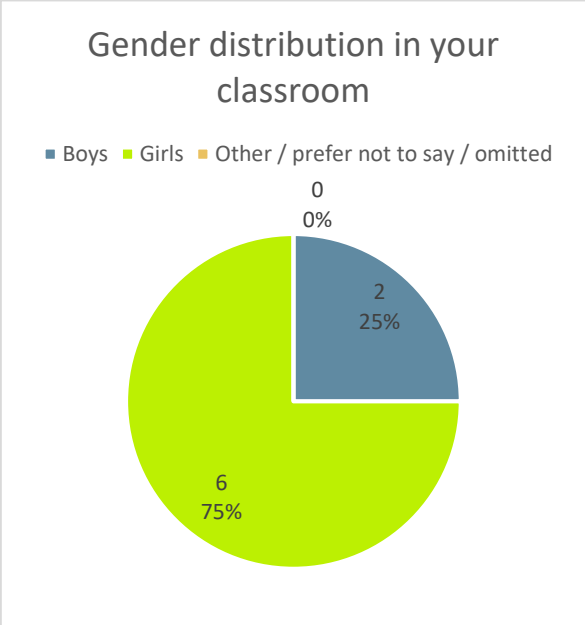

Figure 1: Gender distribution in your classroom

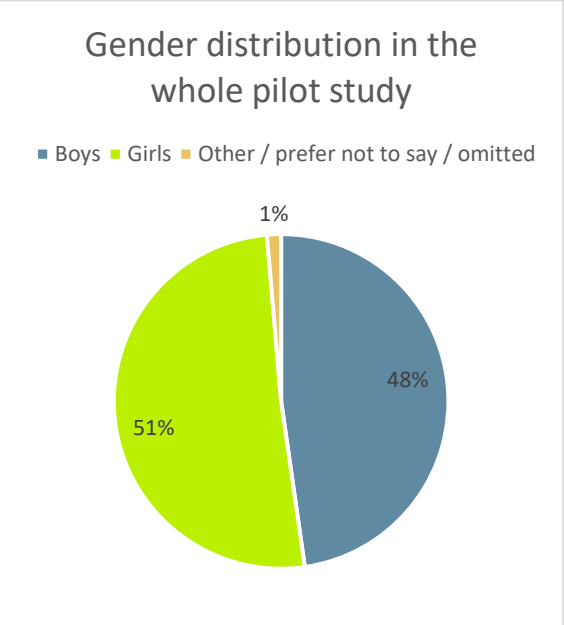

Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 27 of the 58 participating countries show no gender gap in mathematics performance? Only in 4 countries did girls outperform the boys (Mullis et al., 2020).

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' mathematical performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in mathematics on average. The 5% of students who "never" speak the test language at home scored the lowest in mathematics (ibid.). To learn more about the correlation between the children's language prerequisites and their mathematics performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).

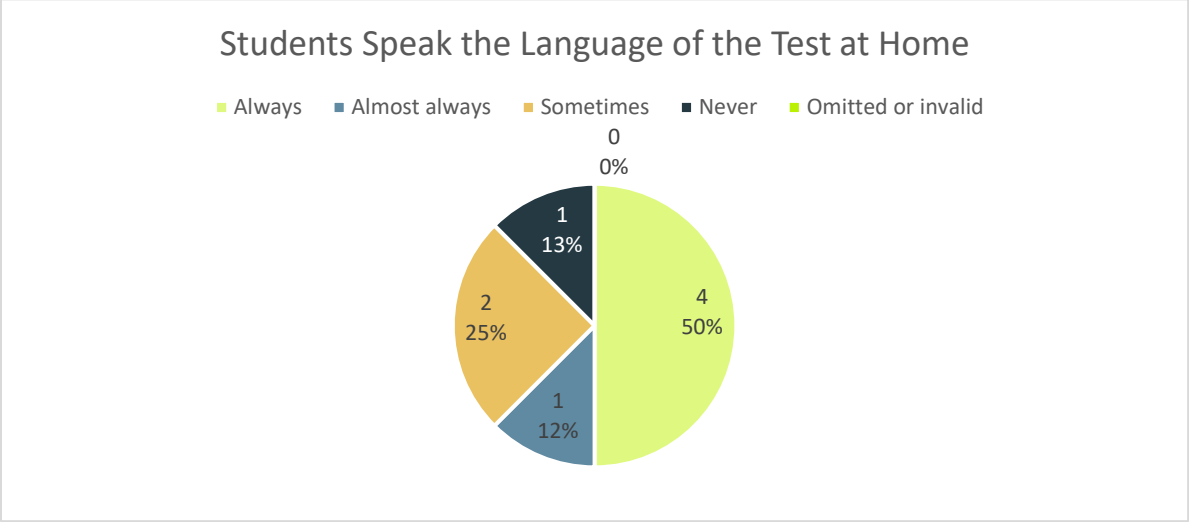

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

Research has shown that the motivation to learn on the part of the students can contribute quite decisively to learning success. Conversely, a lack of motivation can contribute to significantly poorer performance (Deci & Ryan 2009). Motivation also plays an essential role in the formation of an attitude towards a school subject (Mata et al. 2012). We asked your students about their attitudes towards mathematics as a subject.
The items, where students could agree on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I enjoy learning mathematics
- I wish I did not have to study mathematics (reverse)
- Mathematics is boring (reverse)
- I learn many interesting things in mathematics

- I like mathematics
- I like any schoolwork that involves numbers
- I like to solve mathematics problems
- I look forward to mathematics lessons
- Mathematics is one of my favorite subjects

In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

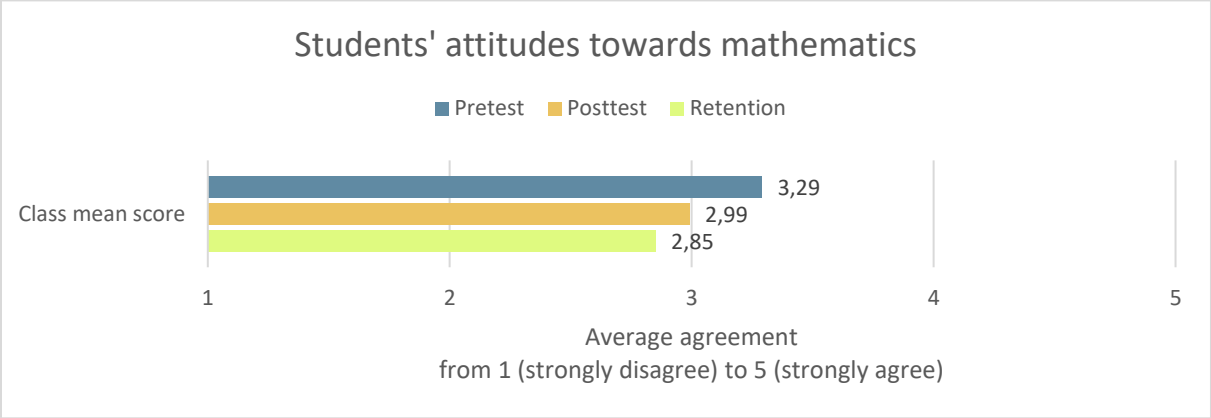

Figure 4: Students' attitudes towards mathematics (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their mathematics lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
- My teacher is easy to understand
- I am interested in what my teacher says
- My teacher gives me interesting things to do
- My teacher has clear answers to my questions
- My teacher is good at explaining mathematics
- My teacher lets me show what I have learned
- My teacher does a variety of things to help us learn
- My teacher tells me how to do better when I make a mistake
- My teacher listens to what I have to say

Did you know how your students feel about their mathematics lessons? Feel free to consider now what factors might have contributed to your students' attitude changes. Please note that your students' subjective attitudes toward your subject do not constitute an evaluation of your qualities as a teacher.

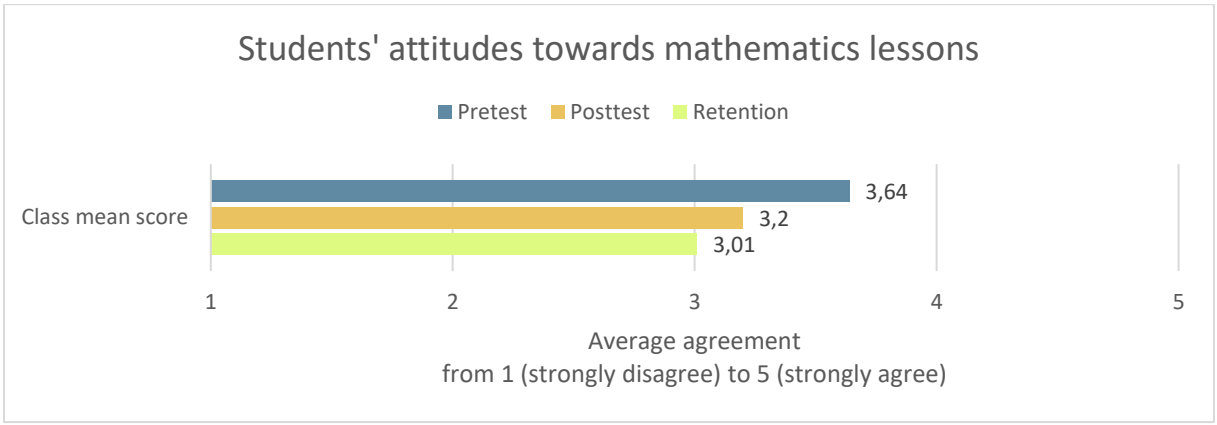

Figure 5: Students' attitudes about their mathematics lessons (pre test, post test & retention test data)

Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
The items for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree) were:

- I usually to well in mathematics
- Mathematics is harder for me than for many of my classmates (reverse)
- I am just not good at mathematics (reverse)
- I learn things quickly in mathematics
- Mathematics makes me nervous (reverse)
- I am good at working out difficult mathematics problems
- My teacher tells me I am good at mathematics
- Mathematics is harder for me than any other subject (reverse)
- Mathematics makes me confused (reverse)

Are you surprised by the results? Which factors could have promoted or inhibited development?

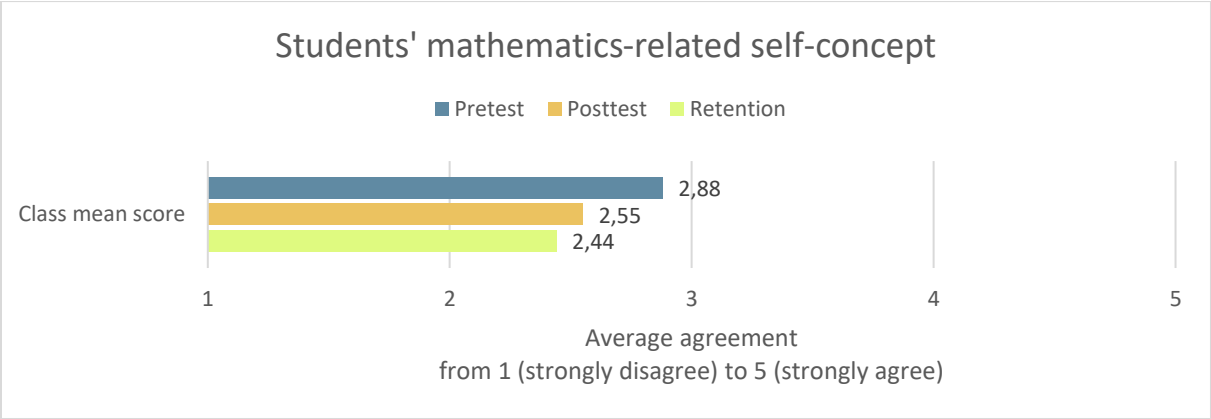

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 8 students[1])

In the pre test, the average score in your class is 54,55 % of correct answers.

In the post test, your students scored an average of 61,36 % of correct answers.

In the retention test, your class average is 63,64 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for: 2T191

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate mathematics teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.

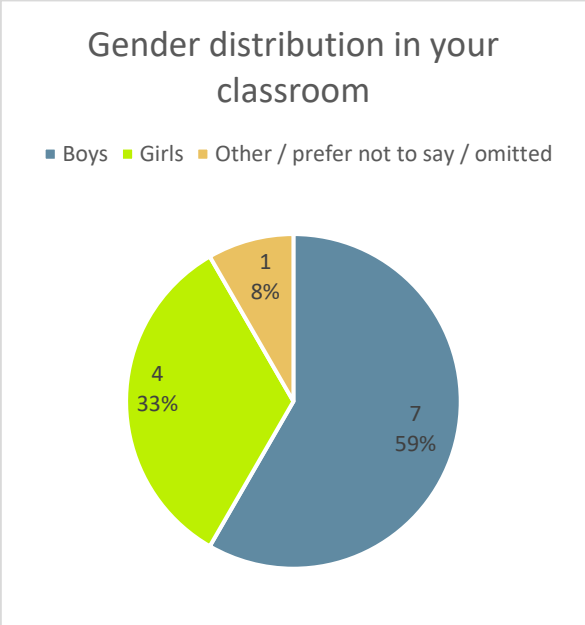

Figure 1: Gender distribution in your classroom

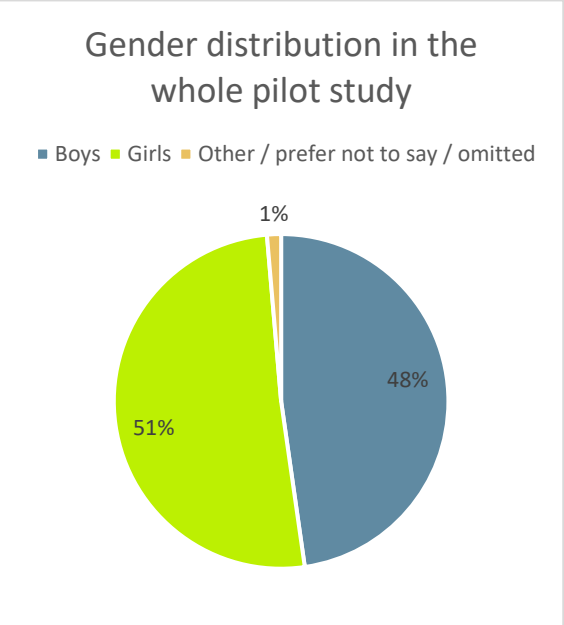

Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 27 of the 58 participating countries show no gender gap in mathematics performance? Only in 4 countries did girls outperform the boys (Mullis et al., 2020).

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' mathematical performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in mathematics on average. The 5% of students who "never" speak the test language at home scored the lowest in mathematics (ibid.). To learn more about the correlation between the children's language prerequisites and their mathematics performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).

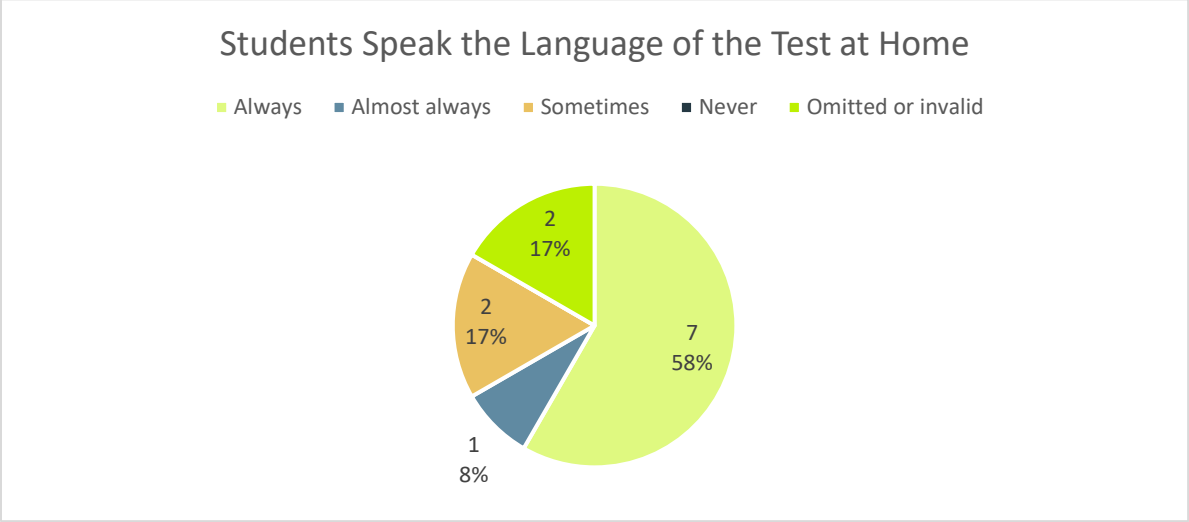

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

Research has shown that the motivation to learn on the part of the students can contribute quite decisively to learning success. Conversely, a lack of motivation can contribute to significantly poorer performance (Deci & Ryan 2009). Motivation also plays an essential role in the formation of an attitude towards a school subject (Mata et al. 2012). We asked your students about their attitudes towards mathematics as a subject.
The items, where students could agree on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I enjoy learning mathematics
- I wish I did not have to study mathematics (reverse)
- Mathematics is boring (reverse)
- I learn many interesting things in mathematics

- I like mathematics
- I like any schoolwork that involves numbers
- I like to solve mathematics problems
- I look forward to mathematics lessons
- Mathematics is one of my favorite subjects

In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

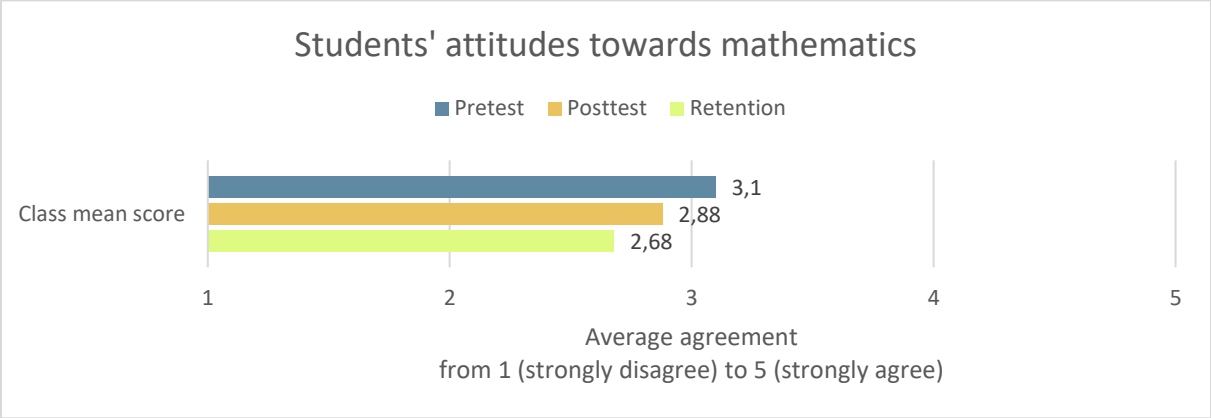

Figure 4: Students' attitudes towards mathematics (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their mathematics lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
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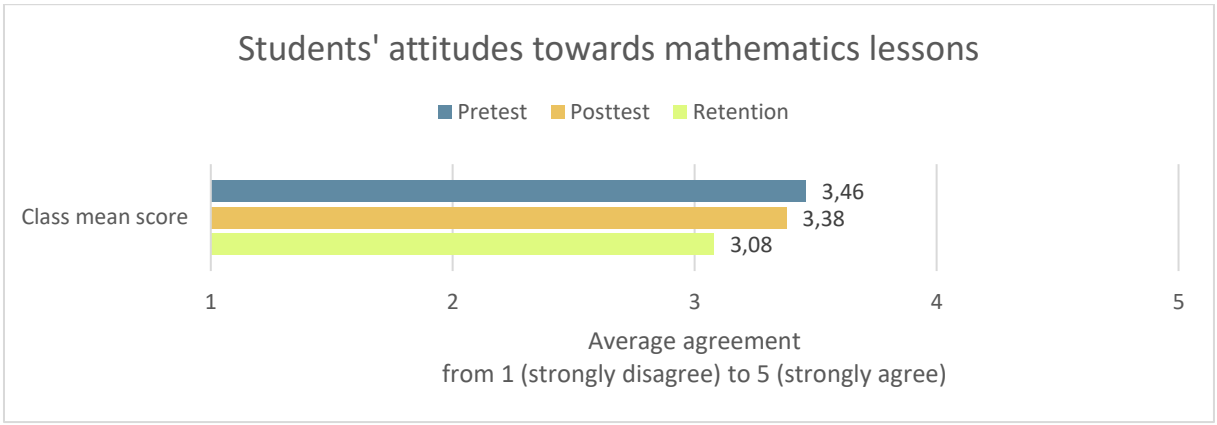

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Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
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- I am good at working out difficult mathematics problems
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Are you surprised by the results? Which factors could have promoted or inhibited development?

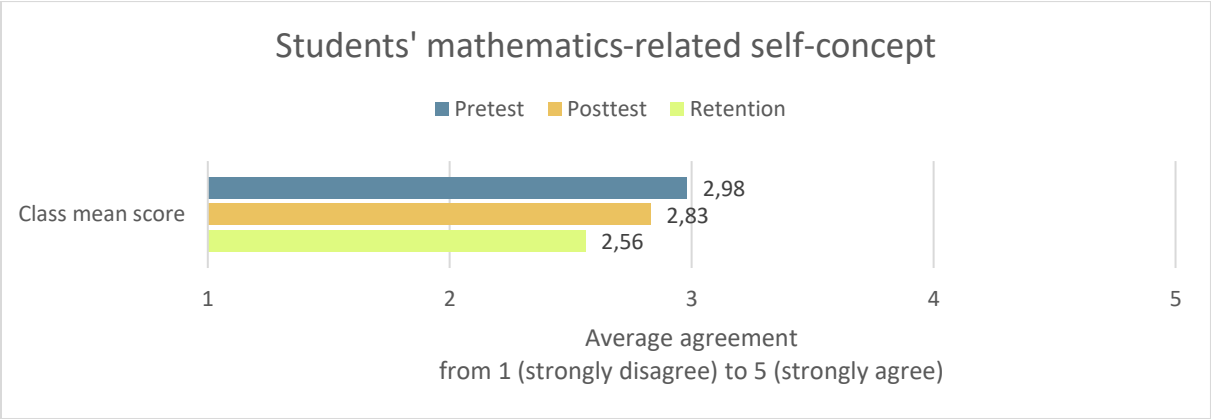

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 12 students[1])

In the pre test, the average score in your class is 55,30 % of correct answers.

In the post test, your students scored an average of 49,24 % of correct answers.

In the retention test, your class average is 65,15 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for:
2T192

Dear ARETE pilot teacher,

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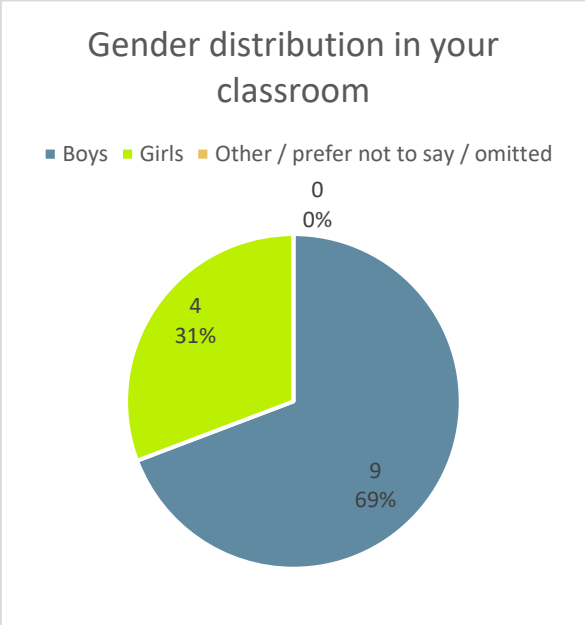
Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.



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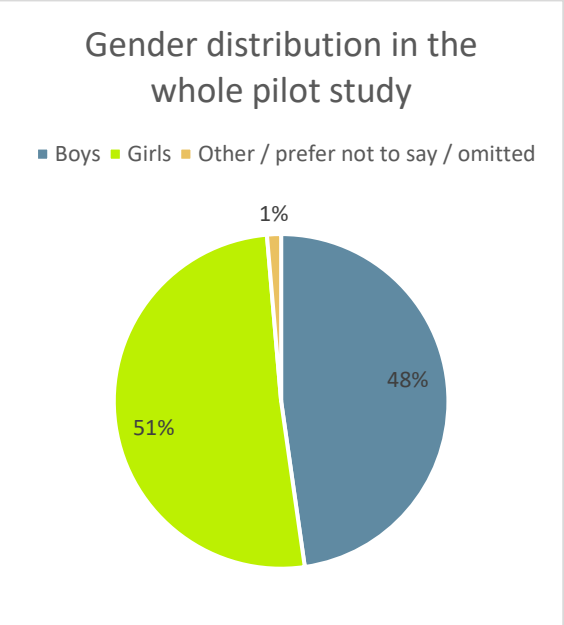

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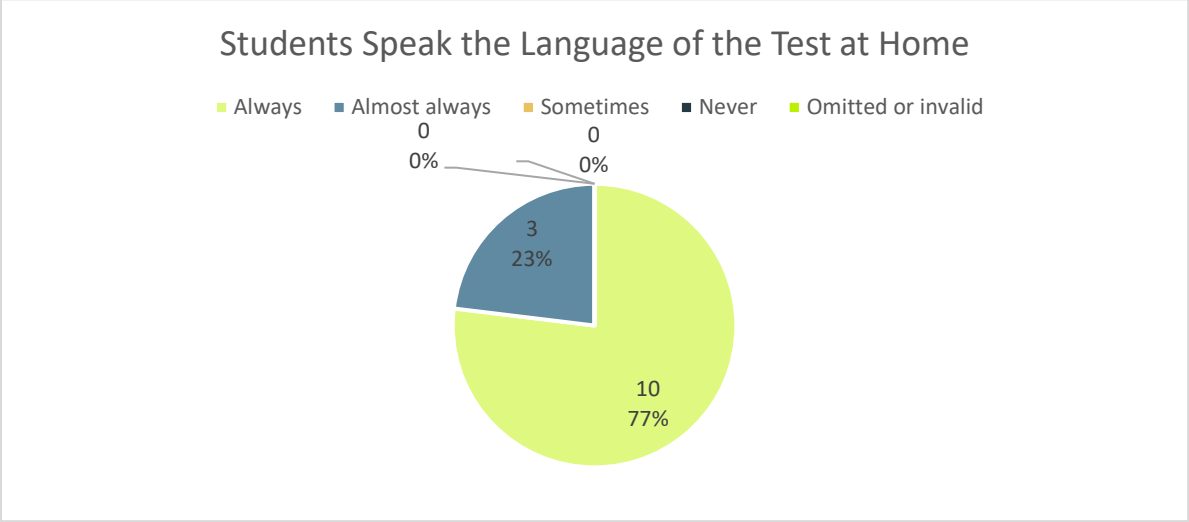

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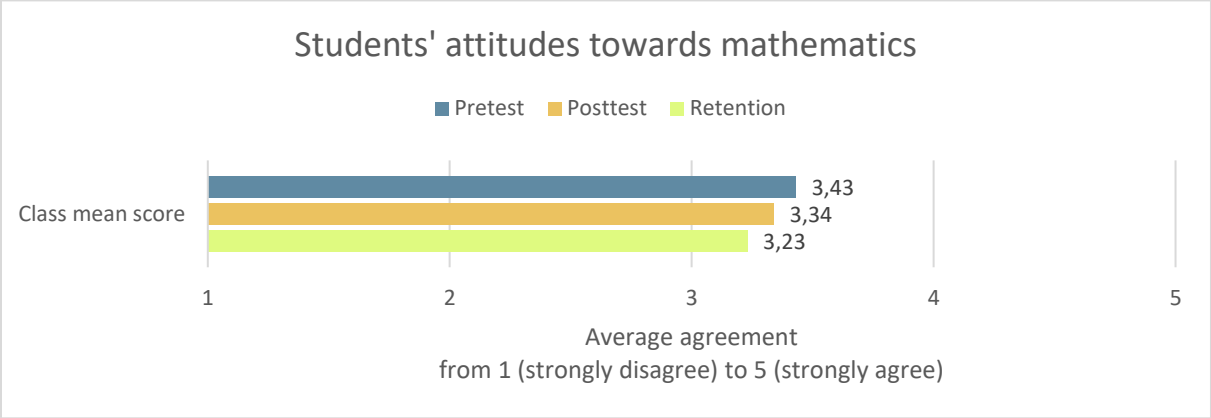

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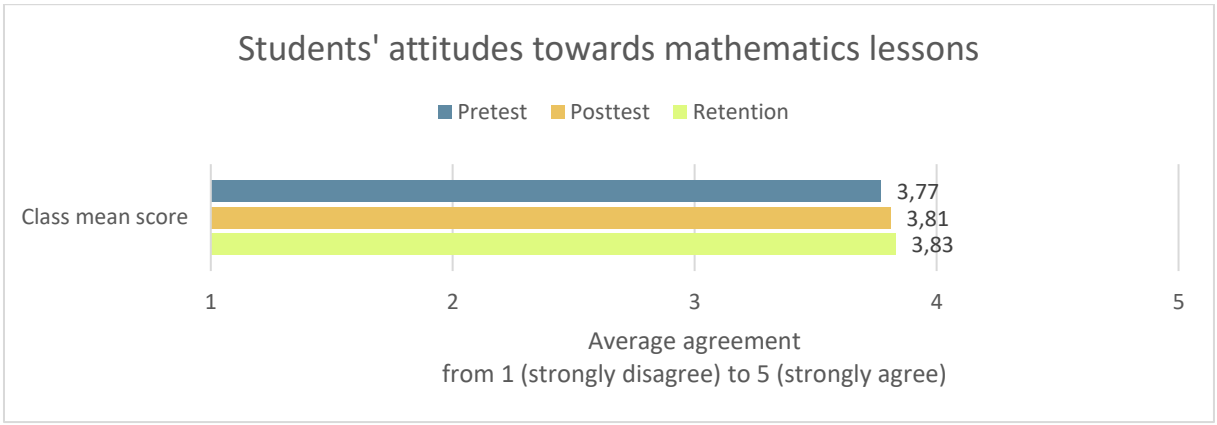

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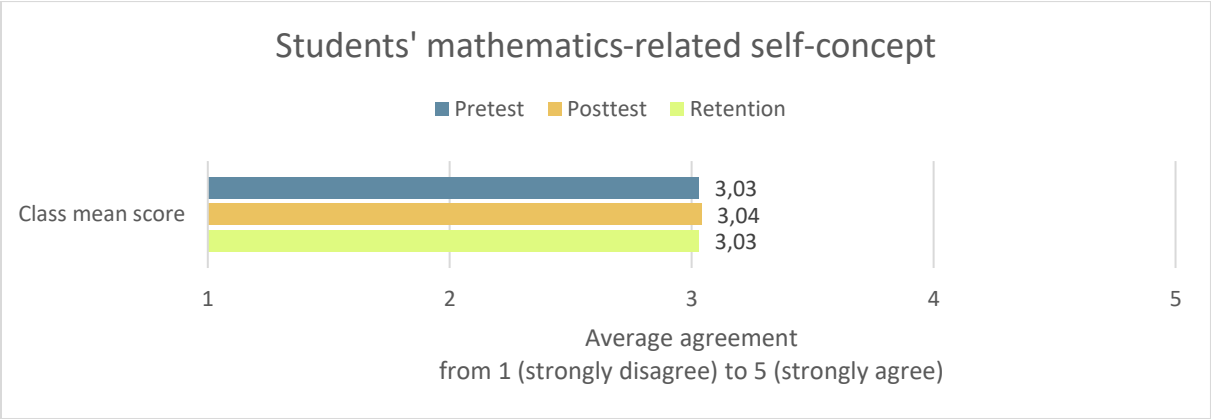

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 13 students[1])

In the pre test, the average score in your class is 57,34 % of correct answers.

In the post test, your students scored an average of 72,73 % of correct answers.

In the retention test, your class average is 71,33 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for:
2T311

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Socio-Demographic Information (according to pre test)

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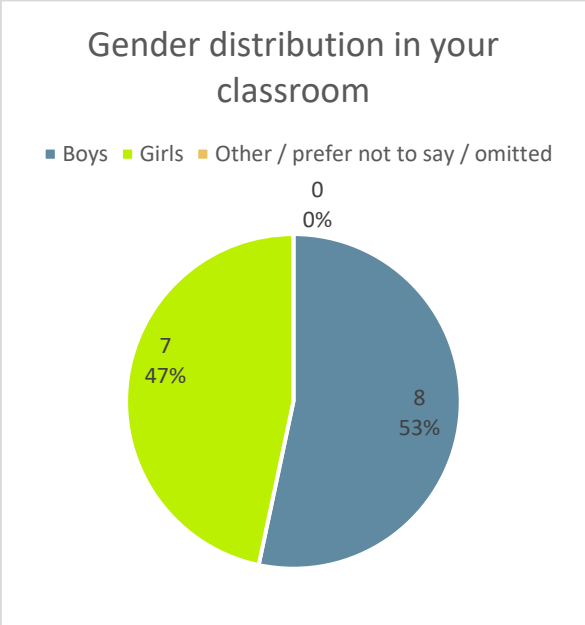

Figure 1: Gender distribution in your classroom

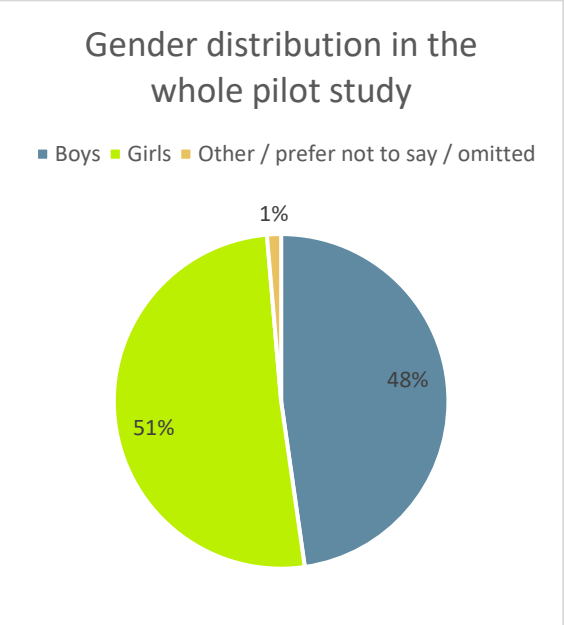

Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 27 of the 58 participating countries show no gender gap in mathematics performance? Only in 4 countries did girls outperform the boys (Mullis et al., 2020).

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' mathematical performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in mathematics on average. The 5% of students who "never" speak the test language at home scored the lowest in mathematics (ibid.). To learn more about the correlation between the children's language prerequisites and their mathematics performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).

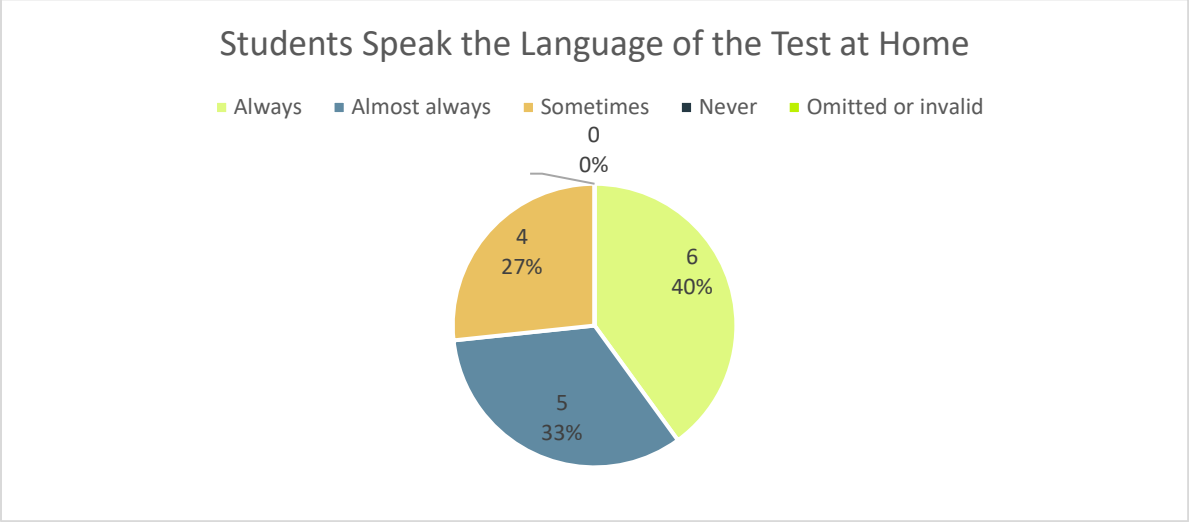

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

Research has shown that the motivation to learn on the part of the students can contribute quite decisively to learning success. Conversely, a lack of motivation can contribute to significantly poorer performance (Deci & Ryan 2009). Motivation also plays an essential role in the formation of an attitude towards a school subject (Mata et al. 2012). We asked your students about their attitudes towards mathematics as a subject.
The items, where students could agree on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I enjoy learning mathematics
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- I like any schoolwork that involves numbers
- I like to solve mathematics problems
- I look forward to mathematics lessons
- Mathematics is one of my favorite subjects

In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

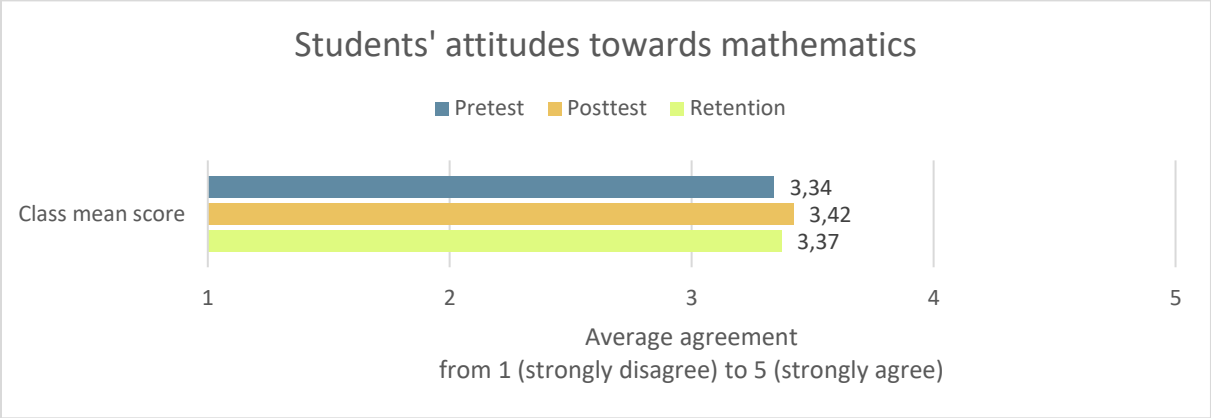

Figure 4: Students' attitudes towards mathematics (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their mathematics lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
- My teacher is easy to understand
- I am interested in what my teacher says
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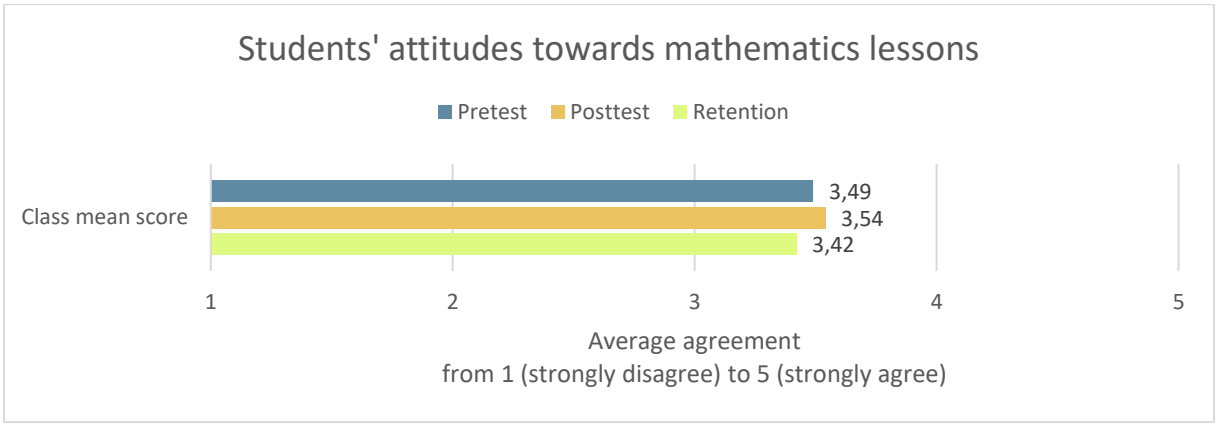

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Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
The items for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree) were:

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- I am good at working out difficult mathematics problems
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Are you surprised by the results? Which factors could have promoted or inhibited development?

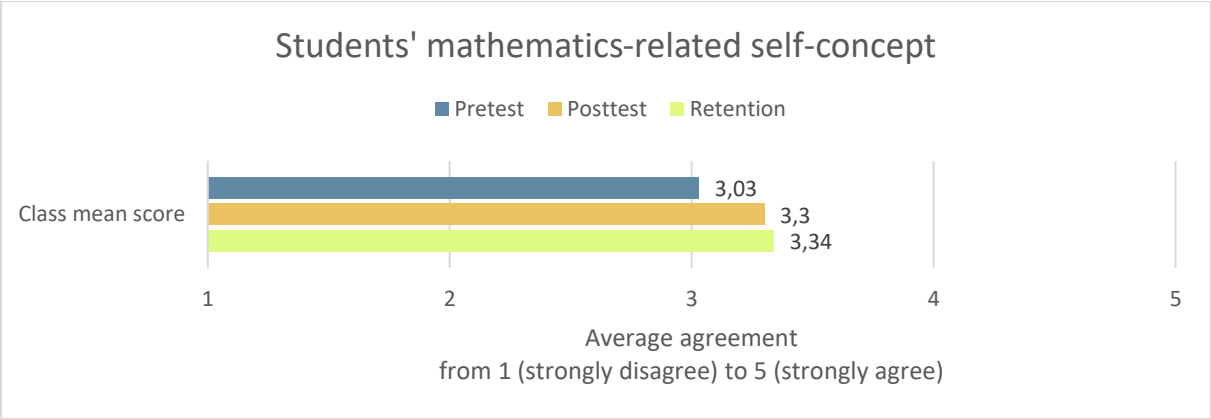

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 15 students[1])

In the pre test, the average score in your class is 49,44 % of correct answers.

In the post test, your students scored an average of 67,22 % of correct answers.

In the retention test, your class average is 77,78 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for:
2T312

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate mathematics teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

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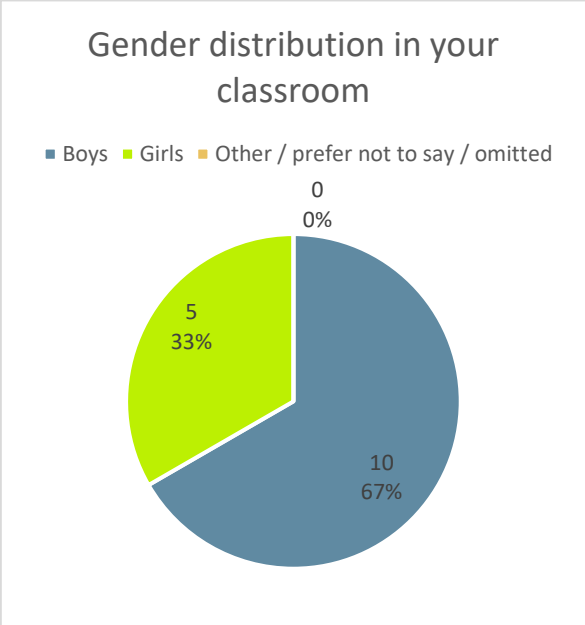
When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.



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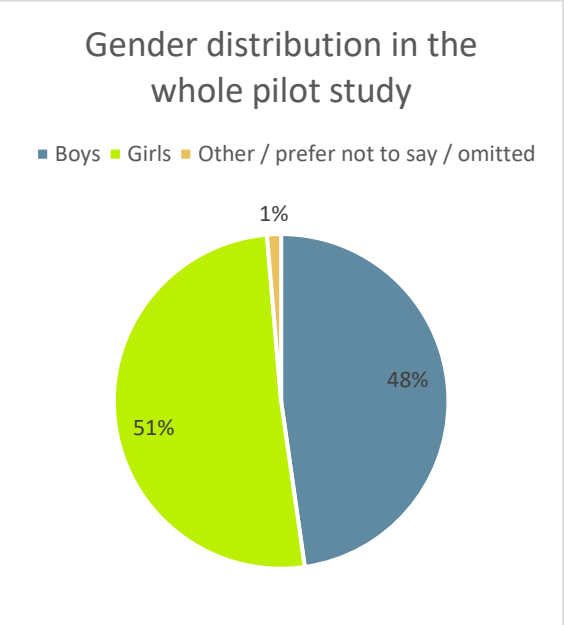

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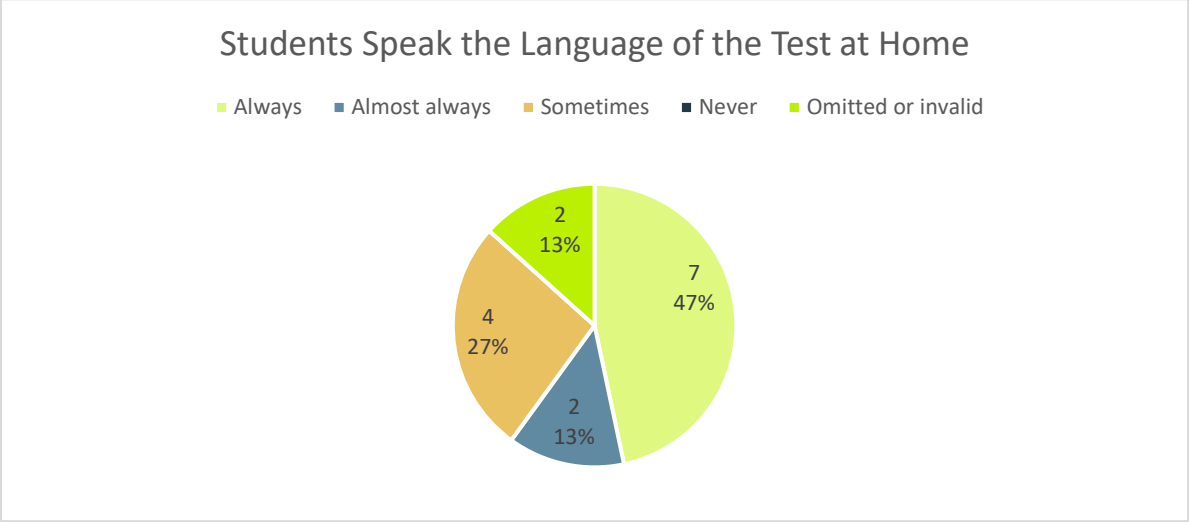

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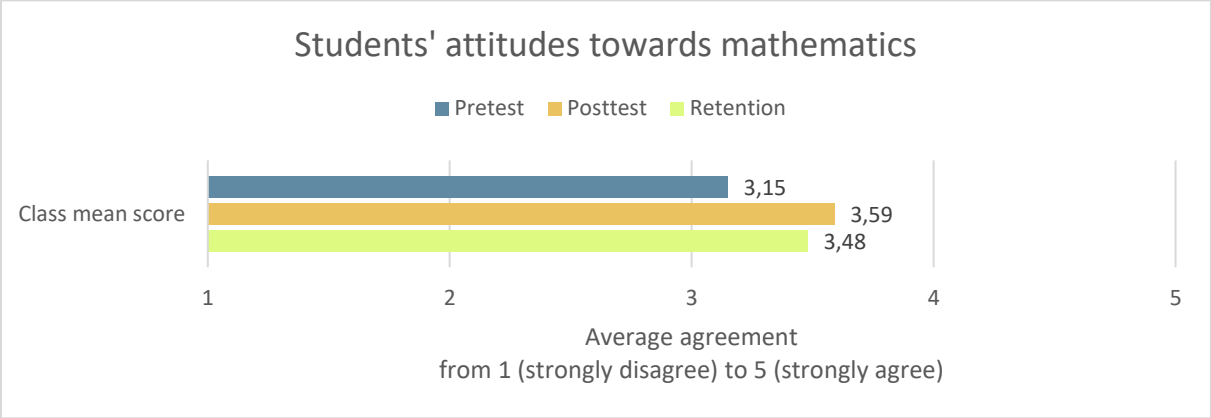

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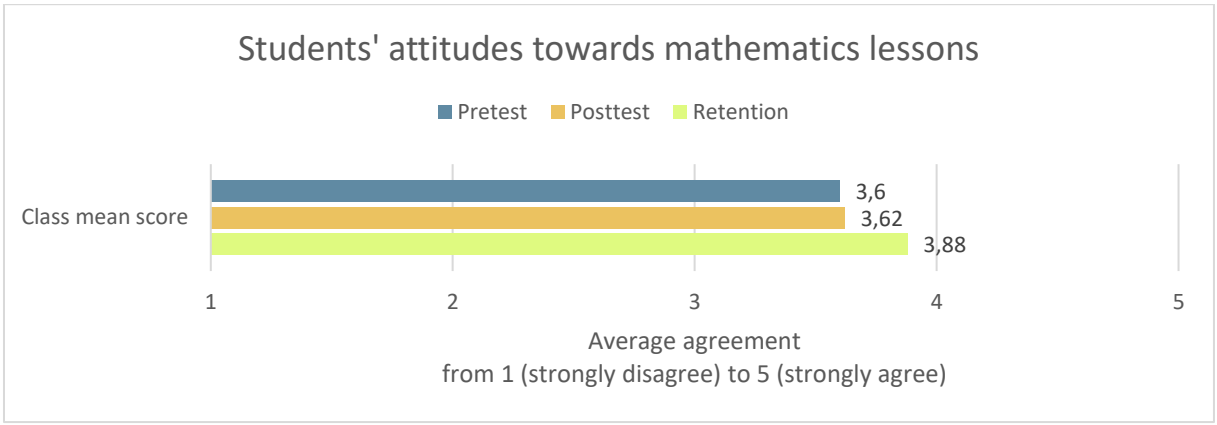

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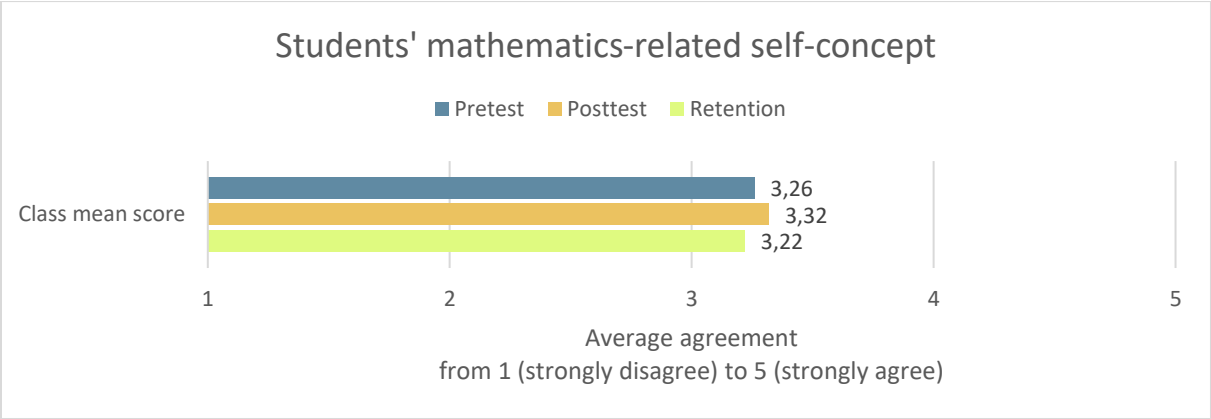

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Mean Performance of Your Class in the knowledge test (data from 15 students[1])

In the pre test, the average score in your class is 52,78 % of correct answers.

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In the retention test, your class average is 62,78 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for:
2T371

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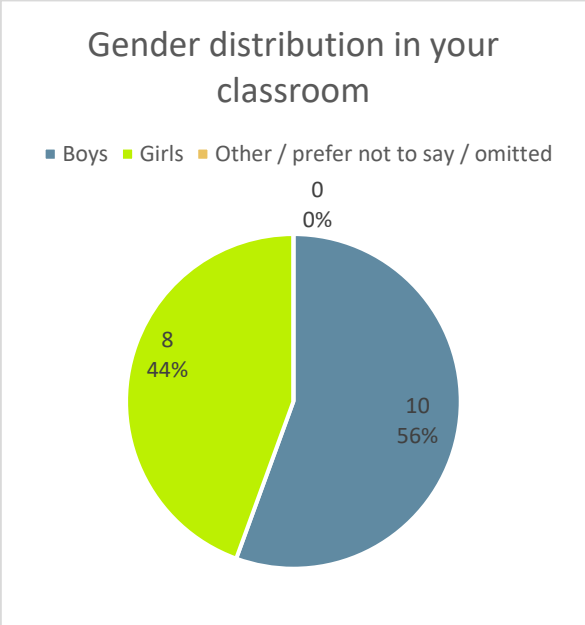

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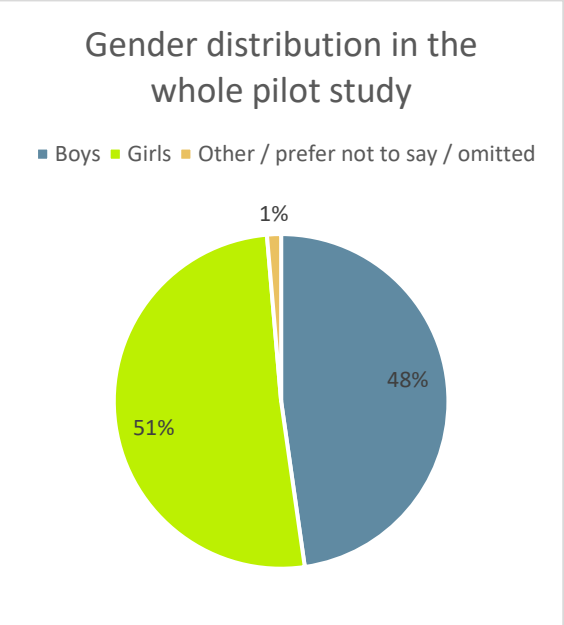

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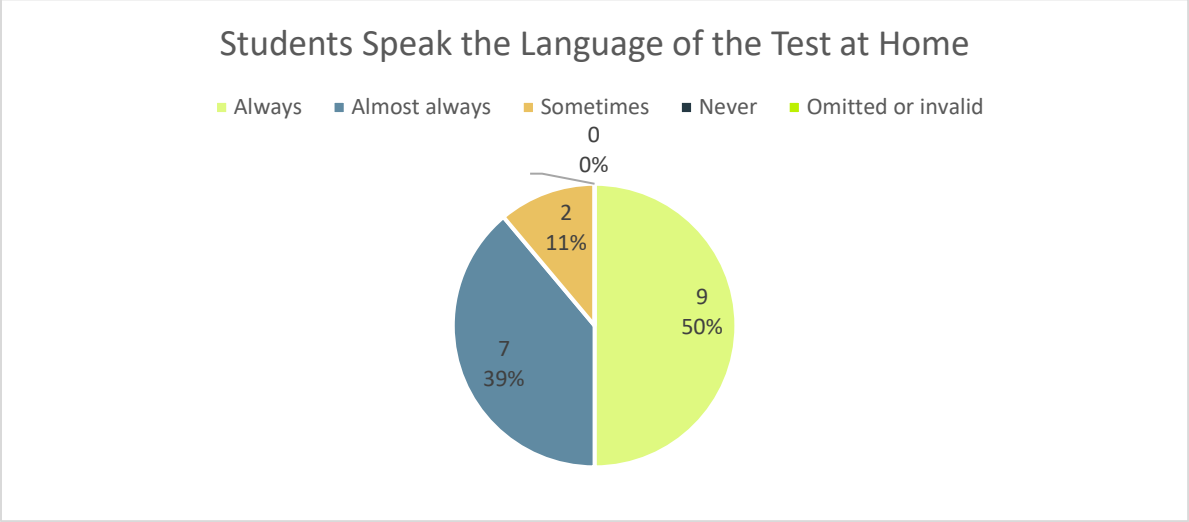

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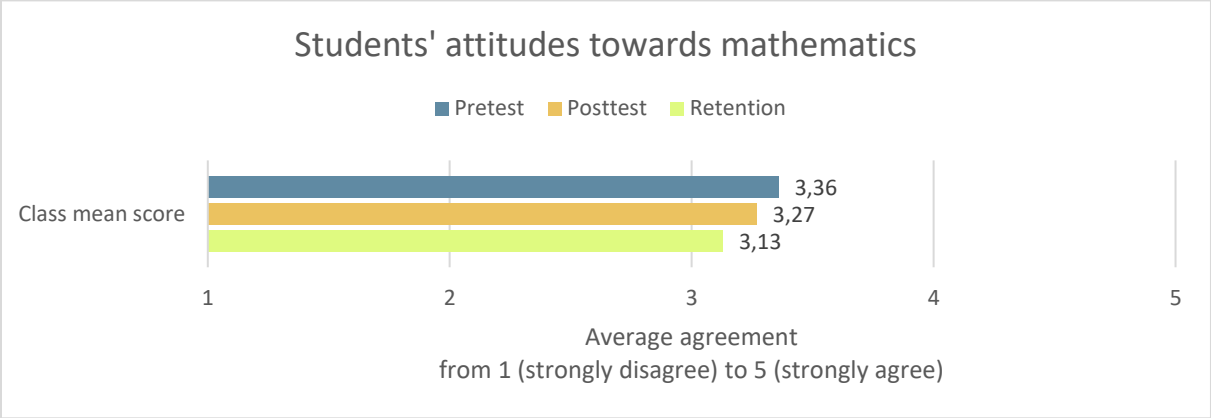

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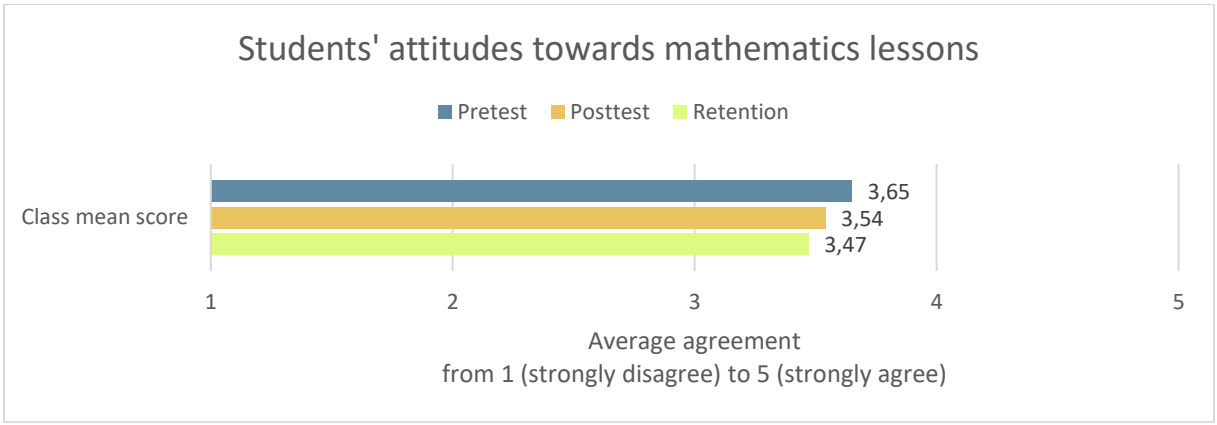

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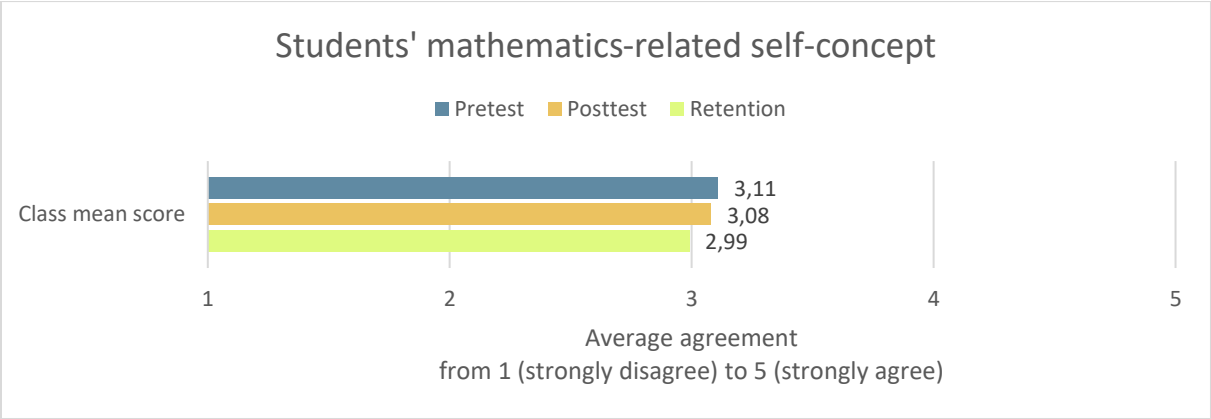

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 18 students[1])

In the pre test, the average score in your class is 84,85 % of correct answers.

In the post test, your students scored an average of 89,39 % of correct answers.

In the retention test, your class average is 89,90 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for:
2T372

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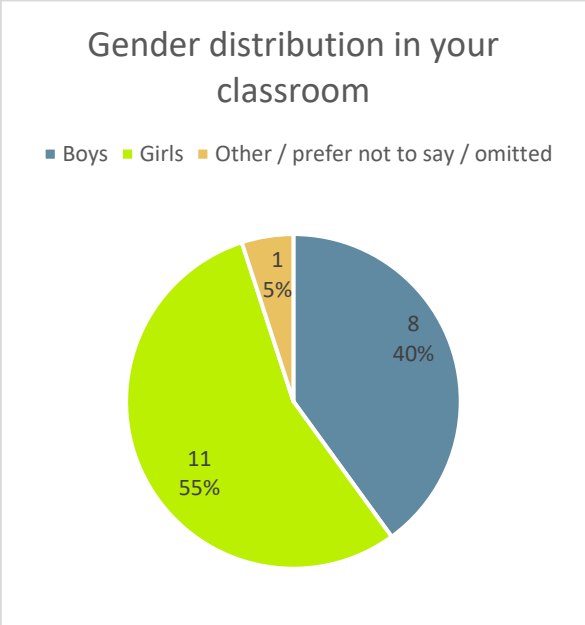

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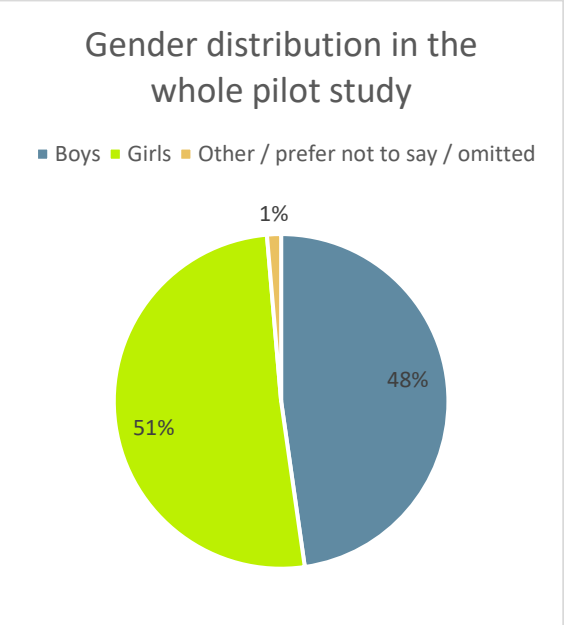

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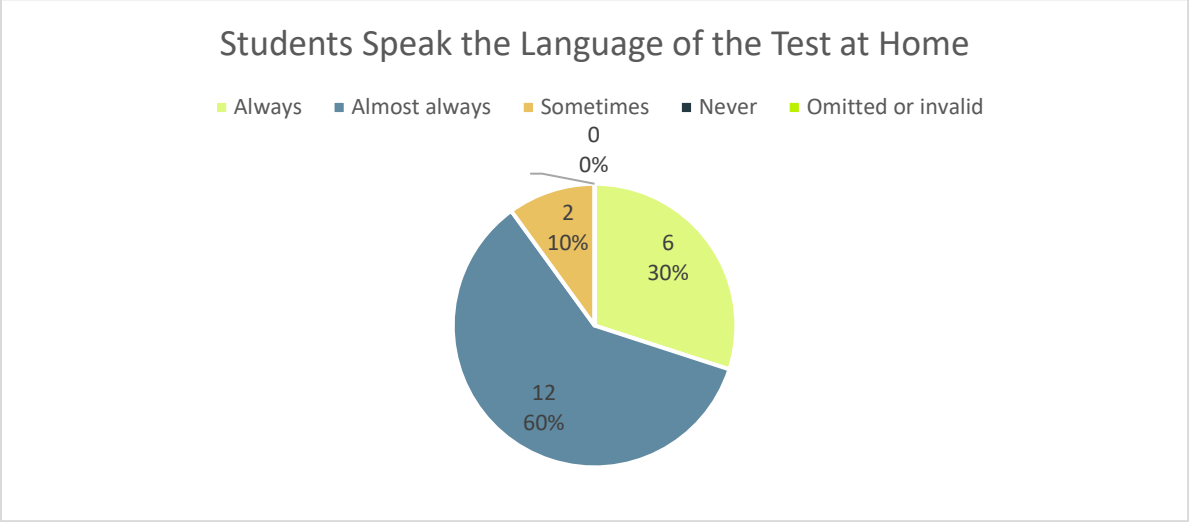

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

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- I like mathematics
- I like any schoolwork that involves numbers
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In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

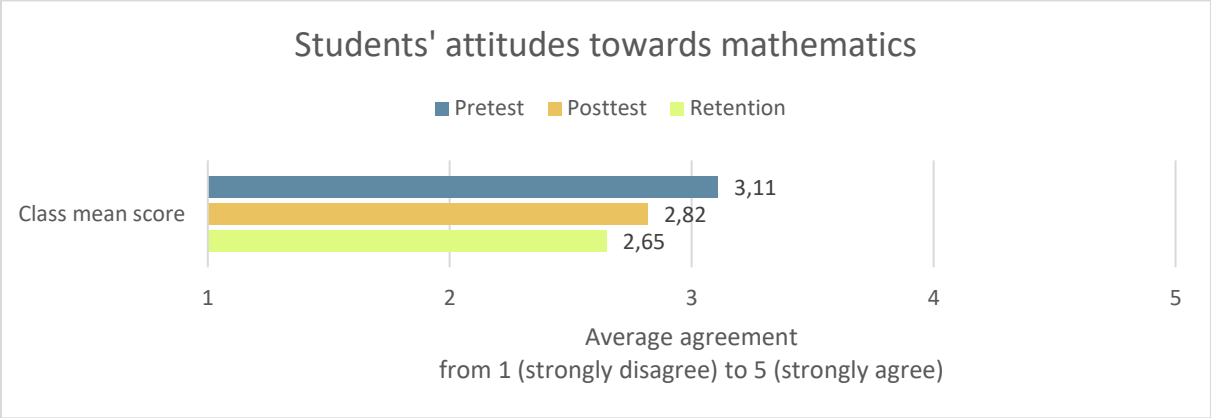

Figure 4: Students' attitudes towards mathematics (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their mathematics lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
- My teacher is easy to understand
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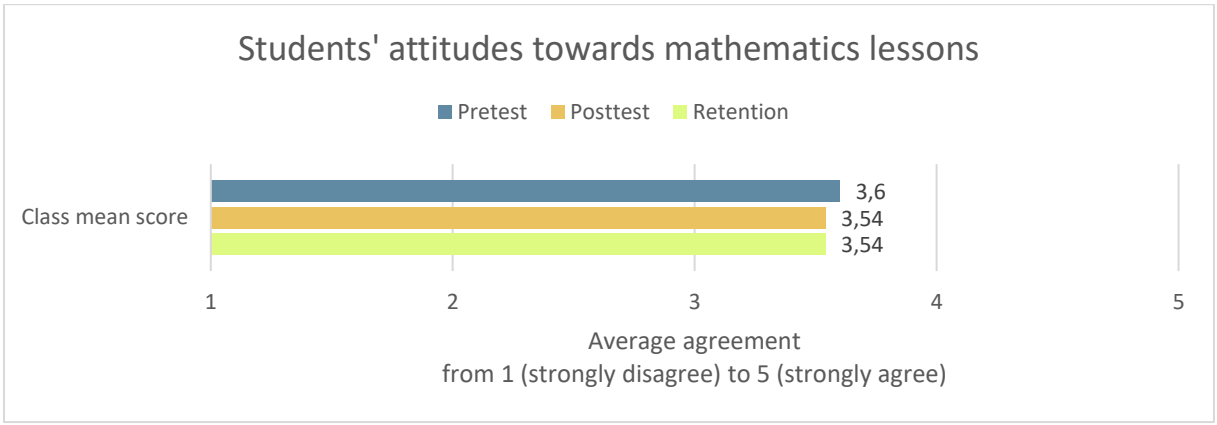

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Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
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Are you surprised by the results? Which factors could have promoted or inhibited development?

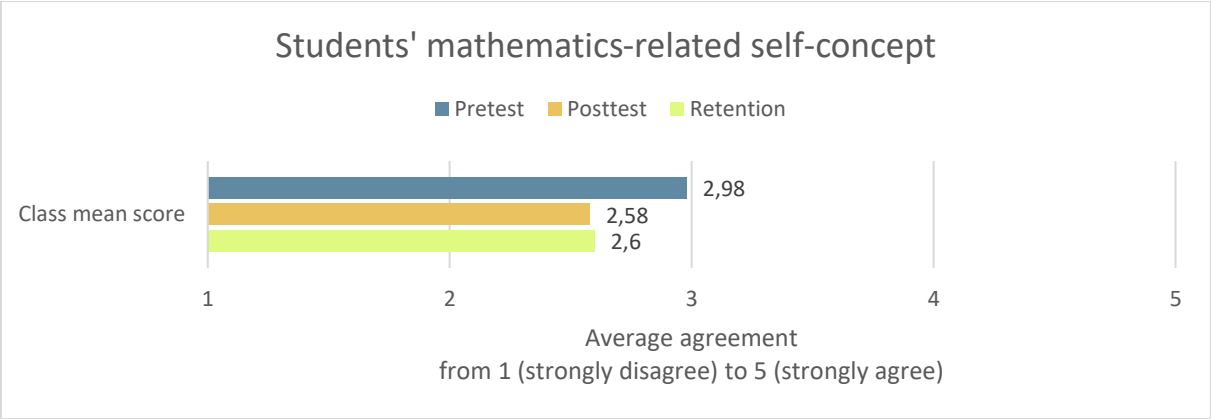

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 20 students[1])

In the pre test, the average score in your class is 72,73 % of correct answers.

In the post test, your students scored an average of 80,45 % of correct answers.

In the retention test, your class average is 88,64 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

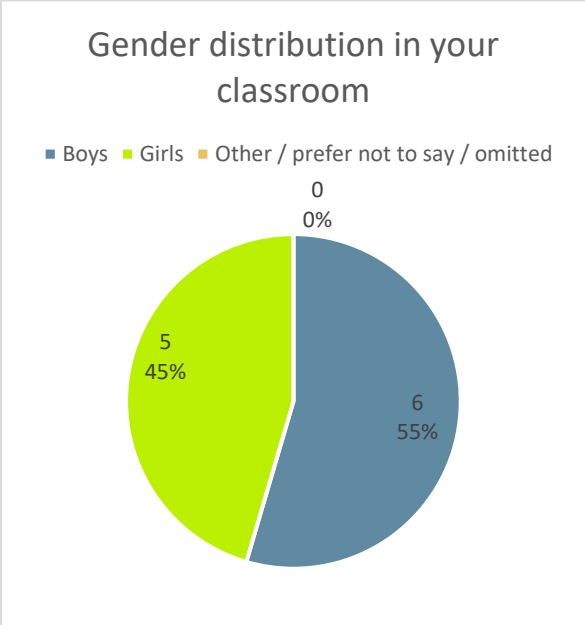
Individual Teacher Feedback for:
2T391

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate mathematics teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.



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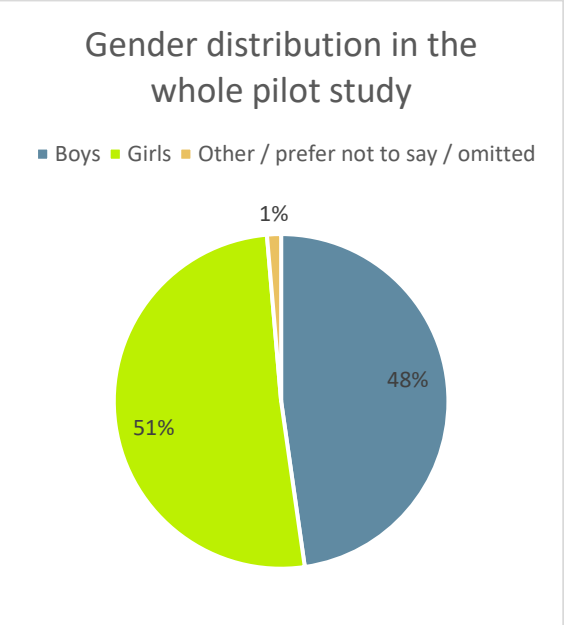

Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

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Students Speak the Language of the Test at Home

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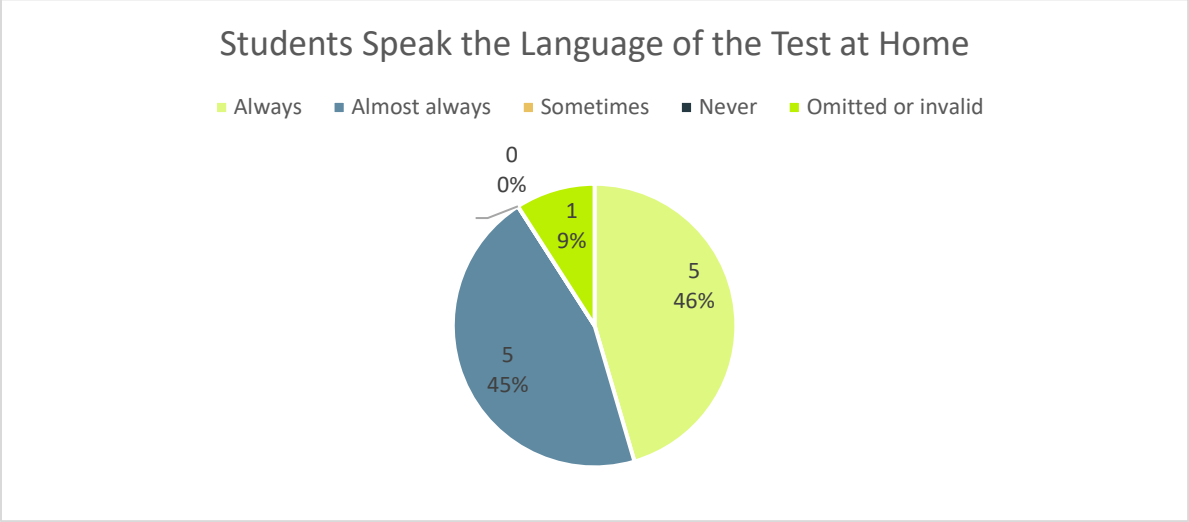

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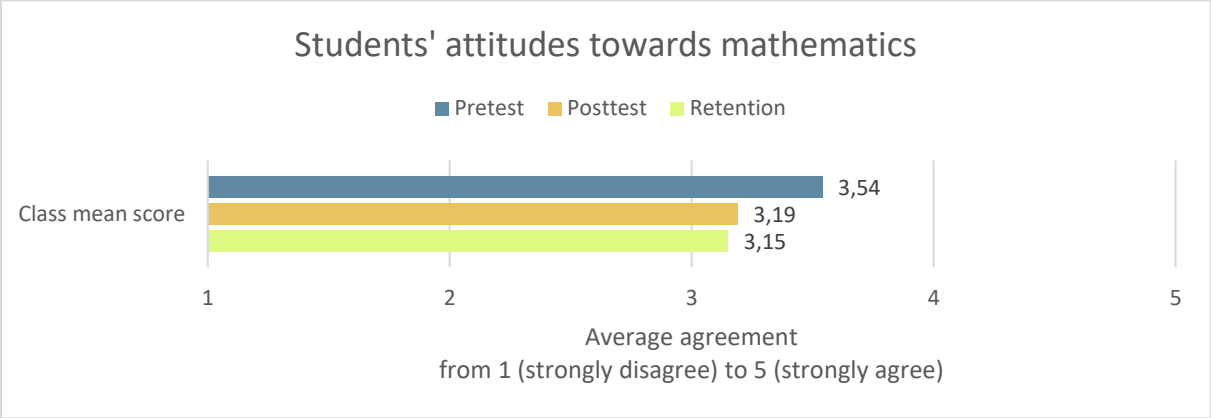

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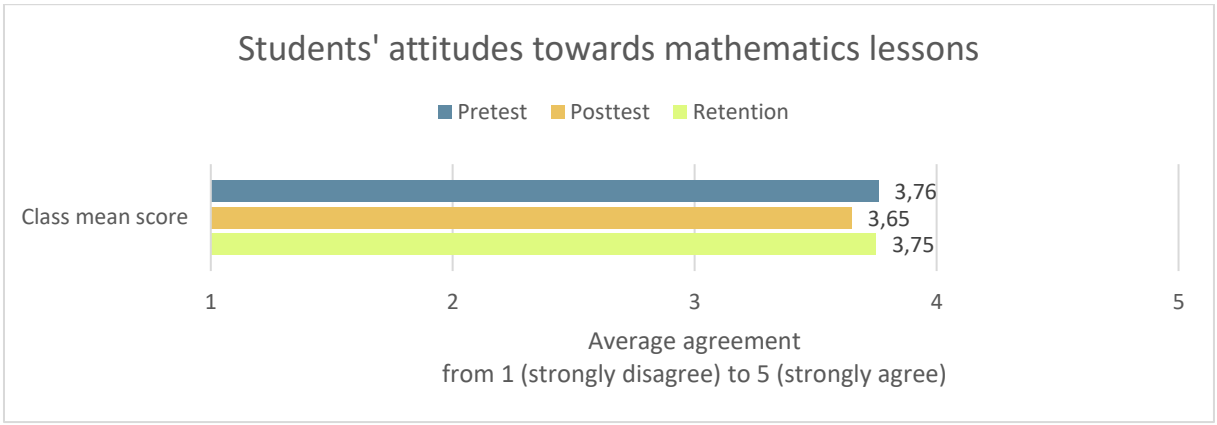

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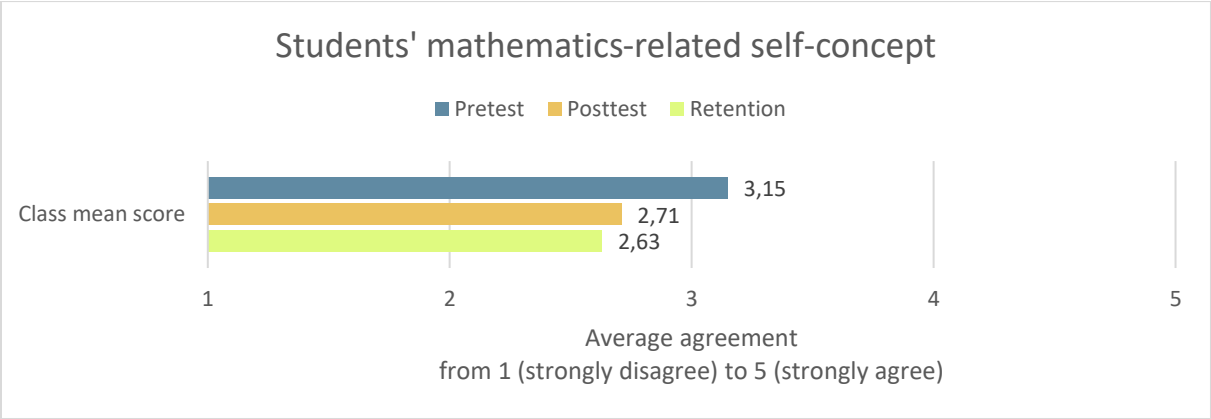

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 11 students[1])

In the pre test, the average score in your class is 59,09 % of correct answers.

In the post test, your students scored an average of 80,30 % of correct answers.

In the retention test, your class average is 75,76 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

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References

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for:
2T392

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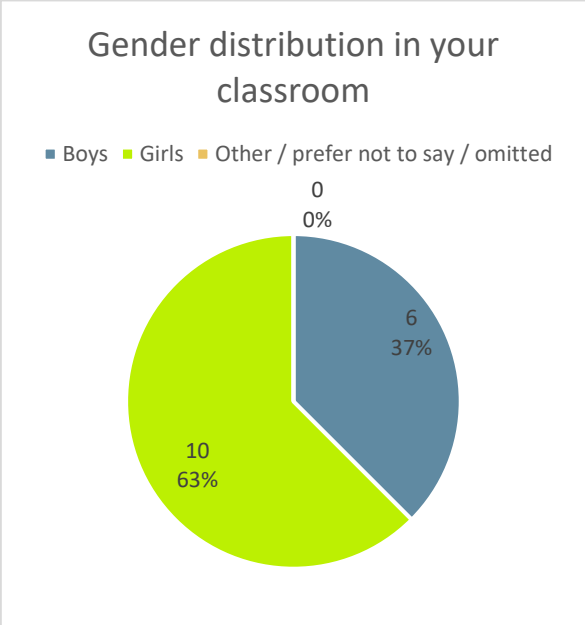

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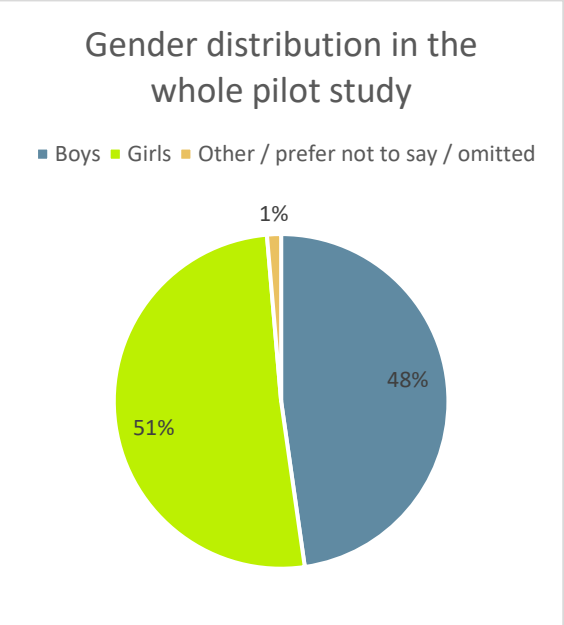

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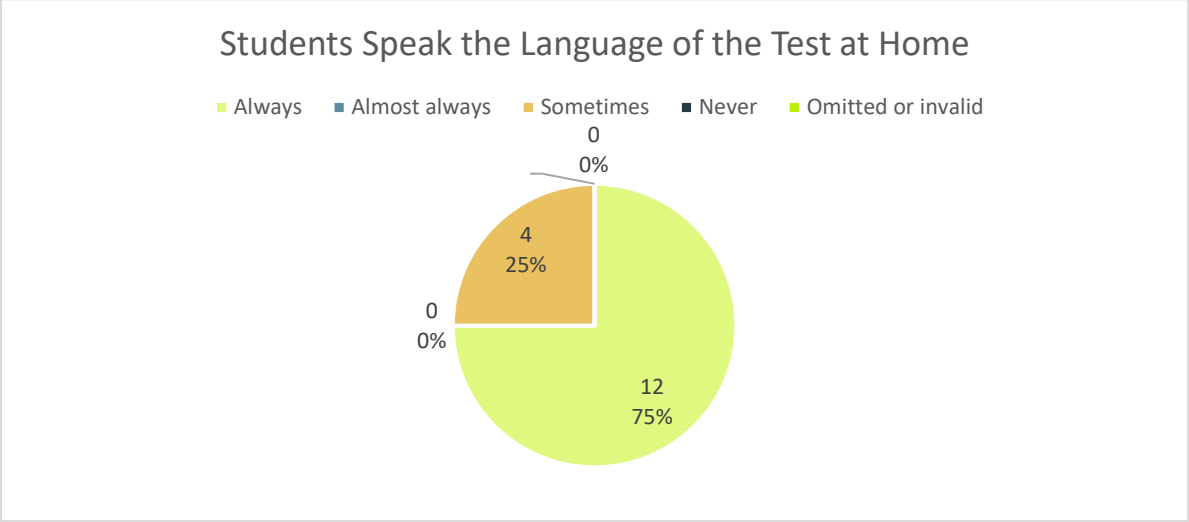

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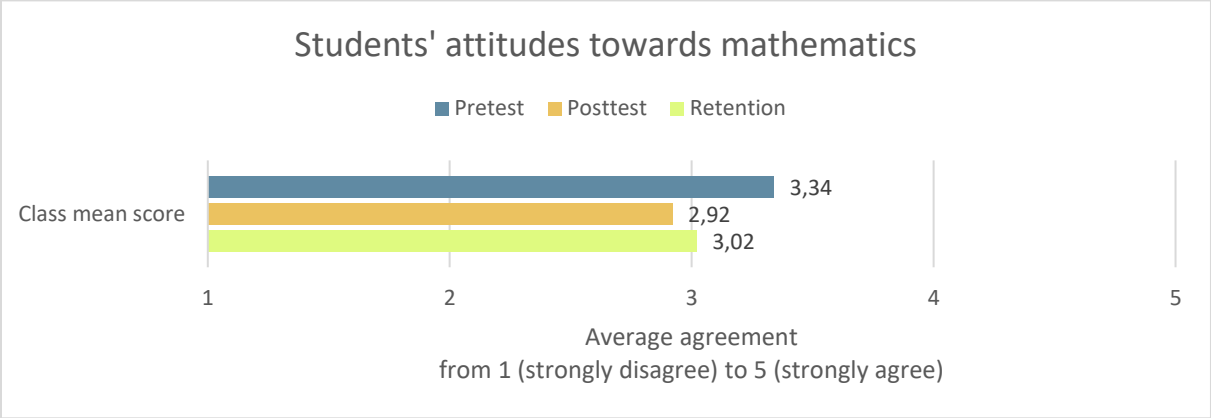

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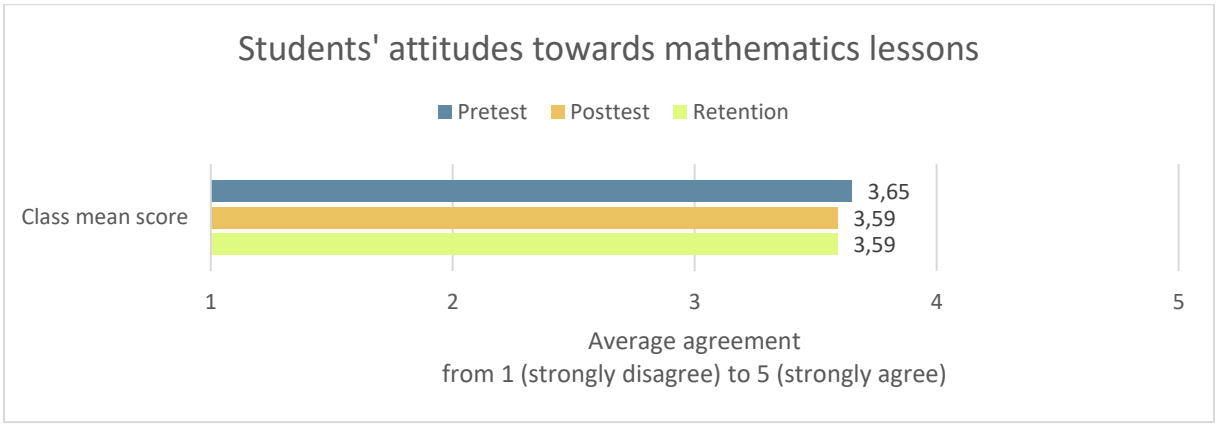

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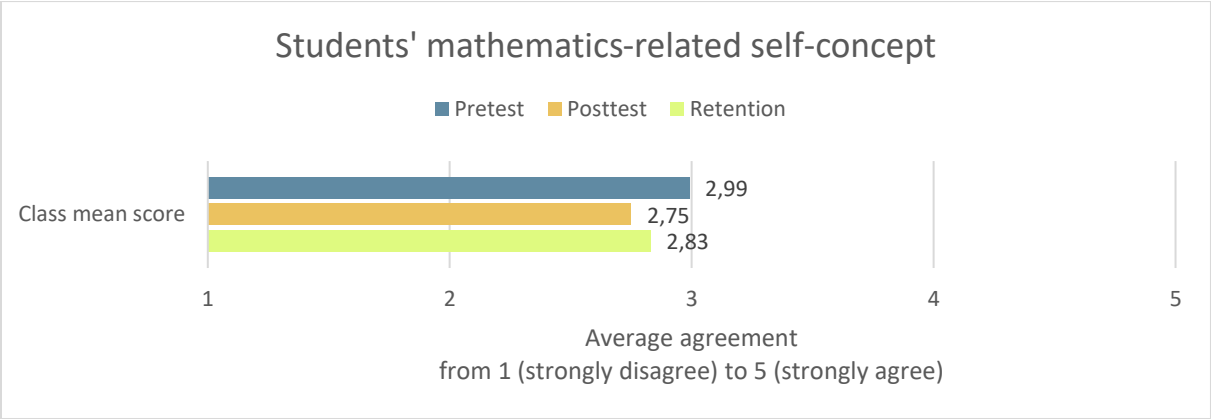

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Mean Performance of Your Class in the knowledge test (data from 16 students[1])

In the pre test, the average score in your class is 47,92 % of correct answers.

In the post test, your students scored an average of 48,44 % of correct answers.

In the retention test, your class average is 57,81 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for:
2T481

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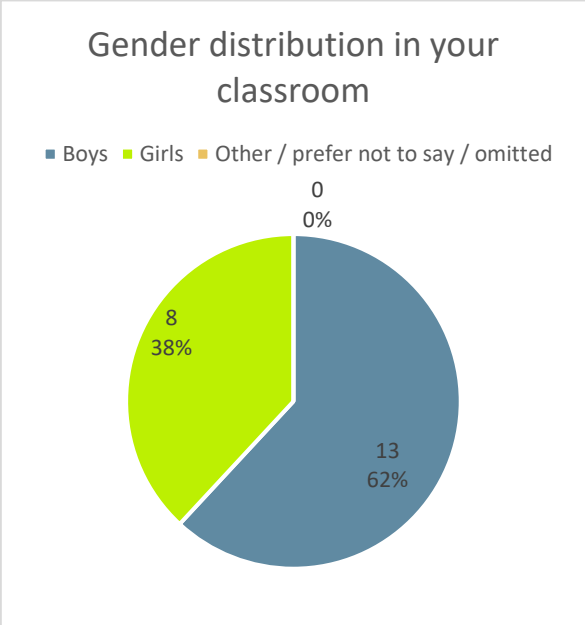

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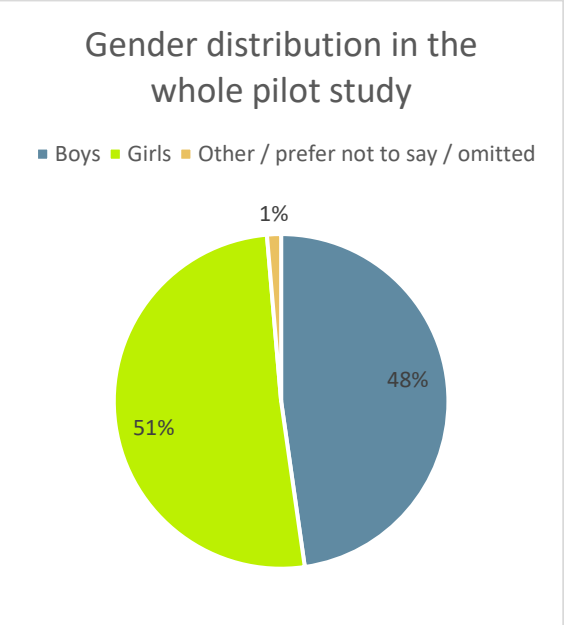

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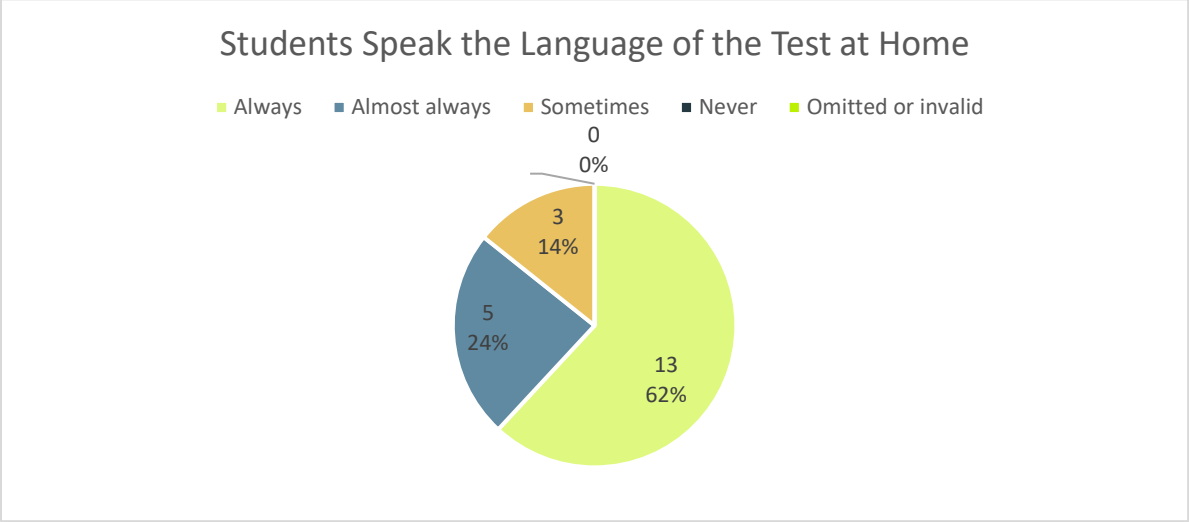

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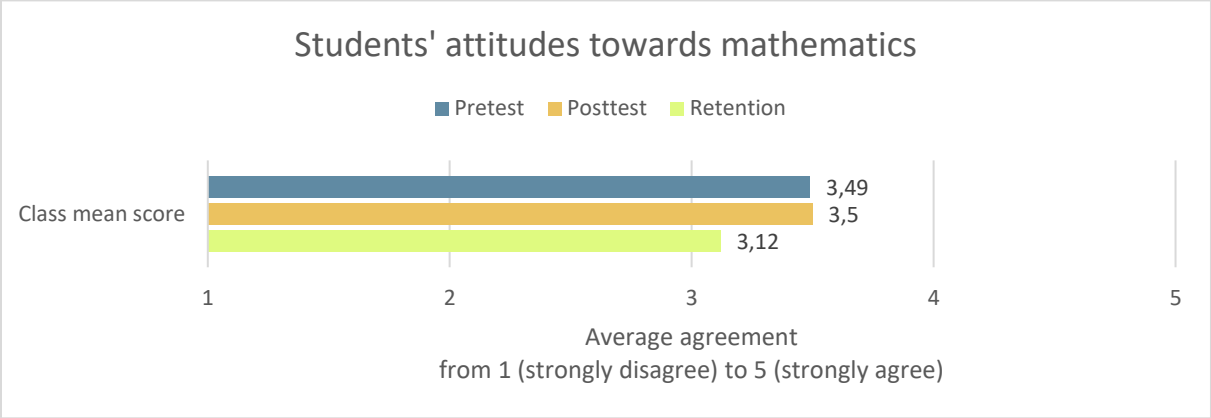

Figure 4: Students' attitudes towards mathematics (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their mathematics lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
- My teacher is easy to understand
- I am interested in what my teacher says
- My teacher gives me interesting things to do
- My teacher has clear answers to my questions
- My teacher is good at explaining mathematics
- My teacher lets me show what I have learned
- My teacher does a variety of things to help us learn
- My teacher tells me how to do better when I make a mistake
- My teacher listens to what I have to say

Did you know how your students feel about their mathematics lessons? Feel free to consider now what factors might have contributed to your students' attitude changes. Please note that your students' subjective attitudes toward your subject do not constitute an evaluation of your qualities as a teacher.

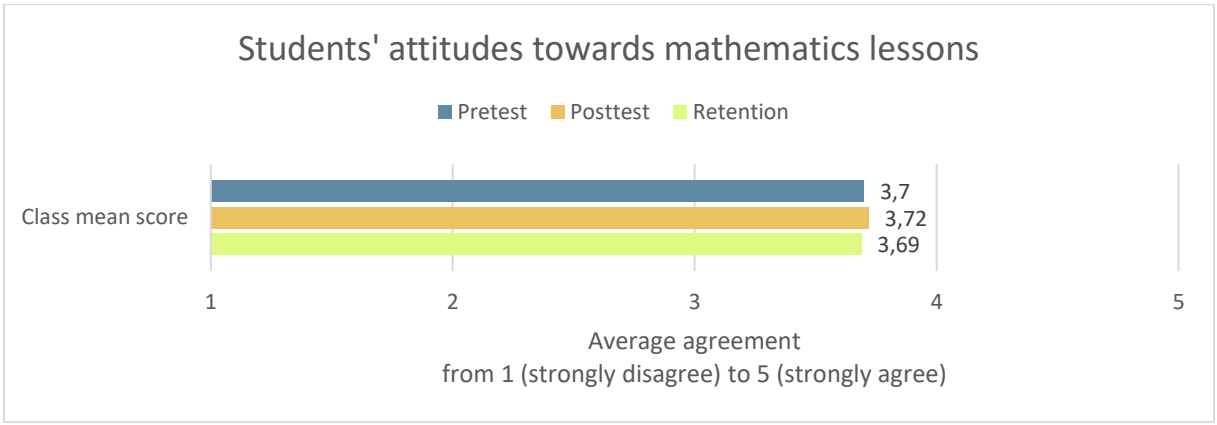

Figure 5: Students' attitudes about their mathematics lessons (pre test, post test & retention test data)

Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
The items for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree) were:

- I usually to well in mathematics
- Mathematics is harder for me than for many of my classmates (reverse)
- I am just not good at mathematics (reverse)
- I learn things quickly in mathematics
- Mathematics makes me nervous (reverse)
- I am good at working out difficult mathematics problems
- My teacher tells me I am good at mathematics
- Mathematics is harder for me than any other subject (reverse)
- Mathematics makes me confused (reverse)

Are you surprised by the results? Which factors could have promoted or inhibited development?

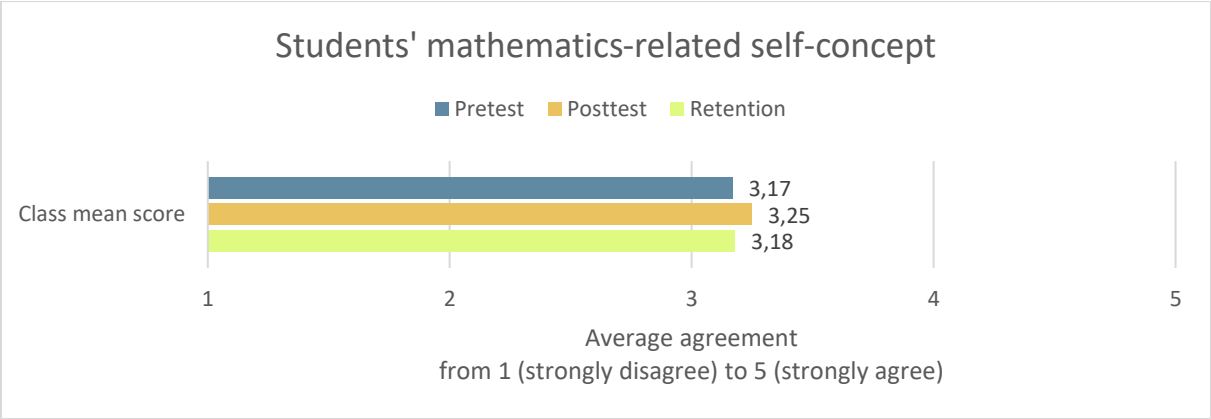

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 21 students[1])

In the pre test, the average score in your class is 58,87 % of correct answers.

In the post test, your students scored an average of 89,61 % of correct answers.

In the retention test, your class average is 87,01 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for:
2T482

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate mathematics teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.

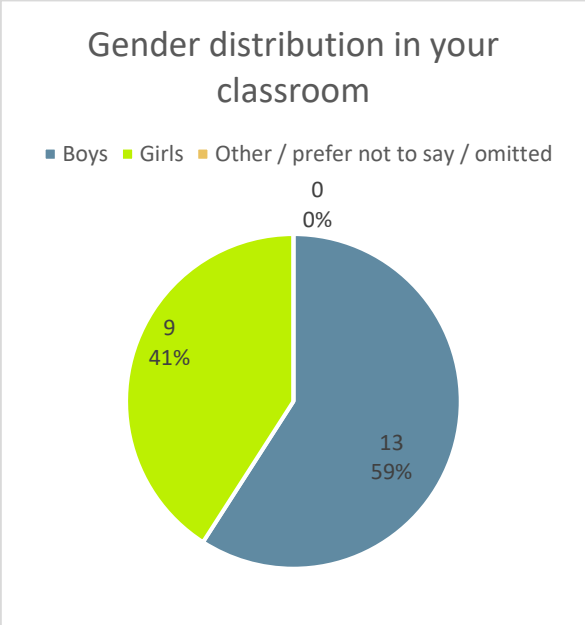

Figure 1: Gender distribution in your classroom

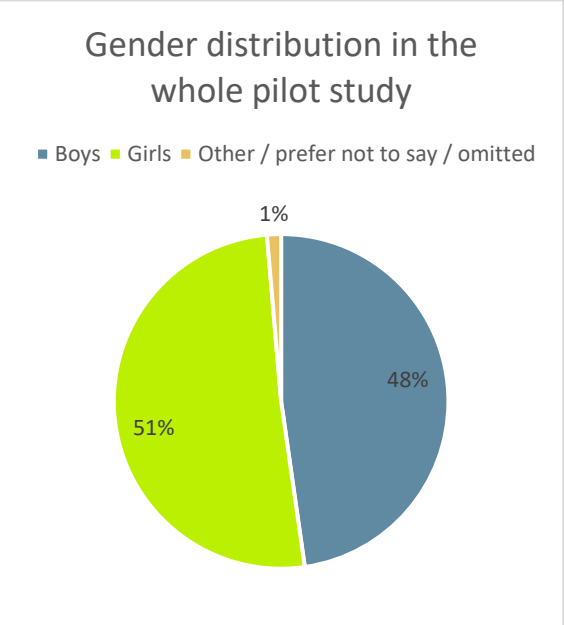

Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 27 of the 58 participating countries show no gender gap in mathematics performance? Only in 4 countries did girls outperform the boys (Mullis et al., 2020).

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' mathematical performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in mathematics on average. The 5% of students who "never" speak the test language at home scored the lowest in mathematics (ibid.). To learn more about the correlation between the children's language prerequisites and their mathematics performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).

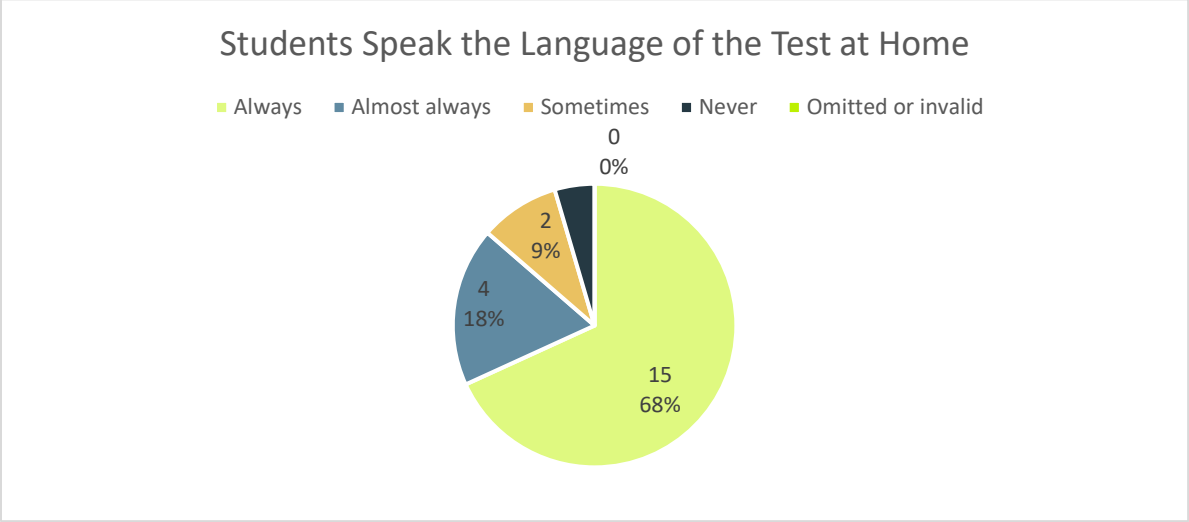

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

Research has shown that the motivation to learn on the part of the students can contribute quite decisively to learning success. Conversely, a lack of motivation can contribute to significantly poorer performance (Deci & Ryan 2009). Motivation also plays an essential role in the formation of an attitude towards a school subject (Mata et al. 2012). We asked your students about their attitudes towards mathematics as a subject.
The items, where students could agree on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I enjoy learning mathematics
- I wish I did not have to study mathematics (reverse)
- Mathematics is boring (reverse)
- I learn many interesting things in mathematics

- I like mathematics
- I like any schoolwork that involves numbers
- I like to solve mathematics problems
- I look forward to mathematics lessons
- Mathematics is one of my favorite subjects

In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

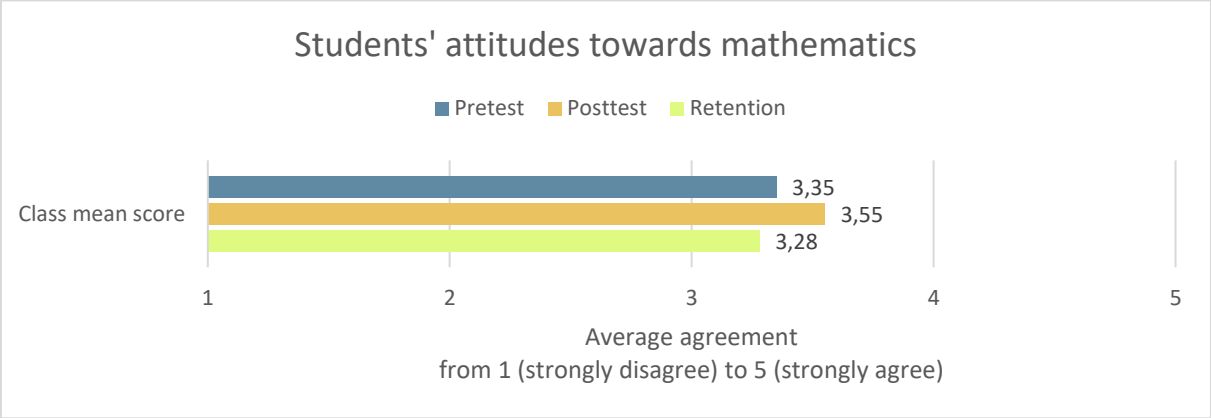

Figure 4: Students' attitudes towards mathematics (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their mathematics lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
- My teacher is easy to understand
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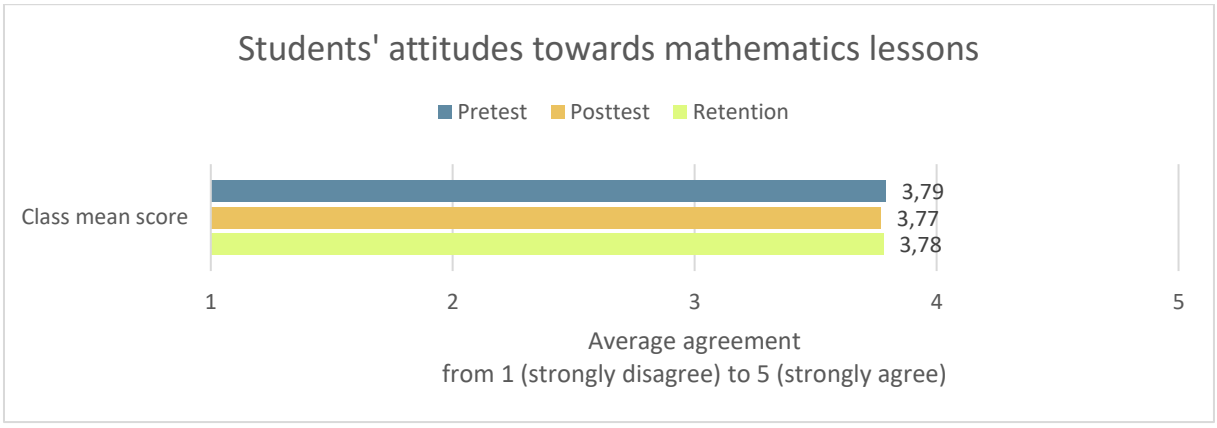

Figure 5: Students' attitudes about their mathematics lessons (pre test, post test & retention test data)

Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
The items for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree) were:

- I usually to well in mathematics
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- Mathematics makes me nervous (reverse)
- I am good at working out difficult mathematics problems
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- Mathematics is harder for me than any other subject (reverse)
- Mathematics makes me confused (reverse)

Are you surprised by the results? Which factors could have promoted or inhibited development?

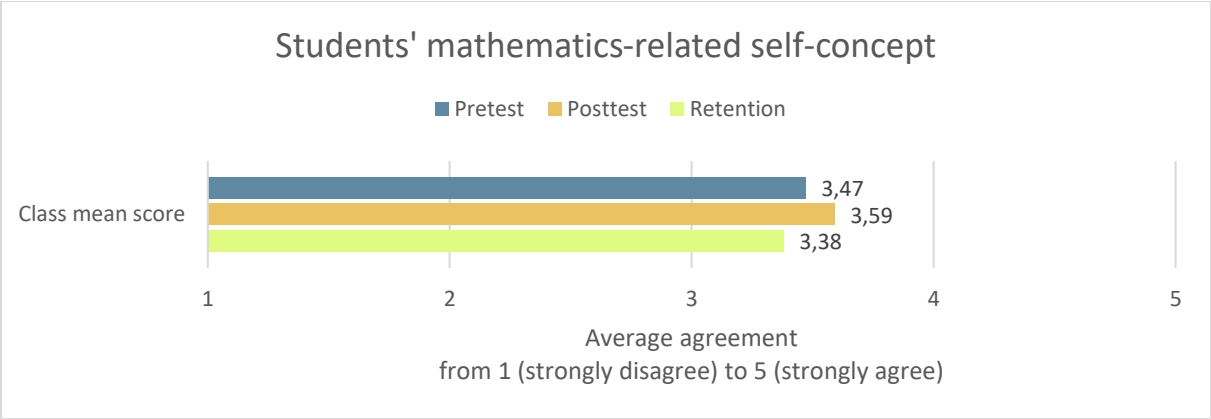

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 22 students[1])

In the pre test, the average score in your class is 63,22 % of correct answers.

In the post test, your students scored an average of 76,19 % of correct answers.

In the retention test, your class average is 83,88 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for:
2T591

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate mathematics teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.

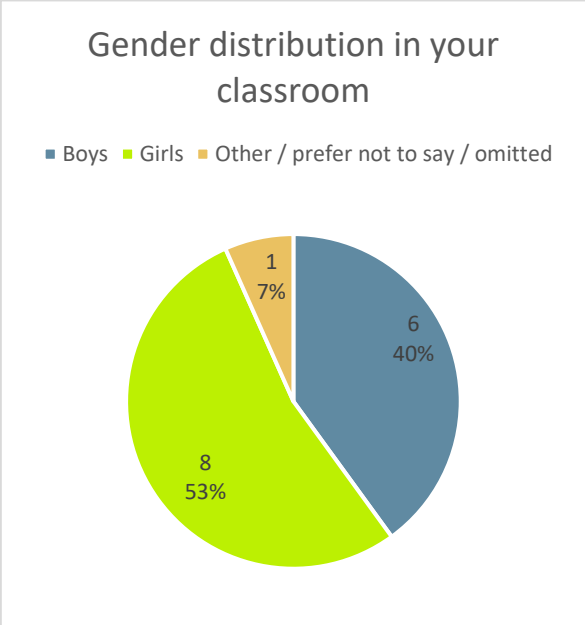

Figure 1: Gender distribution in your classroom

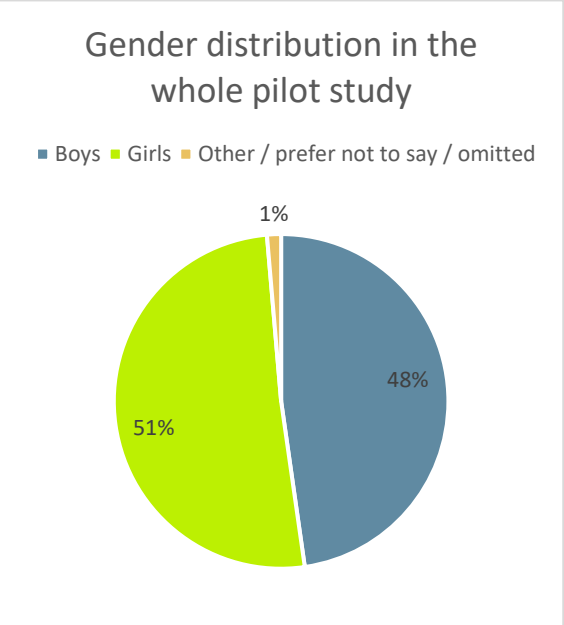

Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 27 of the 58 participating countries show no gender gap in mathematics performance? Only in 4 countries did girls outperform the boys (Mullis et al., 2020).

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' mathematical performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in mathematics on average. The 5% of students who "never" speak the test language at home scored the lowest in mathematics (ibid.). To learn more about the correlation between the children's language prerequisites and their mathematics performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).

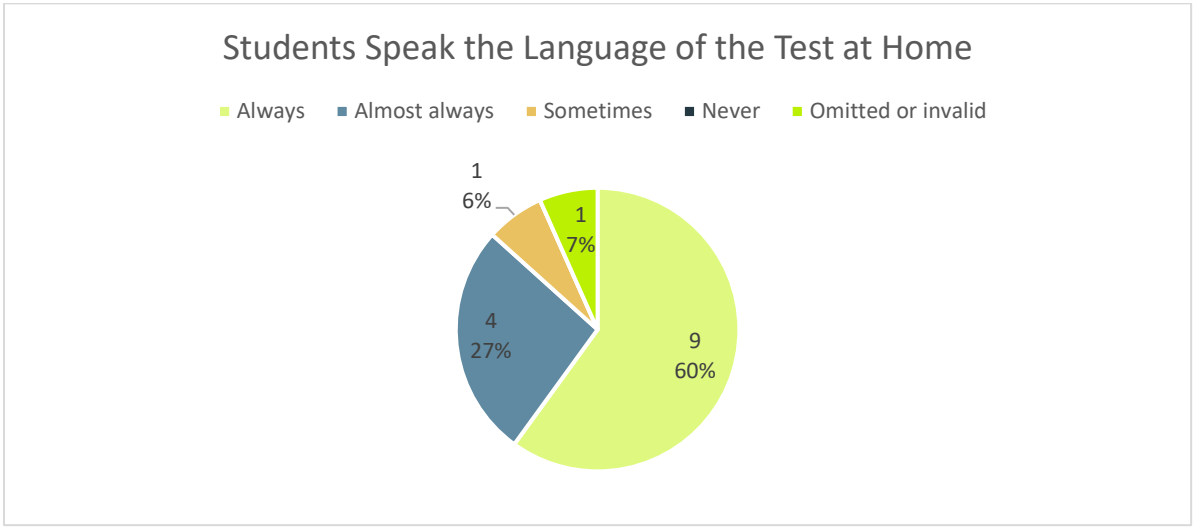

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

Research has shown that the motivation to learn on the part of the students can contribute quite decisively to learning success. Conversely, a lack of motivation can contribute to significantly poorer performance (Deci & Ryan 2009). Motivation also plays an essential role in the formation of an attitude towards a school subject (Mata et al. 2012). We asked your students about their attitudes towards mathematics as a subject.
The items, where students could agree on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I enjoy learning mathematics
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- Mathematics is boring (reverse)
- I learn many interesting things in mathematics

- I like mathematics
- I like any schoolwork that involves numbers
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- I look forward to mathematics lessons
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In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

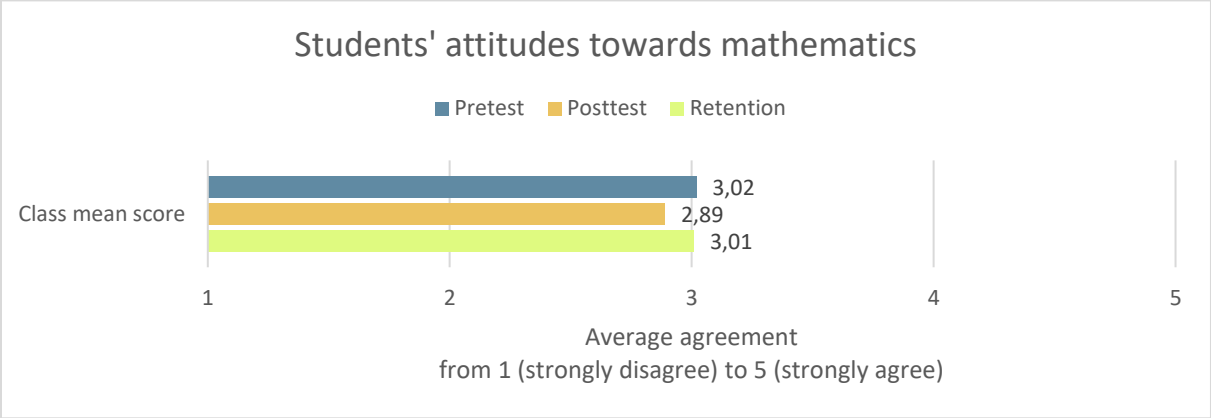

Figure 4: Students' attitudes towards mathematics (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their mathematics lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
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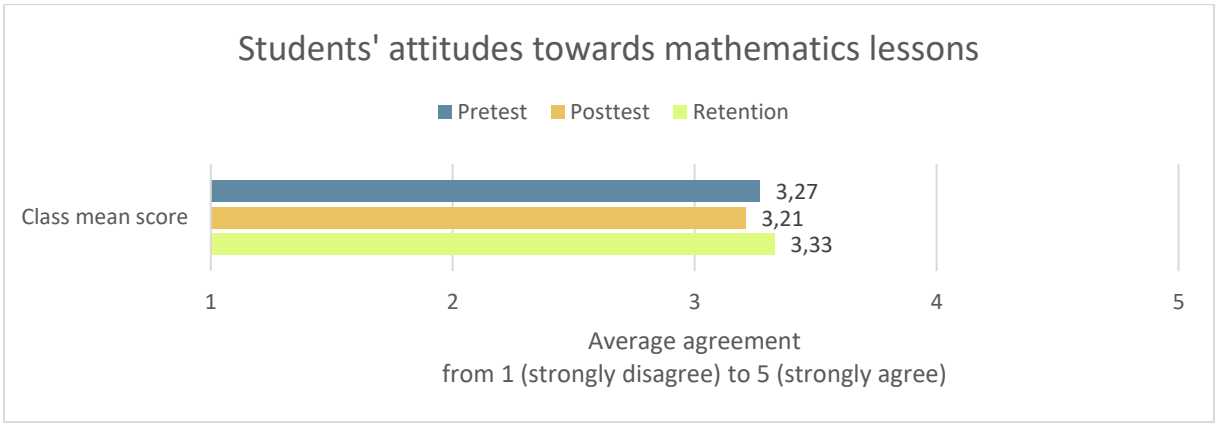

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Are you surprised by the results? Which factors could have promoted or inhibited development?

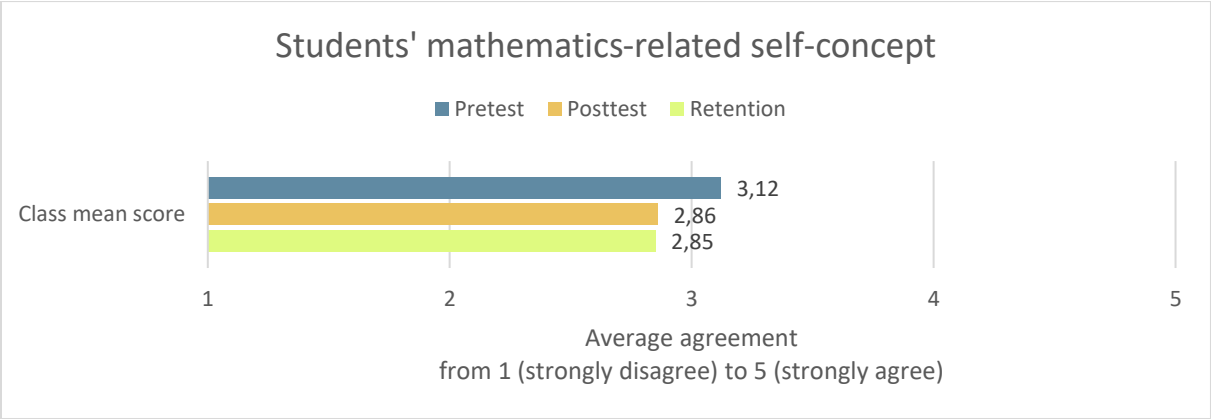

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 15 students[1])

In the pre test, the average score in your class is 26,11 % of correct answers.

In the post test, your students scored an average of 48,33 % of correct answers.

In the retention test, your class average is 45,56 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

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References

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ARETE

ARETE Pilot Study · Pilot 2 · Mathematics

Individual Teacher Feedback for:
2T592

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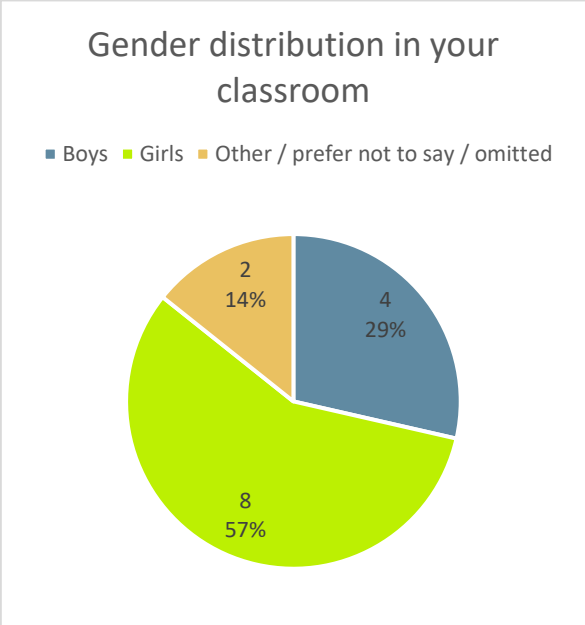
Thank you for your engagement in our study on the use of augmented reality to facilitate mathematics teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.



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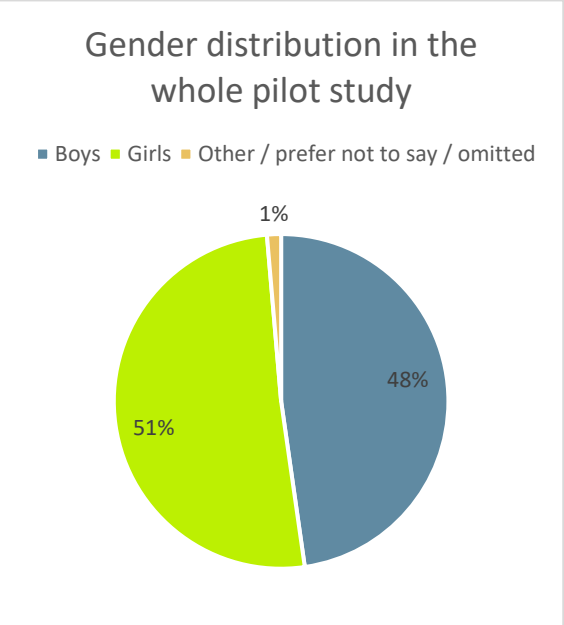

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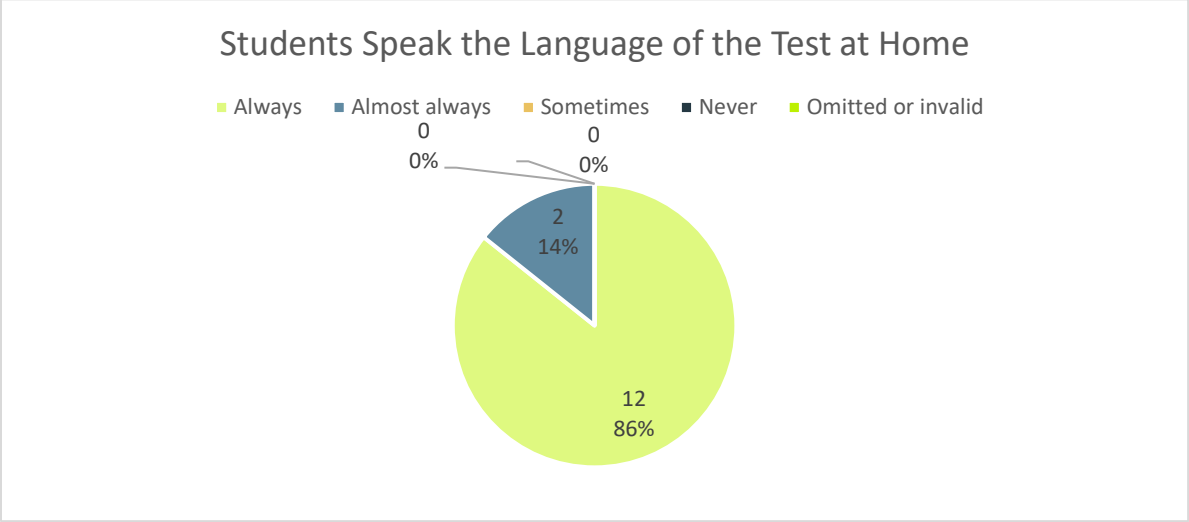

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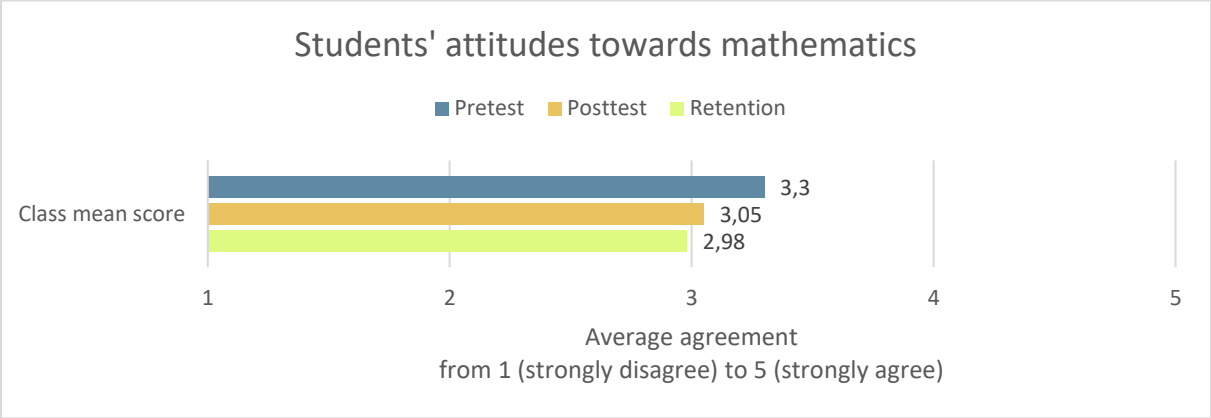

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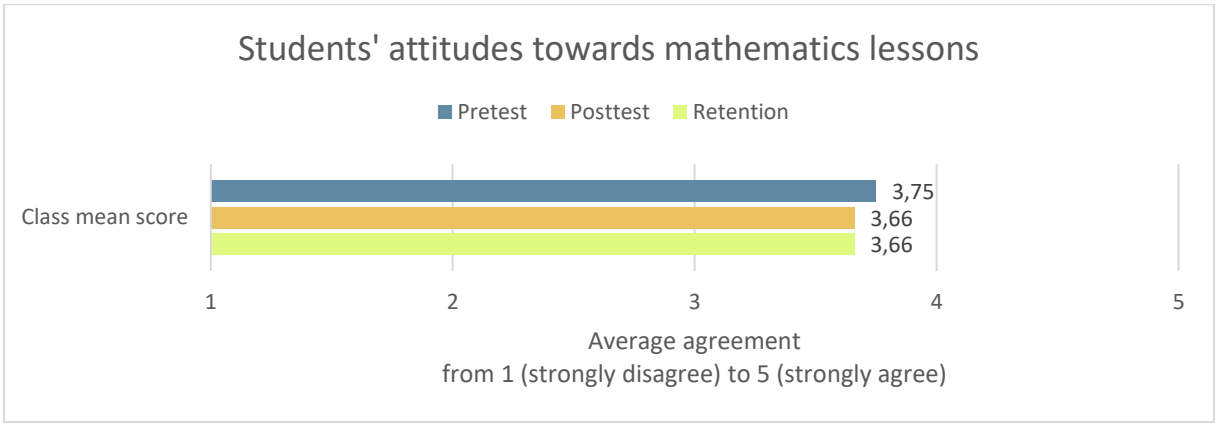

Figure 5: Students' attitudes about their mathematics lessons (pre test, post test & retention test data)

Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
The items for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree) were:

- I usually to well in mathematics
- Mathematics is harder for me than for many of my classmates (reverse)
- I am just not good at mathematics (reverse)
- I learn things quickly in mathematics
- Mathematics makes me nervous (reverse)
- I am good at working out difficult mathematics problems
- My teacher tells me I am good at mathematics
- Mathematics is harder for me than any other subject (reverse)
- Mathematics makes me confused (reverse)

Are you surprised by the results? Which factors could have promoted or inhibited development?

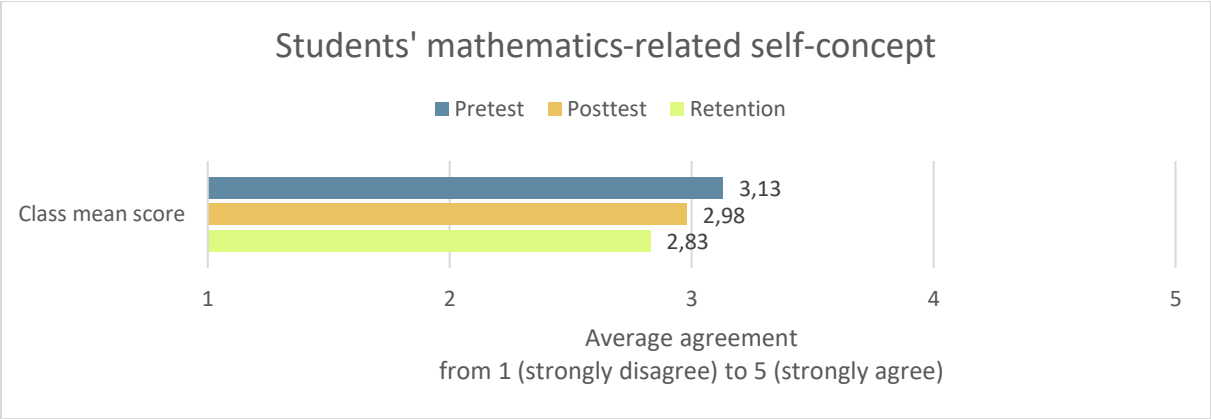

Figure 6: Students' mathematics-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 14 students[1])

In the pre test, the average score in your class is 39,88 % of correct answers.

In the post test, your students scored an average of 69,05 % of correct answers.

In the retention test, your class average is 68,45 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Science

Individual Teacher Feedback for:
2T013

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate science teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.

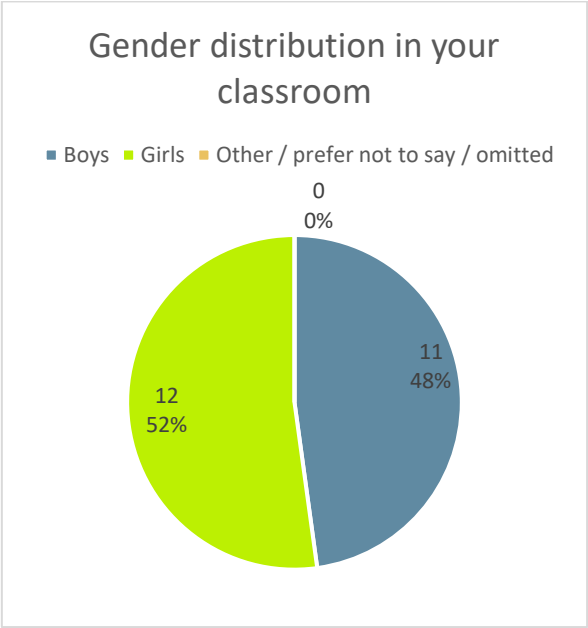


Figure 1: Gender distribution in your classroom

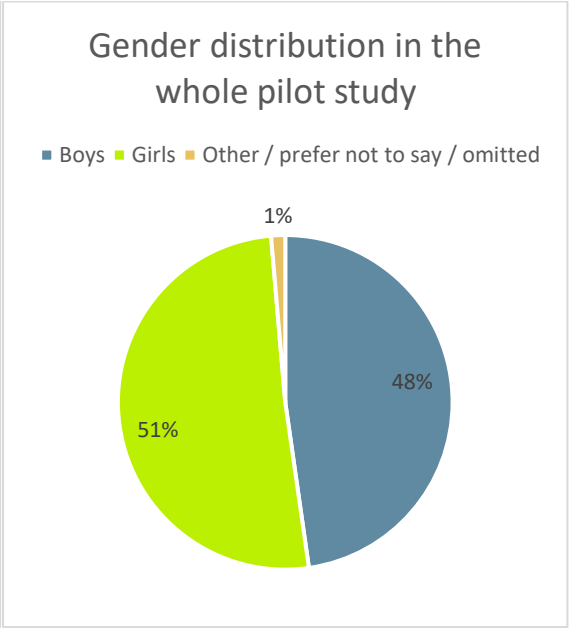


Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 33 of the 58 participating countries show no gender gap in science performance? Only in 7 countries did boys outperform the girls (Mullis et al., 2020). In 18 countries, girls had higher average achievement than boys.

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' science performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in science on average. The 5% of students who "never" speak the test language at home scored the lowest in science (ibid.). To learn more about the correlation between the children's language prerequisites and their science performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).

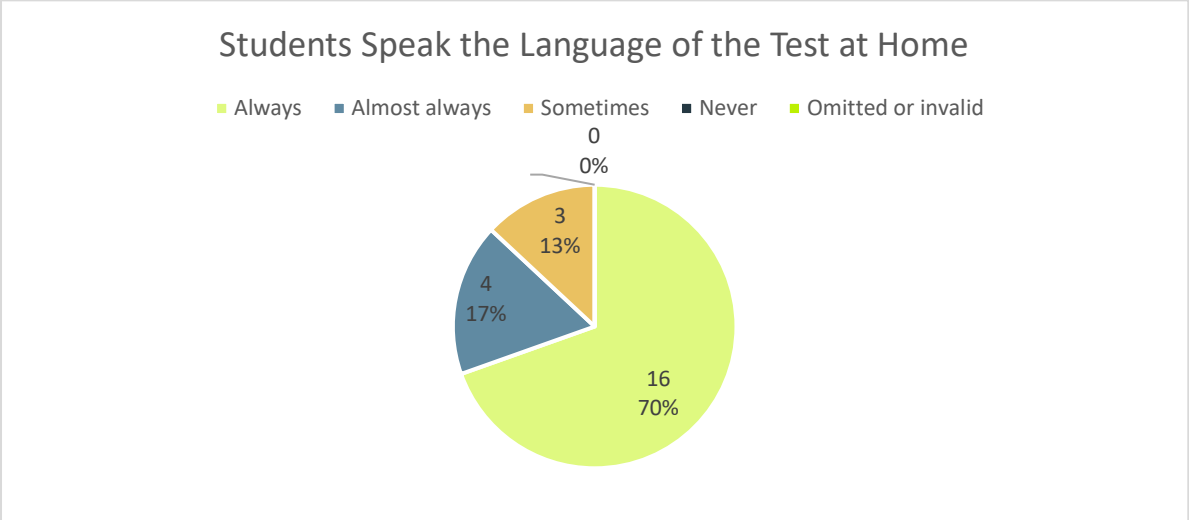


Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

Research has shown that the motivation to learn on the part of the students can contribute quite decisively to learning success. Conversely, a lack of motivation can contribute to significantly poorer performance (Deci & Ryan 2009). Motivation also plays an essential role in the formation of an attitude towards a school subject (Mata et al. 2012). We asked your students about their attitudes towards science as a subject.
The items, where students could agree on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I enjoy learning science
- I wish I did not have to study science (reverse)
- Science is boring (reverse)

- I learn many interesting things in science
- I like science
- I look forward to learning science in school
- Science teaches me how things in the world work
- I like to do science experiments
- Science is one of my favorite subjects

In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

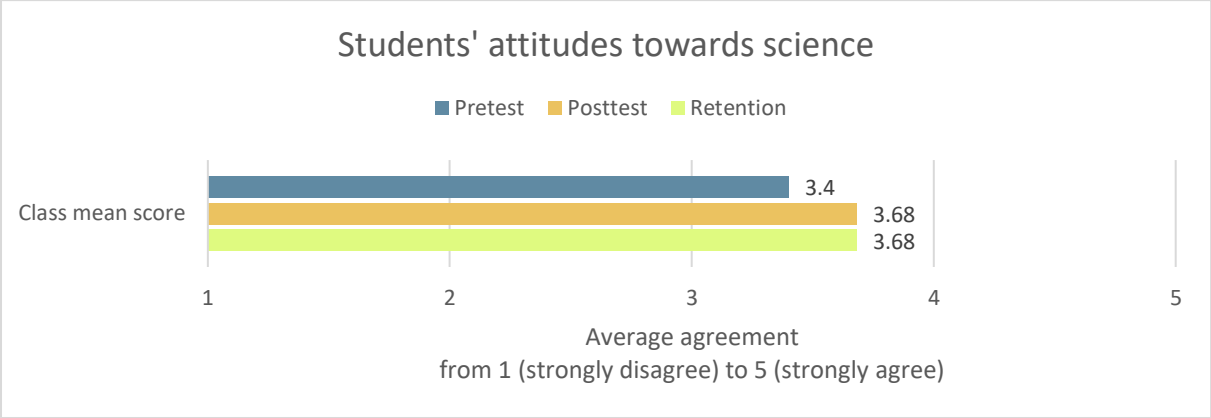


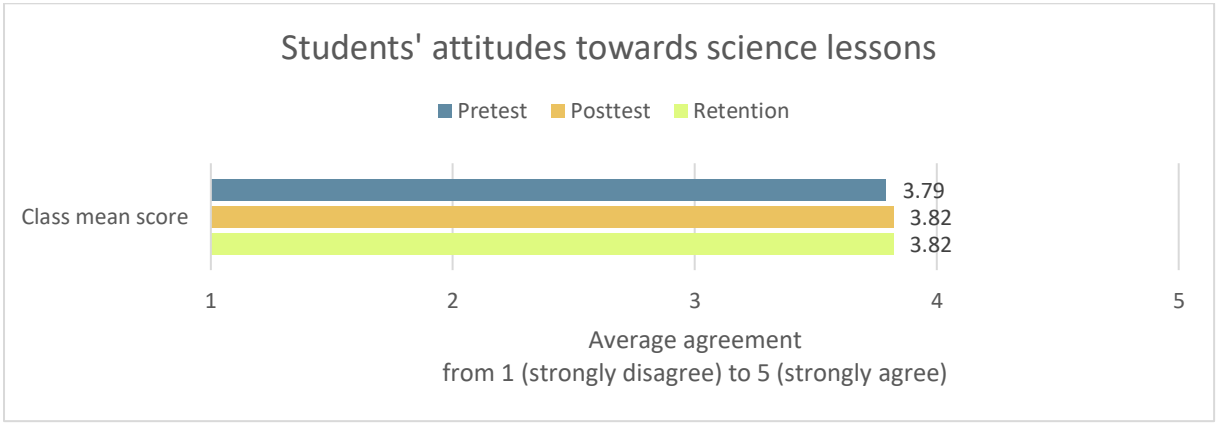
Figure 4: Students' attitudes towards science (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their science lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
- My teacher is easy to understand
- I am interested in what my teacher says
- My teacher gives me interesting things to do
- My teacher has clear answers to my questions
- My teacher is good at explaining science
- My teacher lets me show what I have learned
- My teacher does a variety of things to help us learn
- My teacher tells me how to do better when I make a mistake
- My teacher listens to what I have to say

Did you know how your students feel about their science lessons? Feel free to consider now what factors might have contributed to your students' attitude changes. Please note that your

students' subjective attitudes toward your subject do not constitute an evaluation of your qualities as a teacher.



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The items for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree) were:

- I usually to well in science
- Science is harder for me than for many of my classmates (reverse)
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- I learn things quickly in science
- My teacher tells me I am good at science
- Science is harder for me than any other subject (reverse)
- Science makes me confused (reverse)

Are you surprised by the results? Which factors could have promoted or inhibited development?

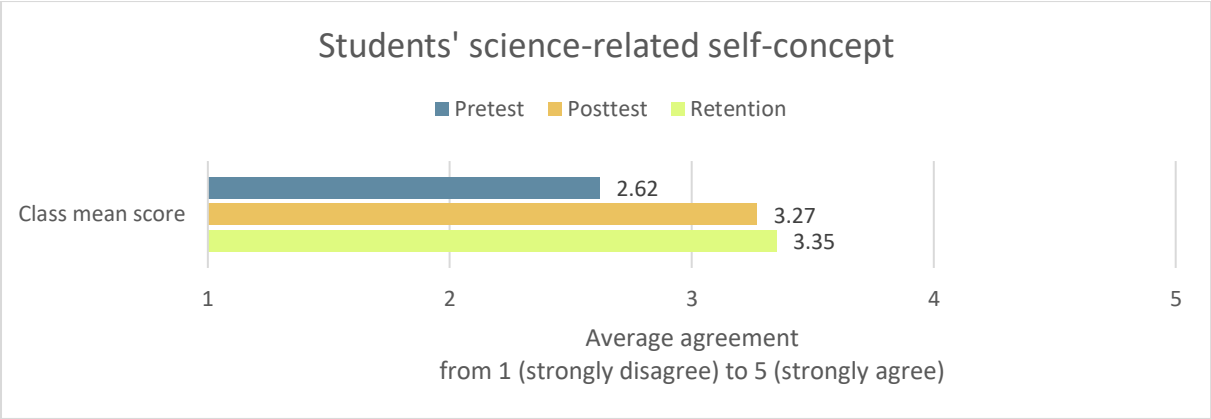

Figure 6: Students' science-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 23 students[1])

In the pre test, the average score in your class is 57,45 % of correct answers.

In the post test, your students scored an average of 64,60 % of correct answers.

In the retention test, your class average is 65,53 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Science

Individual Teacher Feedback for:
2T014

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate science teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.

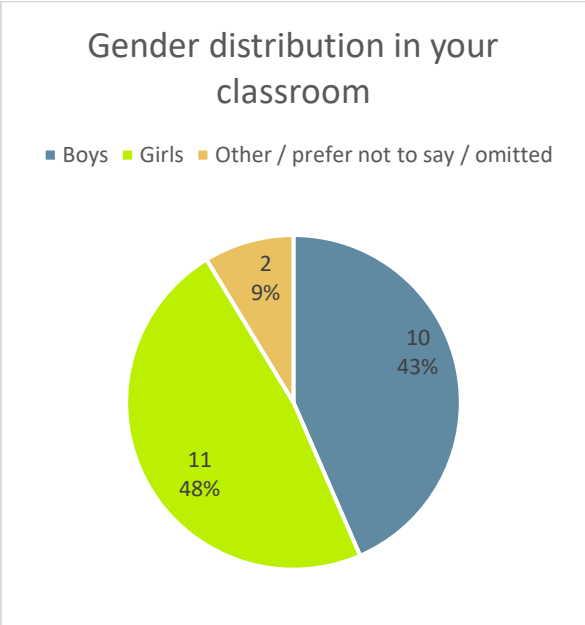

Figure 1: Gender distribution in your classroom

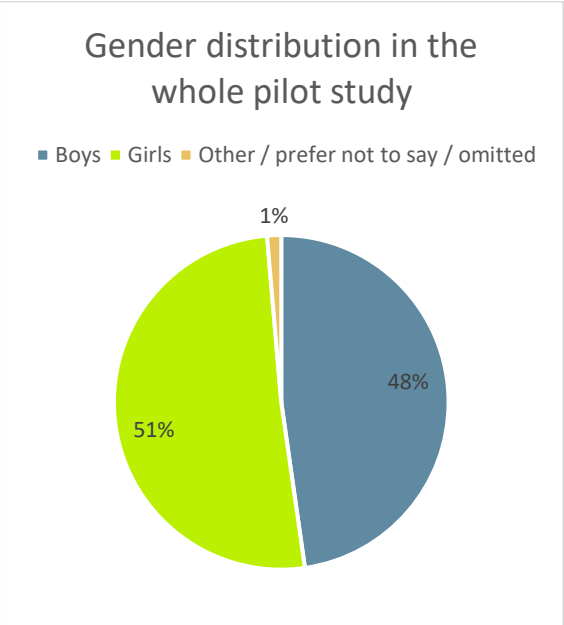

Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 33 of the 58 participating countries show no gender gap in science performance? Only in 7 countries did boys outperform the girls (Mullis et al., 2020). In 18 countries, girls had higher average achievement than boys.

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' science performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in science on average. The 5% of students who "never" speak the test language at home scored the lowest in science (ibid.). To learn more about the correlation between the children's language prerequisites and their science performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).

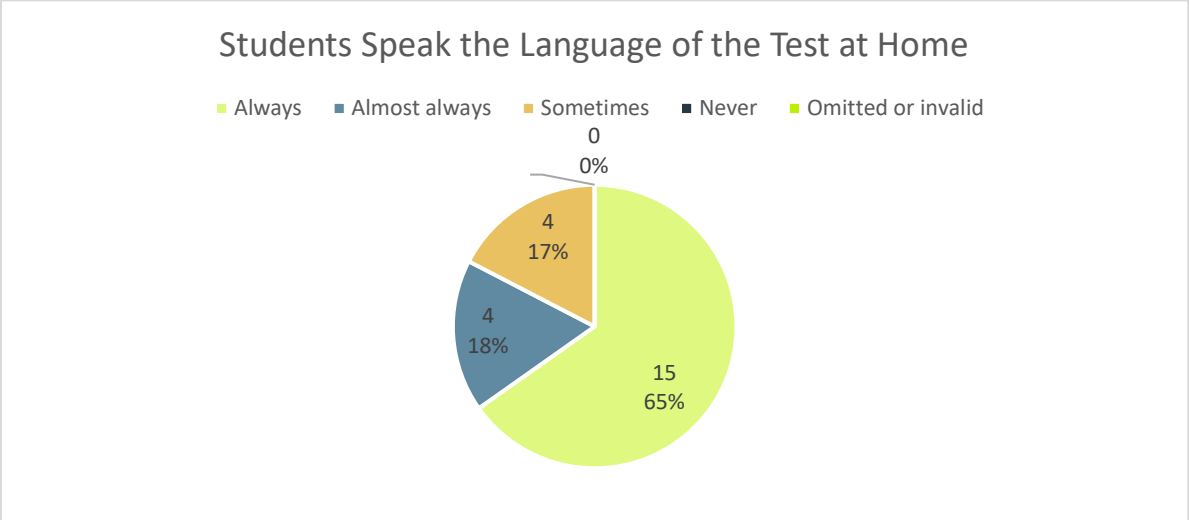

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

Research has shown that the motivation to learn on the part of the students can contribute quite decisively to learning success. Conversely, a lack of motivation can contribute to significantly poorer performance (Deci & Ryan 2009). Motivation also plays an essential role in the formation of an attitude towards a school subject (Mata et al. 2012). We asked your students about their attitudes towards science as a subject.
The items, where students could agree on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I enjoy learning science
- I wish I did not have to study science (reverse)
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- I learn many interesting things in science
- I like science
- I look forward to learning science in school
- Science teaches me how things in the world work
- I like to do science experiments
- Science is one of my favorite subjects

In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

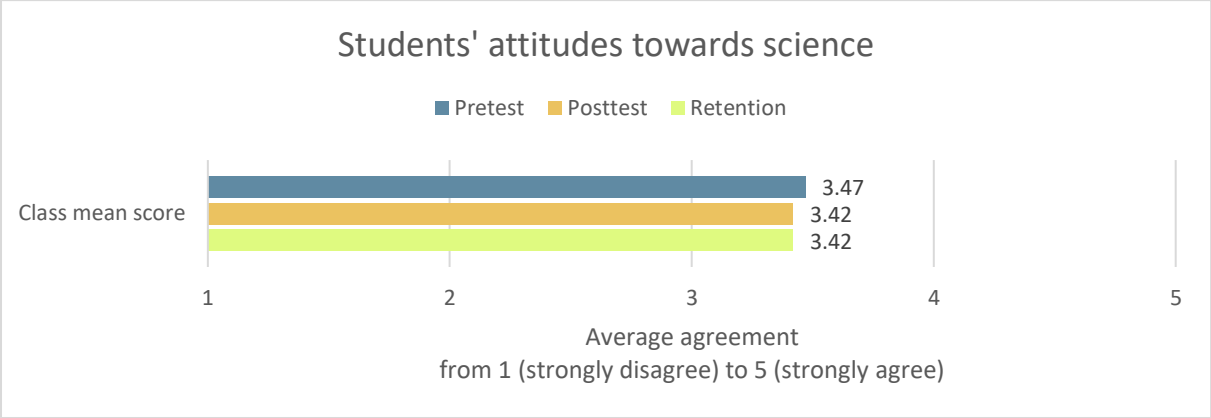

Figure 4: Students' attitudes towards science (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their science lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
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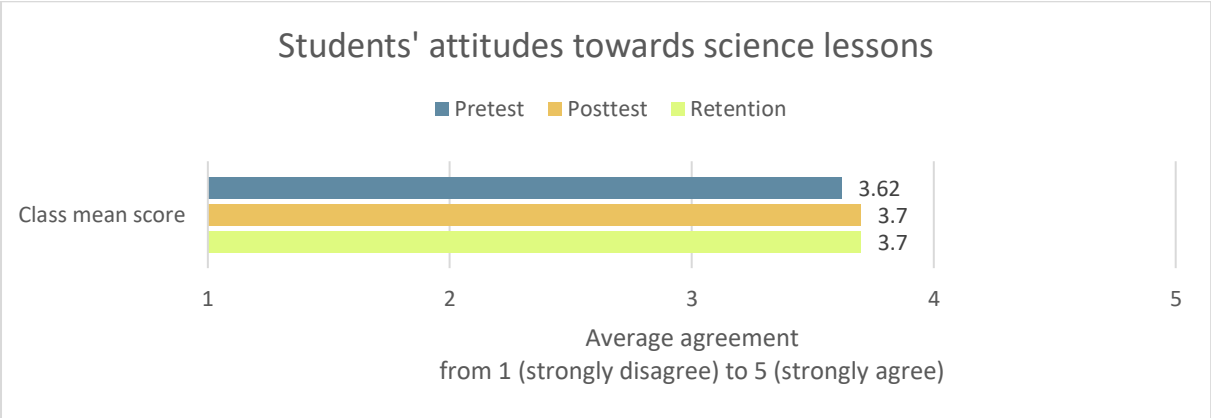

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- I am just not good at science (reverse)
- I learn things quickly in science
- My teacher tells me I am good at science
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- Science makes me confused (reverse)

Are you surprised by the results? Which factors could have promoted or inhibited development?

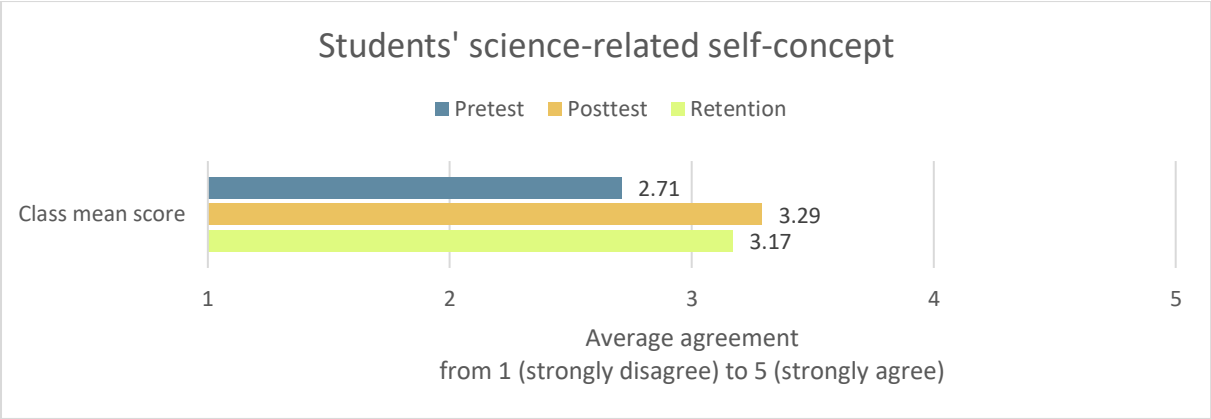

Figure 6: Students' science-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 23 students[1])

In the pre test, the average score in your class is 59,63 % of correct answers.

In the post test, your students scored an average of 66,15 % of correct answers.

In the retention test, your class average is 70,50 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

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ARETE

ARETE Pilot Study · Pilot 2 · Science

Individual Teacher Feedback for:
2T162

Dear ARETE pilot teacher,

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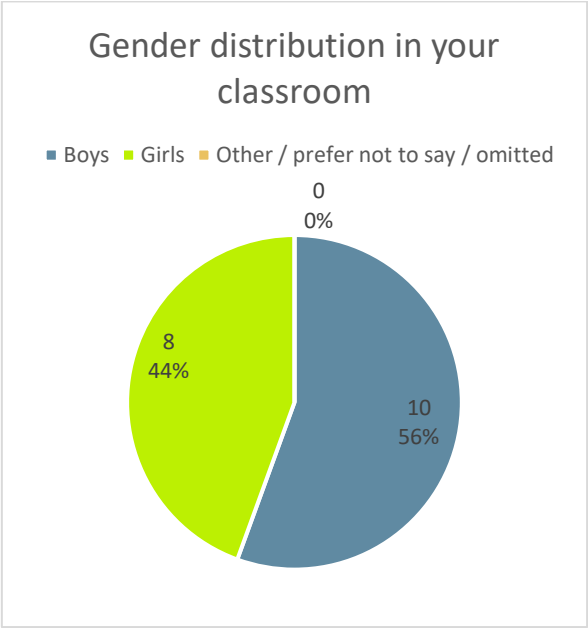

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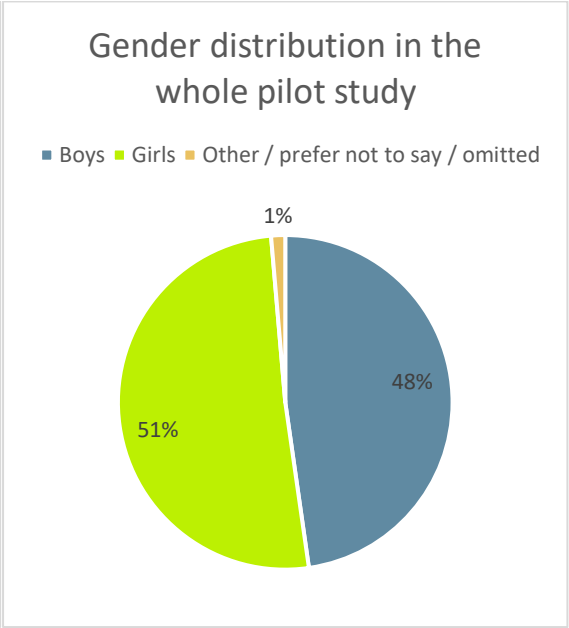

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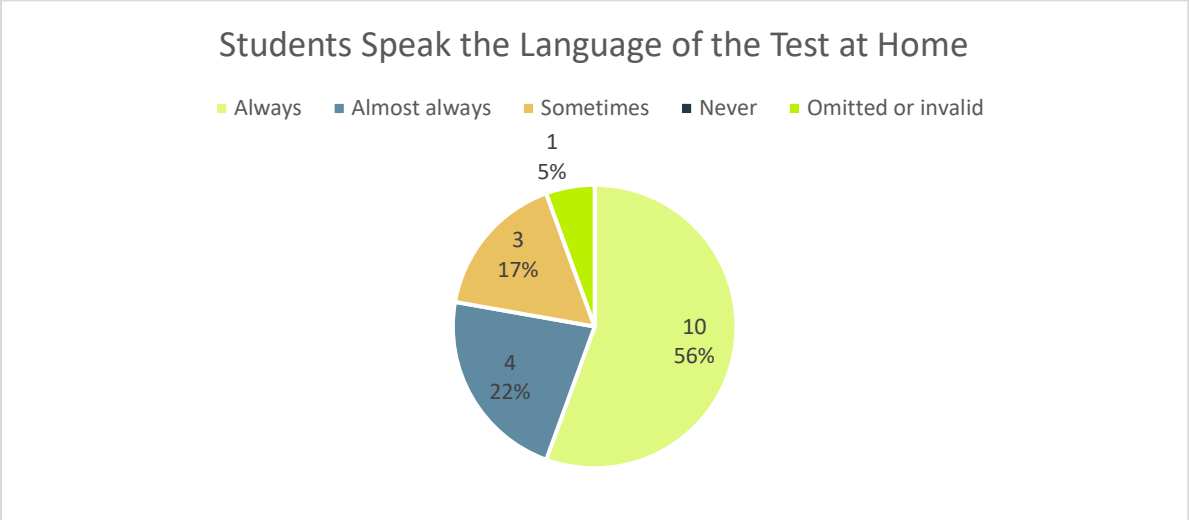

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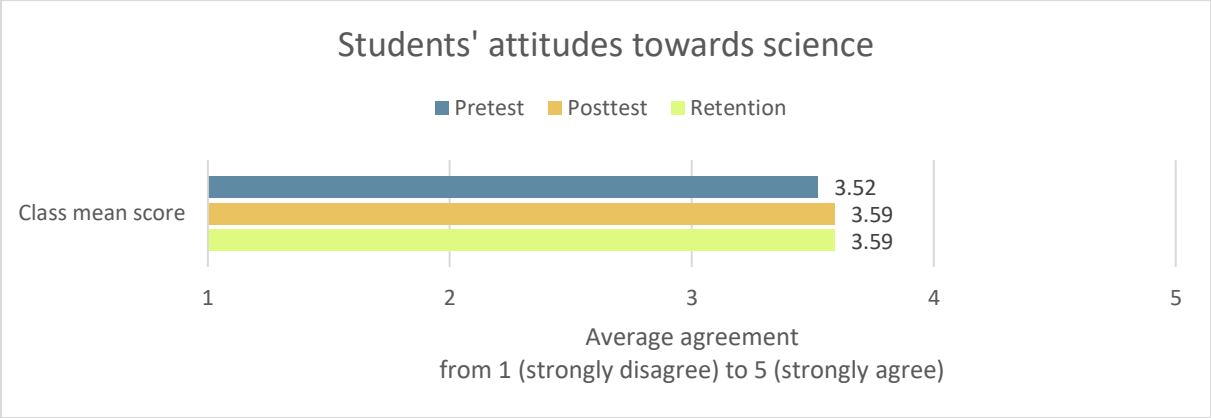

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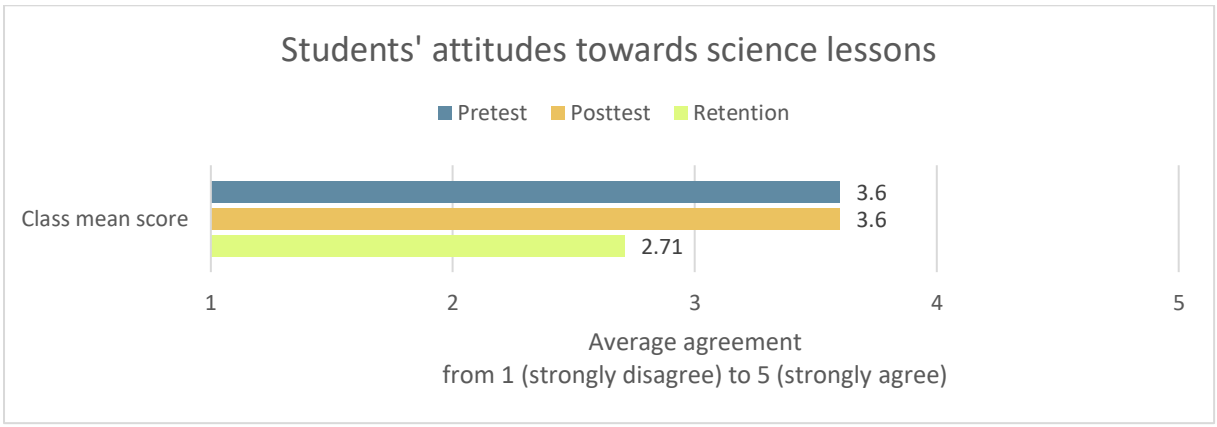

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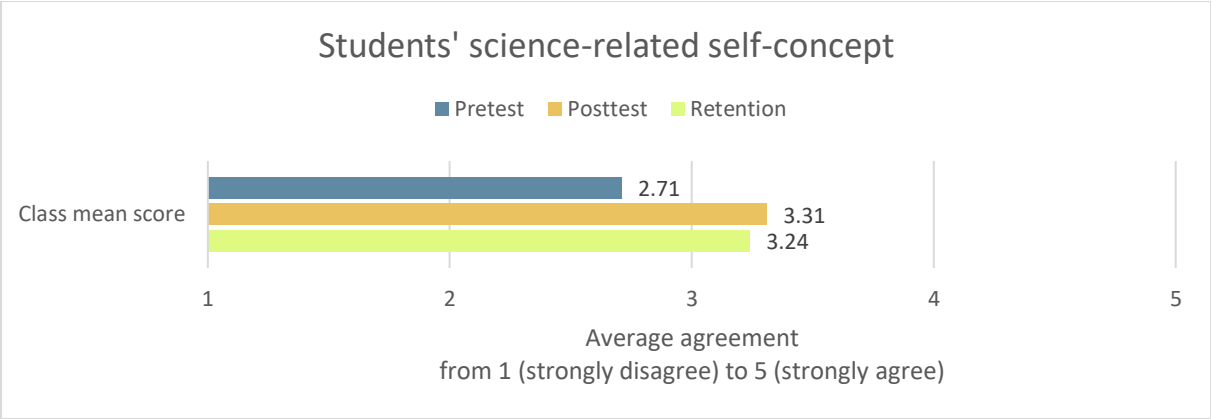

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Mean Performance of Your Class in the knowledge test (data from 18 students[1])

In the pre test, the average score in your class is 56,74 % of correct answers.

In the post test, your students scored an average of 53,57 % of correct answers.

In the retention test, your class average is 62,70 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

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References

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ARETE

ARETE Pilot Study · Pilot 2 · Science

Individual Teacher Feedback for:
2T251

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate science teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.

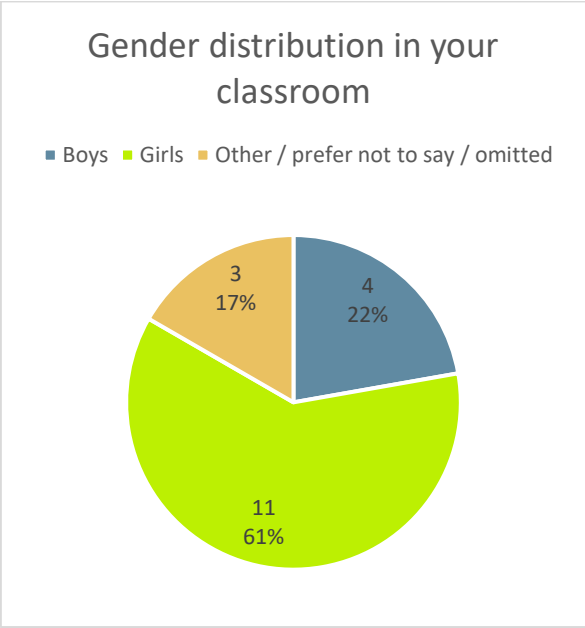

Figure 1: Gender distribution in your classroom

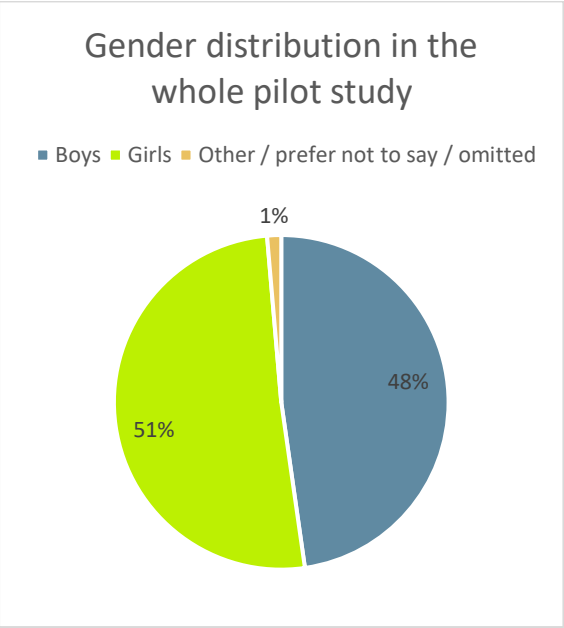

Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 33 of the 58 participating countries show no gender gap in science performance? Only in 7 countries did boys outperform the girls (Mullis et al., 2020). In 18 countries, girls had higher average achievement than boys.

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' science performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in science on average. The 5% of students who "never" speak the test language at home scored the lowest in science (ibid.). To learn more about the correlation between the children's language prerequisites and their science performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).

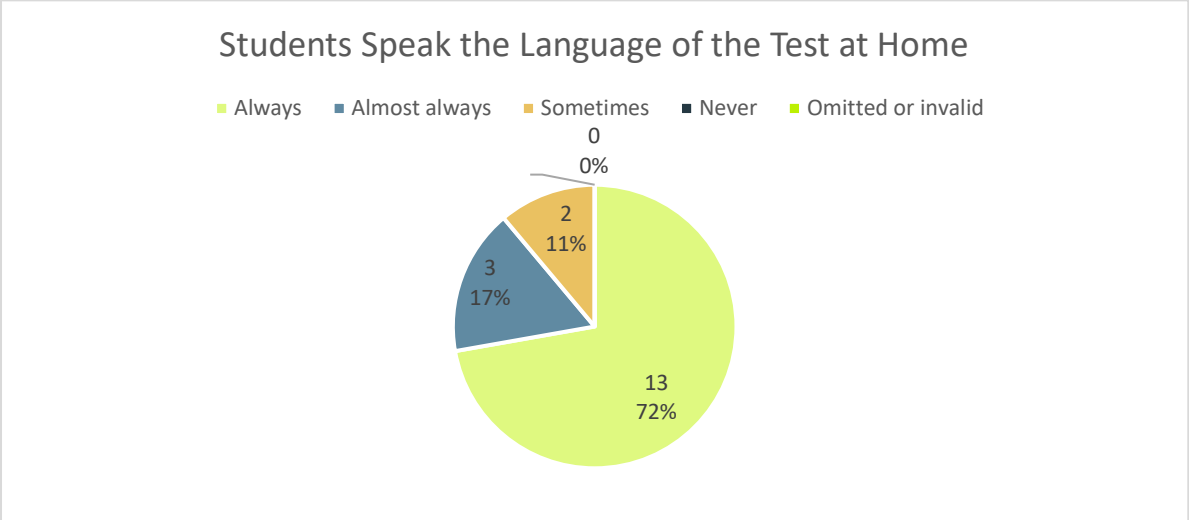

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

Research has shown that the motivation to learn on the part of the students can contribute quite decisively to learning success. Conversely, a lack of motivation can contribute to significantly poorer performance (Deci & Ryan 2009). Motivation also plays an essential role in the formation of an attitude towards a school subject (Mata et al. 2012). We asked your students about their attitudes towards science as a subject.
The items, where students could agree on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I enjoy learning science
- I wish I did not have to study science (reverse)
- Science is boring (reverse)

- I learn many interesting things in science
- I like science
- I look forward to learning science in school
- Science teaches me how things in the world work
- I like to do science experiments
- Science is one of my favorite subjects

In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

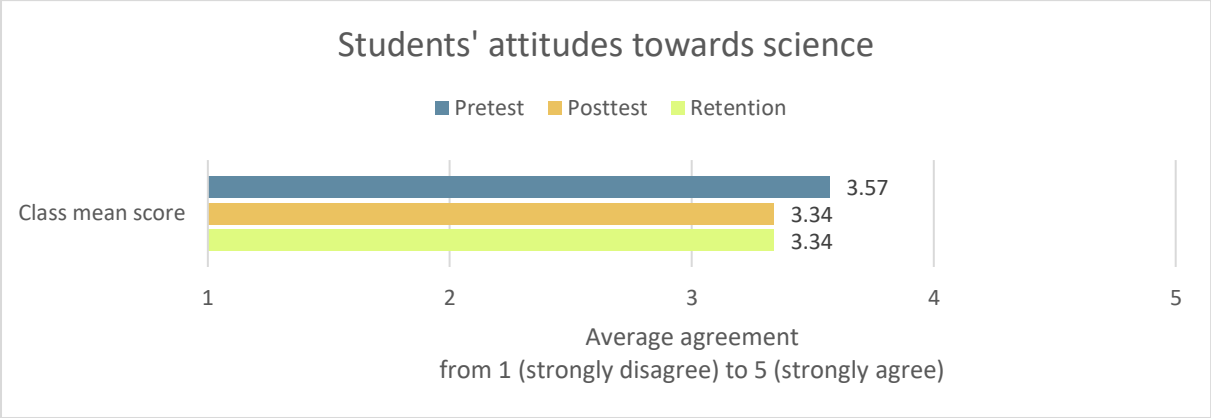

Figure 4: Students' attitudes towards science (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their science lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
- My teacher is easy to understand
- I am interested in what my teacher says
- My teacher gives me interesting things to do
- My teacher has clear answers to my questions
- My teacher is good at explaining science
- My teacher lets me show what I have learned
- My teacher does a variety of things to help us learn
- My teacher tells me how to do better when I make a mistake
- My teacher listens to what I have to say

Did you know how your students feel about their science lessons? Feel free to consider now what factors might have contributed to your students' attitude changes. Please note that your

students' subjective attitudes toward your subject do not constitute an evaluation of your qualities as a teacher.

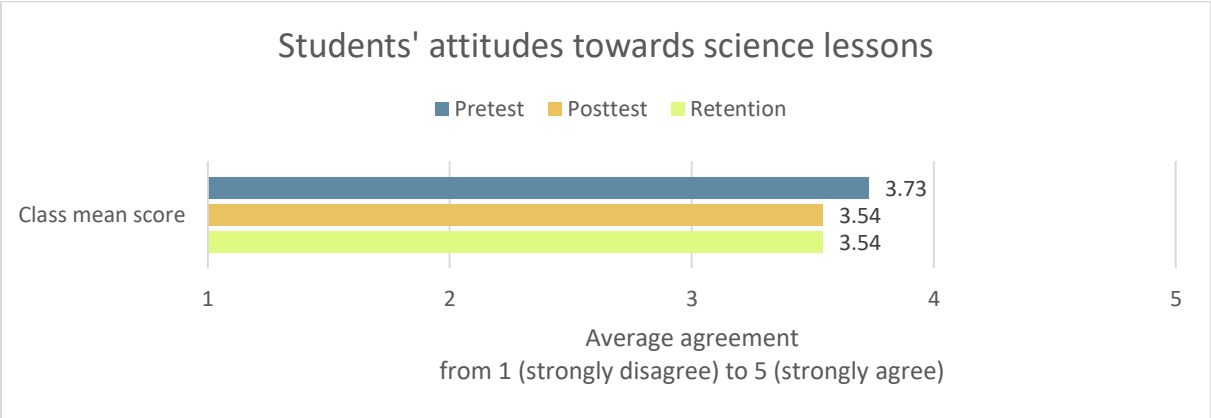

Figure 5: Students' attitudes about their science lessons (pre test, post test & retention test data)

Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
The items for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree) were:

- I usually to well in science
- Science is harder for me than for many of my classmates (reverse)
- I am just not good at science (reverse)
- I learn things quickly in science
- My teacher tells me I am good at science
- Science is harder for me than any other subject (reverse)
- Science makes me confused (reverse)

Are you surprised by the results? Which factors could have promoted or inhibited development?

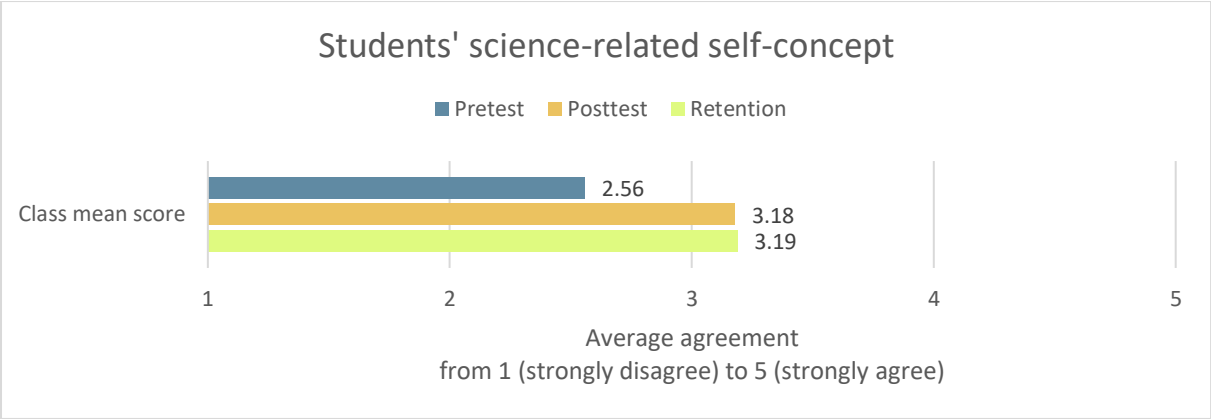

Figure 6: Students' science-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 18 students[1])

In the pre test, the average score in your class is 40,74 % of correct answers.

In the post test, your students scored an average of 41,48 % of correct answers.

In the retention test, your class average is 60,00 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Science

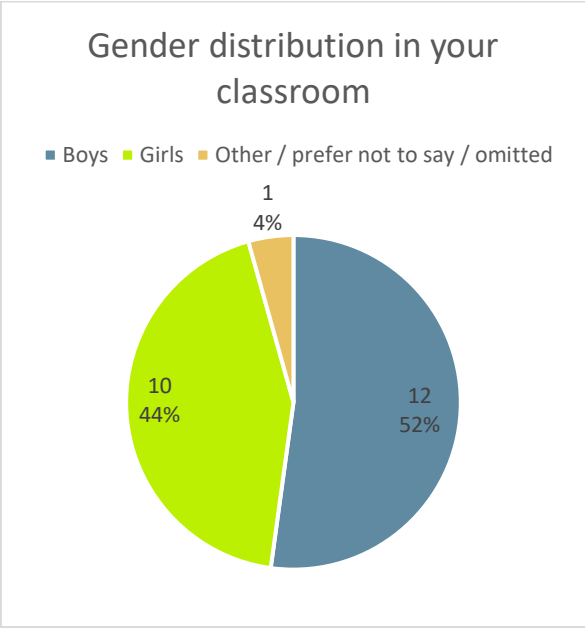
Individual Teacher Feedback for:
2T252

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate science teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.



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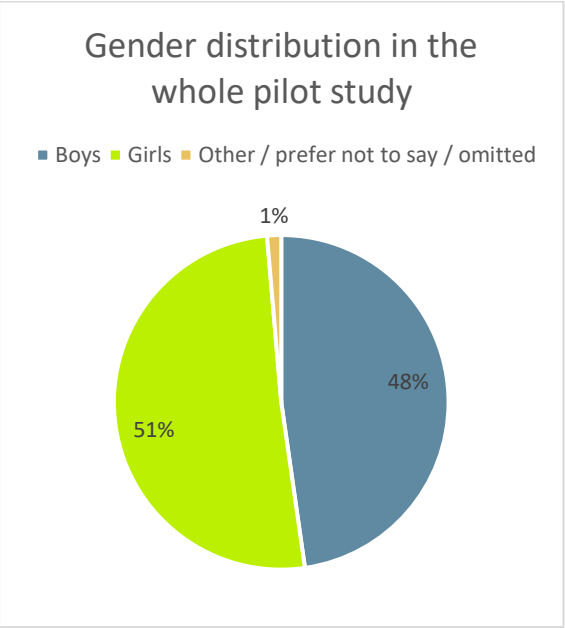

Figure 2: Gender distribution in the whole pilot study

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Students Speak the Language of the Test at Home

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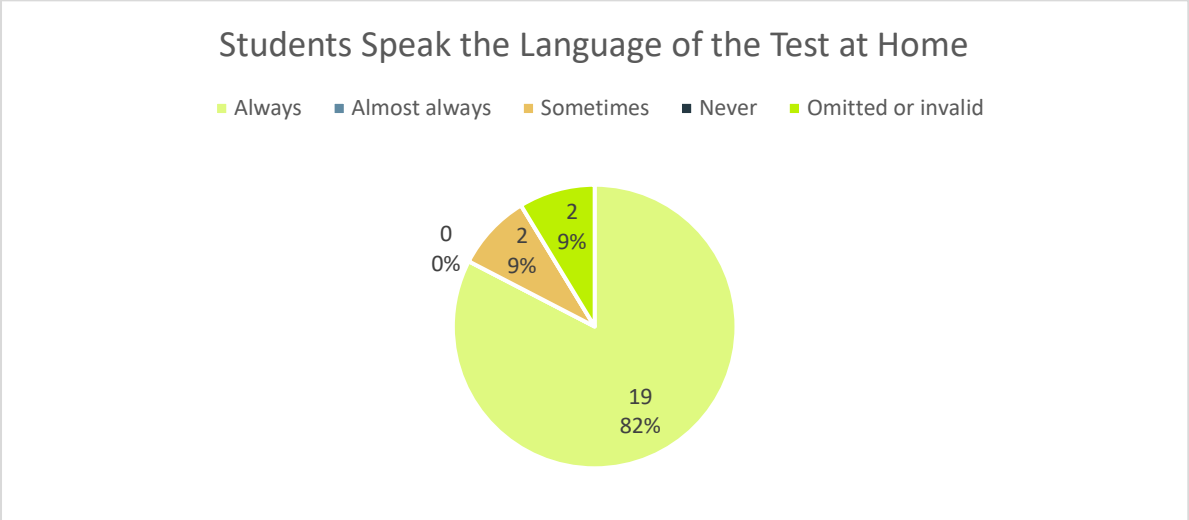

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

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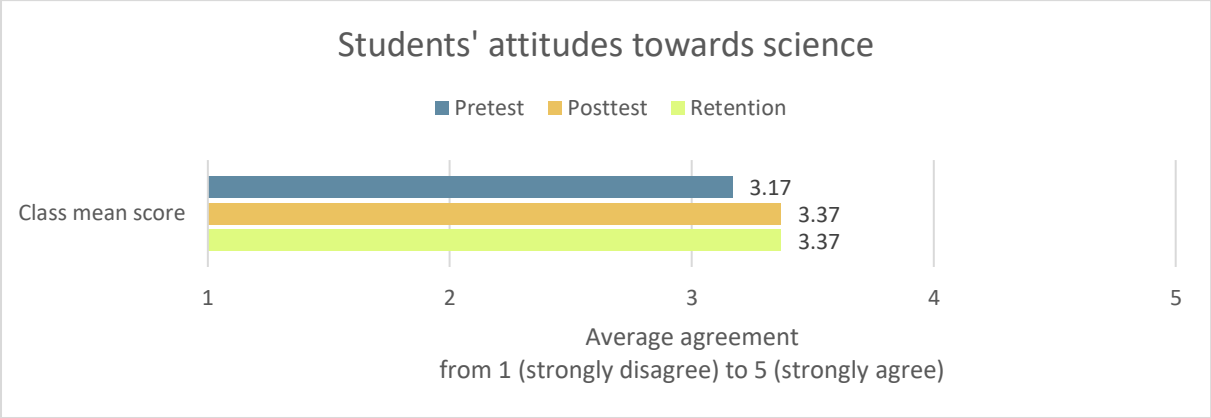

Figure 4: Students' attitudes towards science (pre test, post test & retention test data)

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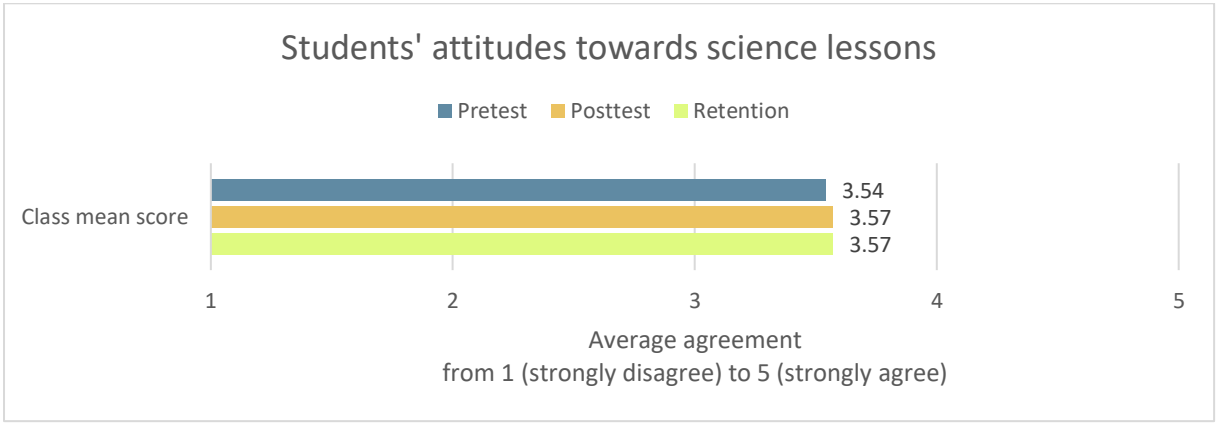

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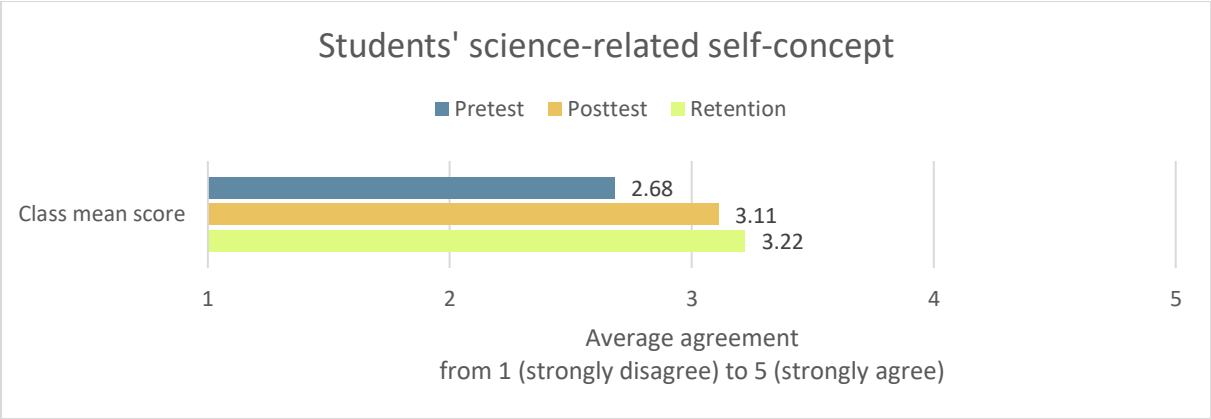

Figure 6: Students' science-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 23 students[1])

In the pre test, the average score in your class is 34,49 % of correct answers.

In the post test, your students scored an average of 51,30 % of correct answers.

In the retention test, your class average is 50,14 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Science

Individual Teacher Feedback for:
2T321

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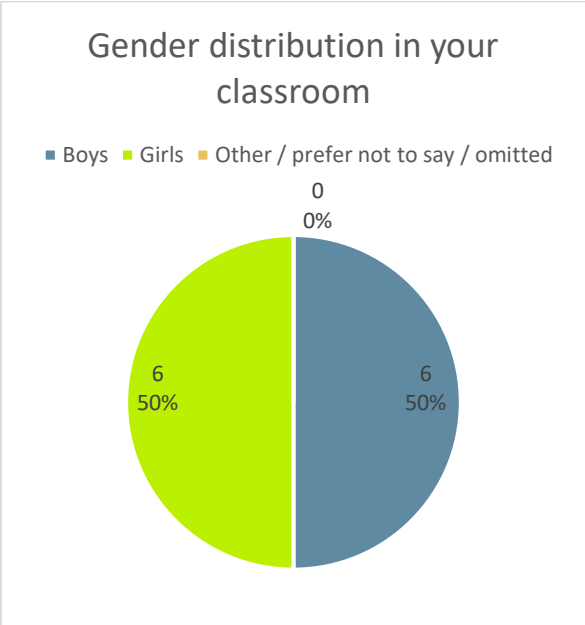

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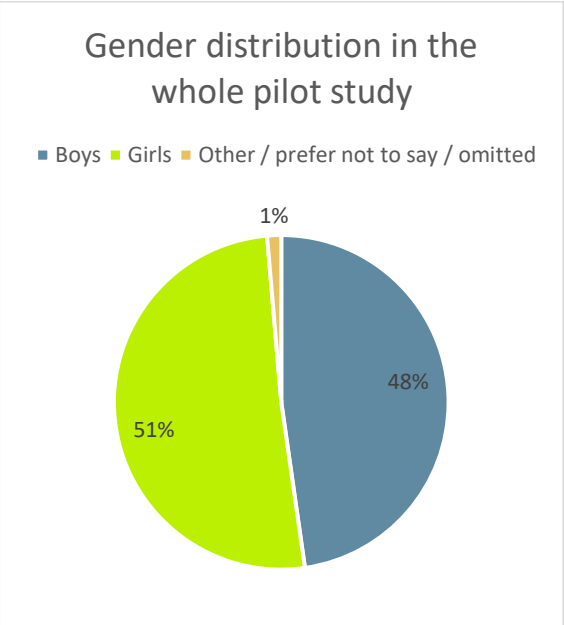

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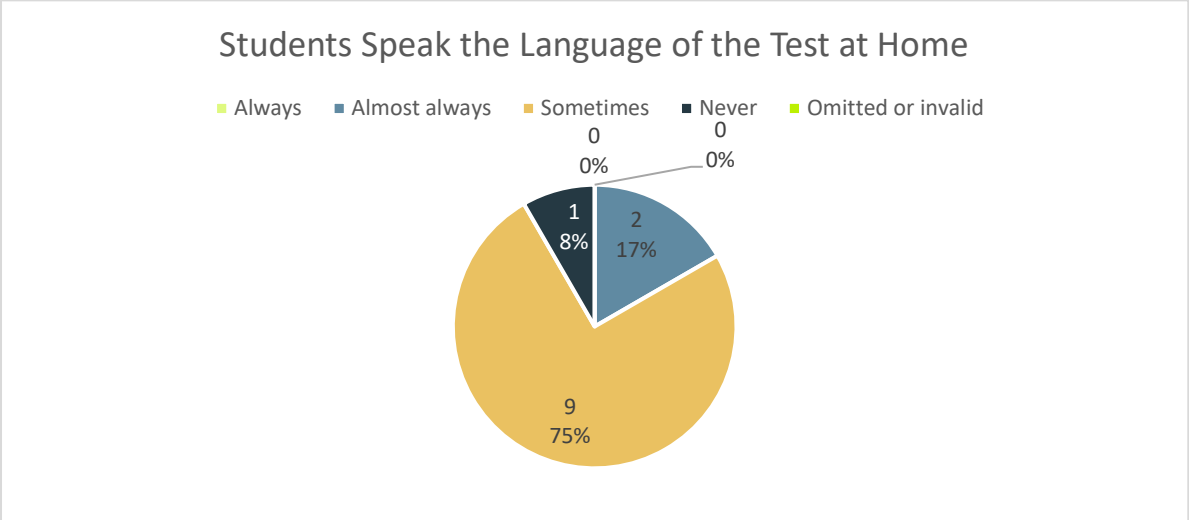

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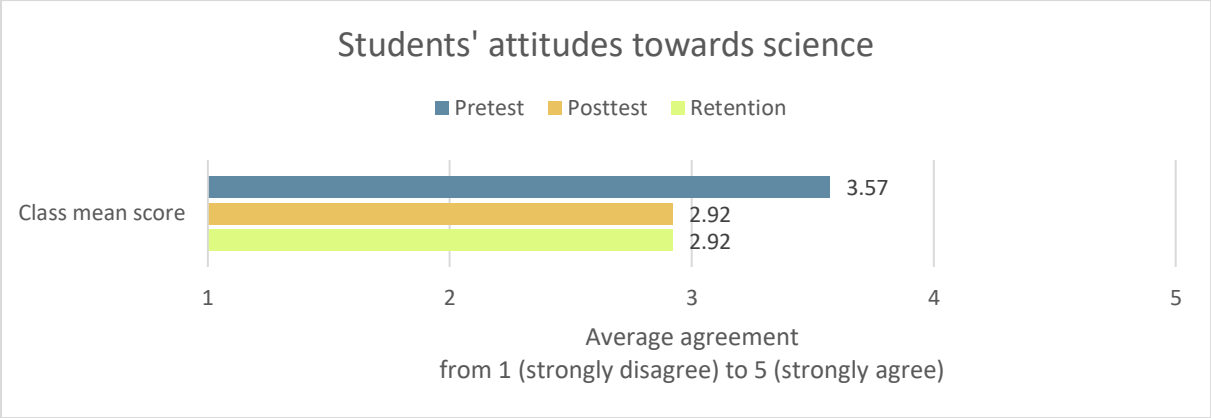

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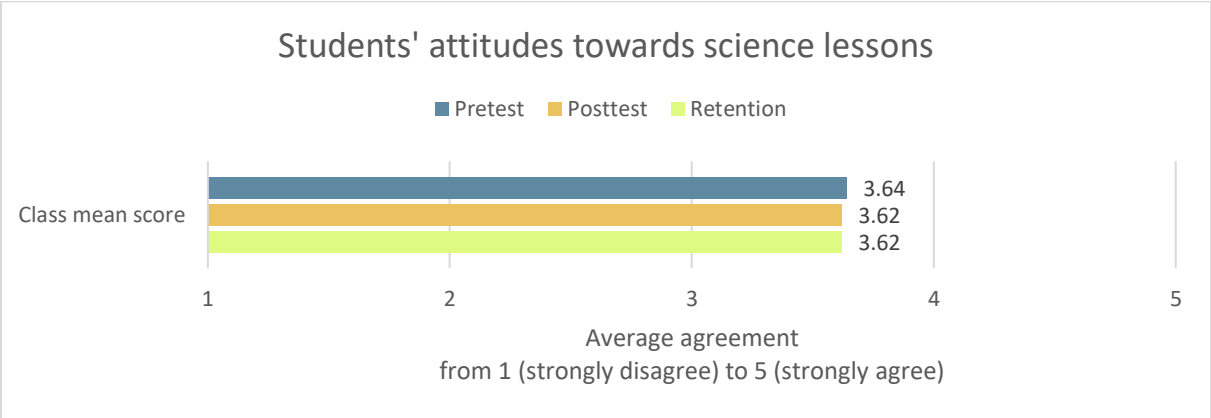

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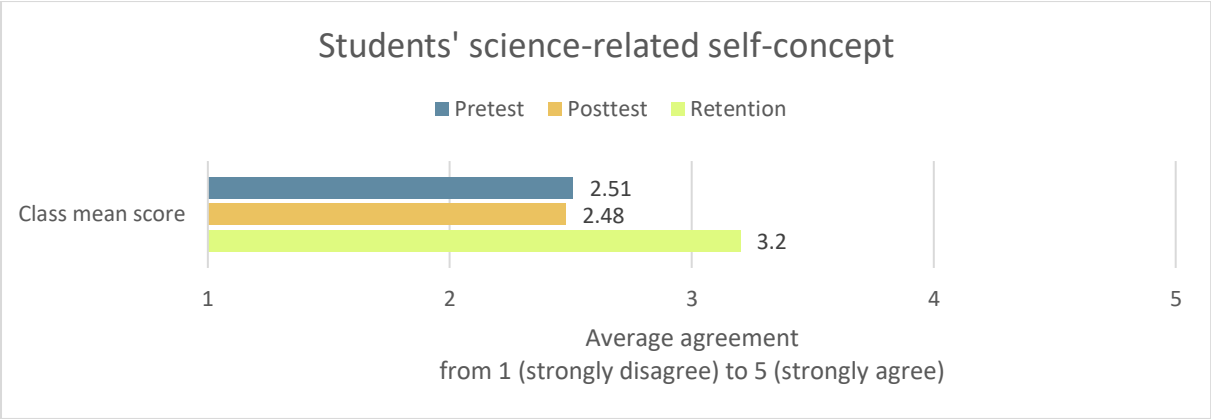

Figure 6: Students' science-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 12 students[1])

In the pre test, the average score in your class is 59,52 % of correct answers.

In the post test, your students scored an average of 80,36 % of correct answers.

In the retention test, your class average is 86,31 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

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ARETE Pilot Study · Pilot 2 · Science

Individual Teacher Feedback for:
2T322

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When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.

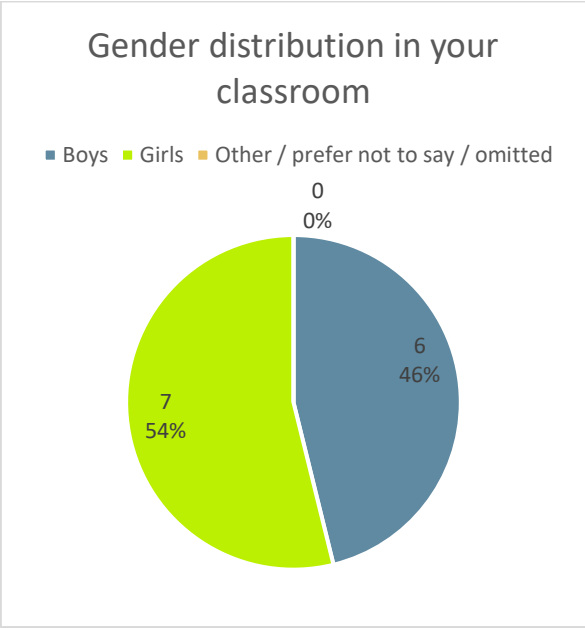

Figure 1: Gender distribution in your classroom

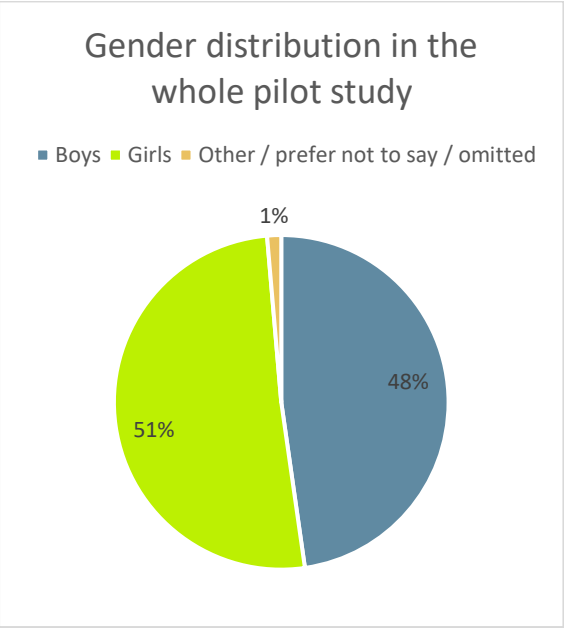

Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 33 of the 58 participating countries show no gender gap in science performance? Only in 7 countries did boys outperform the girls (Mullis et al., 2020). In 18 countries, girls had higher average achievement than boys.

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' science performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in science on average. The 5% of students who "never" speak the test language at home scored the lowest in science (ibid.). To learn more about the correlation between the children's language prerequisites and their science performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).

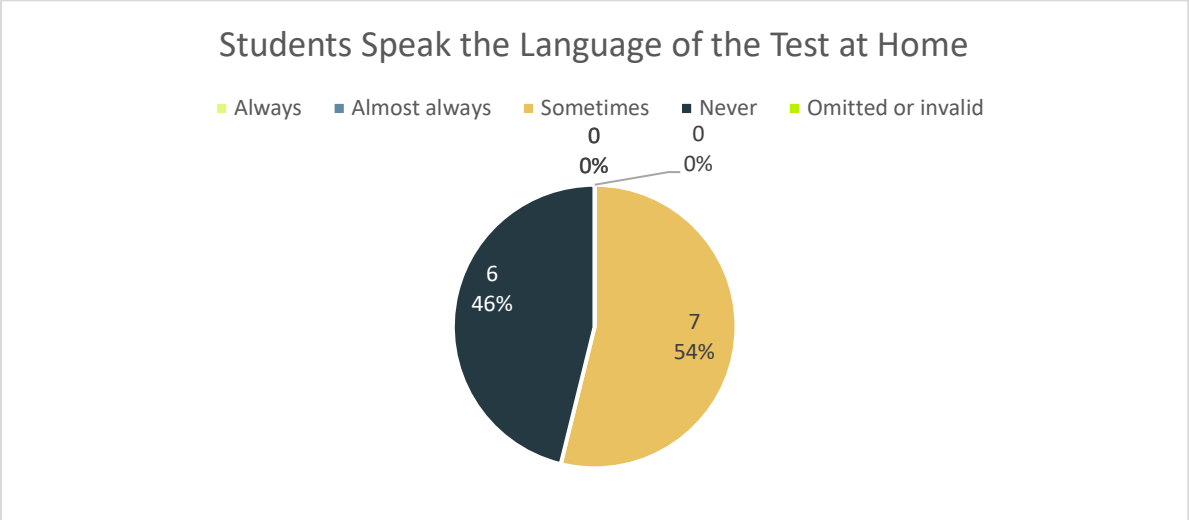

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

Research has shown that the motivation to learn on the part of the students can contribute quite decisively to learning success. Conversely, a lack of motivation can contribute to significantly poorer performance (Deci & Ryan 2009). Motivation also plays an essential role in the formation of an attitude towards a school subject (Mata et al. 2012). We asked your students about their attitudes towards science as a subject.
The items, where students could agree on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I enjoy learning science
- I wish I did not have to study science (reverse)
- Science is boring (reverse)

- I learn many interesting things in science
- I like science
- I look forward to learning science in school
- Science teaches me how things in the world work
- I like to do science experiments
- Science is one of my favorite subjects

In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

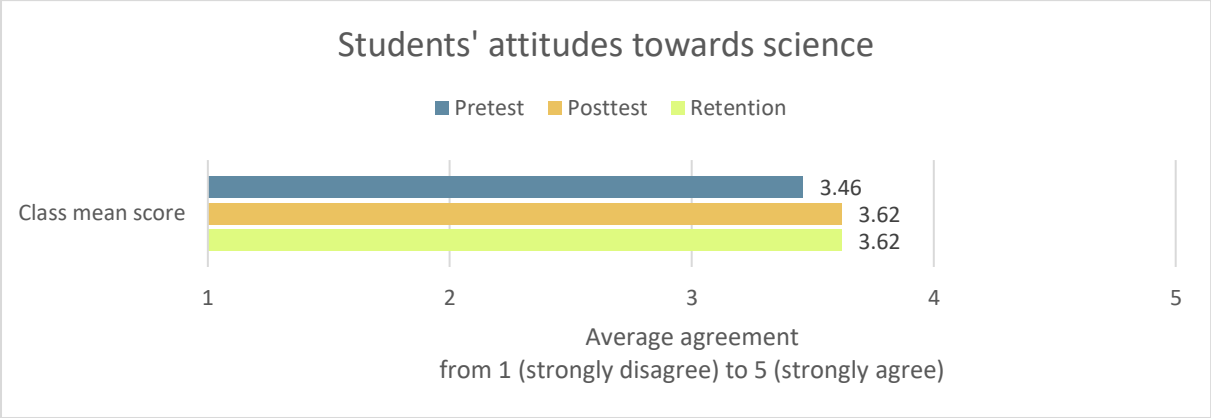

Figure 4: Students' attitudes towards science (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their science lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
- My teacher is easy to understand
- I am interested in what my teacher says
- My teacher gives me interesting things to do
- My teacher has clear answers to my questions
- My teacher is good at explaining science
- My teacher lets me show what I have learned
- My teacher does a variety of things to help us learn
- My teacher tells me how to do better when I make a mistake
- My teacher listens to what I have to say

Did you know how your students feel about their science lessons? Feel free to consider now what factors might have contributed to your students' attitude changes. Please note that your

students' subjective attitudes toward your subject do not constitute an evaluation of your qualities as a teacher.

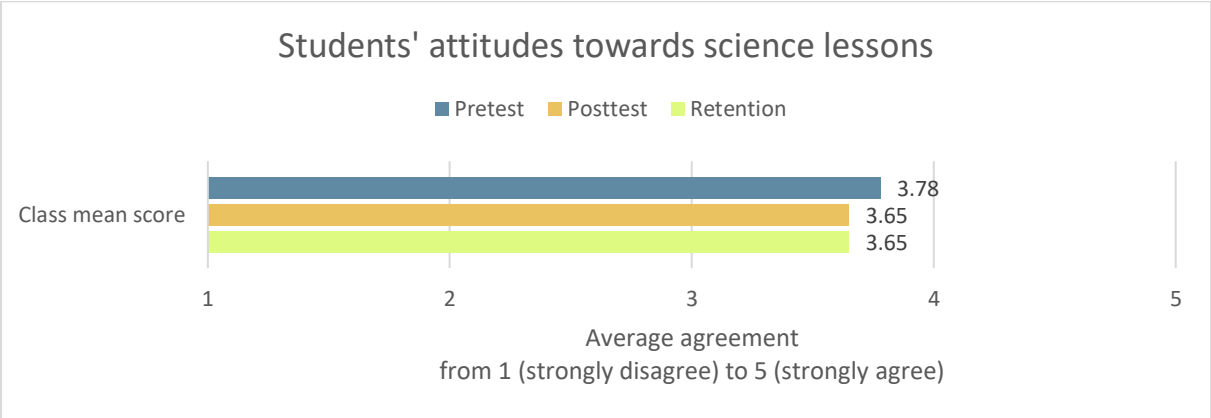

Figure 5: Students' attitudes about their science lessons (pre test, post test & retention test data)

Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
The items for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree) were:

- I usually to well in science
- Science is harder for me than for many of my classmates (reverse)
- I am just not good at science (reverse)
- I learn things quickly in science
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- Science is harder for me than any other subject (reverse)
- Science makes me confused (reverse)

Are you surprised by the results? Which factors could have promoted or inhibited development?

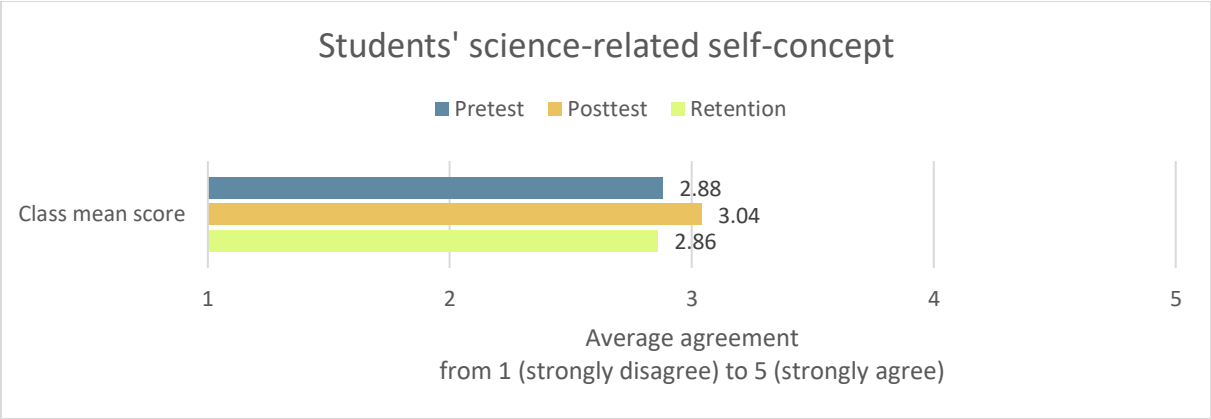

Figure 6: Students' science-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 13 students[1])

In the pre test, the average score in your class is 51,65 % of correct answers.

In the post test, your students scored an average of 63,74 % of correct answers.

In the retention test, your class average is 64,84 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE Pilot Study · Pilot 2 · Science

Individual Teacher Feedback for:
2T381

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate science teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.

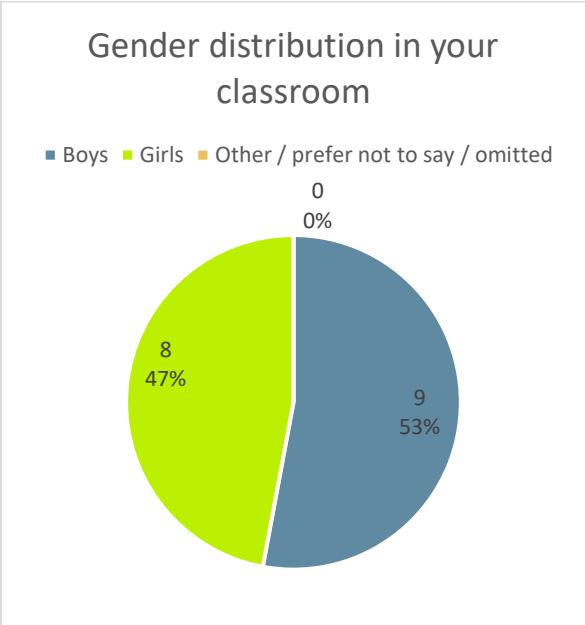

Figure 1: Gender distribution in your classroom

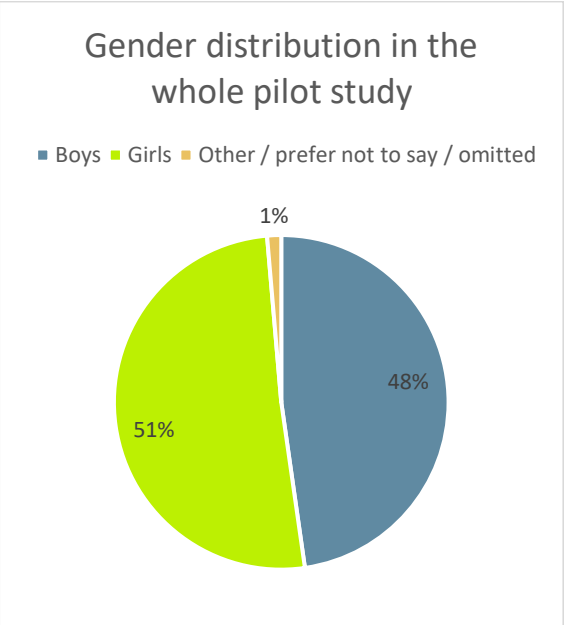

Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 33 of the 58 participating countries show no gender gap in science performance? Only in 7 countries did boys outperform the girls (Mullis et al., 2020). In 18 countries, girls had higher average achievement than boys.

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' science performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in science on average. The 5% of students who "never" speak the test language at home scored the lowest in science (ibid.). To learn more about the correlation between the children's language prerequisites and their science performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).

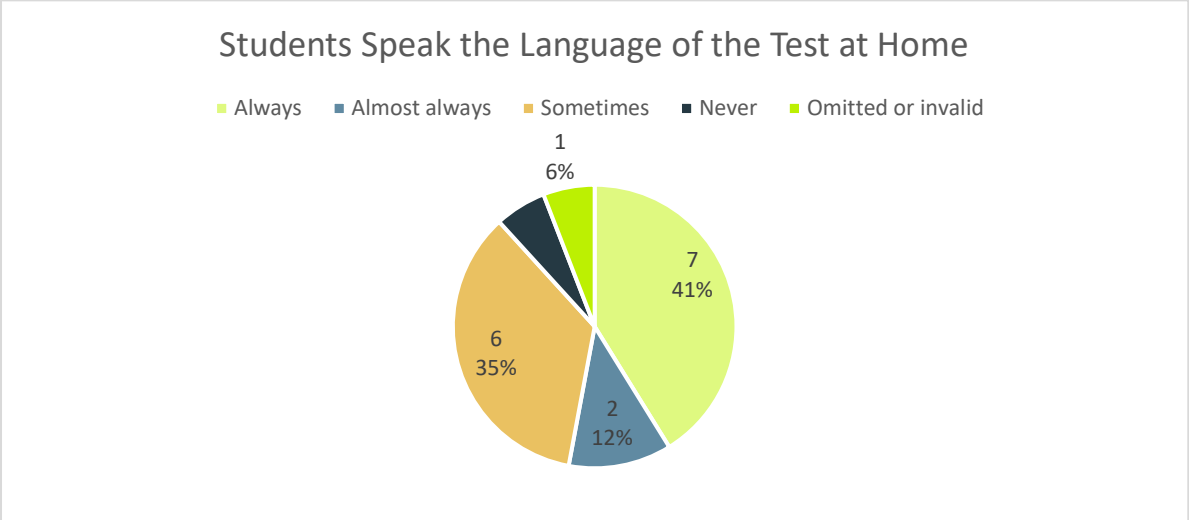

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

Research has shown that the motivation to learn on the part of the students can contribute quite decisively to learning success. Conversely, a lack of motivation can contribute to significantly poorer performance (Deci & Ryan 2009). Motivation also plays an essential role in the formation of an attitude towards a school subject (Mata et al. 2012). We asked your students about their attitudes towards science as a subject.
The items, where students could agree on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I enjoy learning science
- I wish I did not have to study science (reverse)
- Science is boring (reverse)

- I learn many interesting things in science
- I like science
- I look forward to learning science in school
- Science teaches me how things in the world work
- I like to do science experiments
- Science is one of my favorite subjects

In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

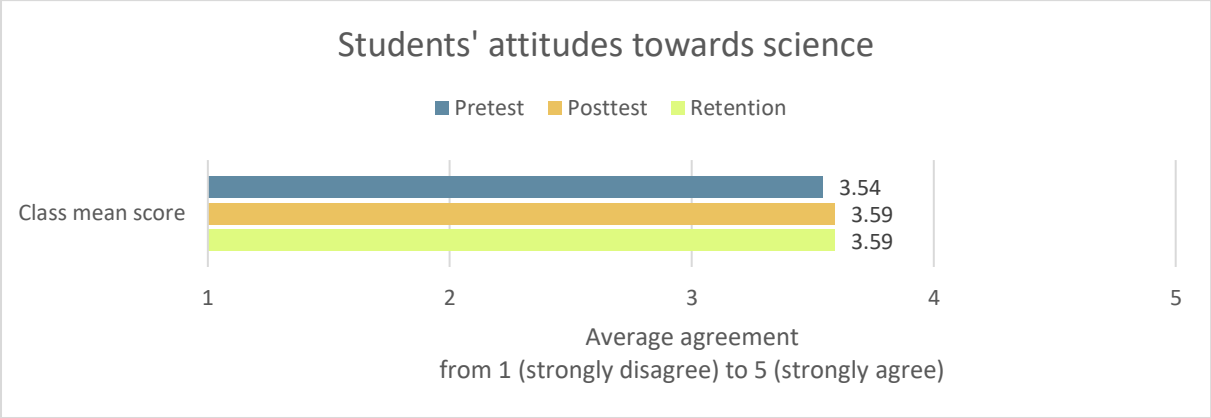

Figure 4: Students' attitudes towards science (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their science lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
- My teacher is easy to understand
- I am interested in what my teacher says
- My teacher gives me interesting things to do
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- My teacher is good at explaining science
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Did you know how your students feel about their science lessons? Feel free to consider now what factors might have contributed to your students' attitude changes. Please note that your

students' subjective attitudes toward your subject do not constitute an evaluation of your qualities as a teacher.

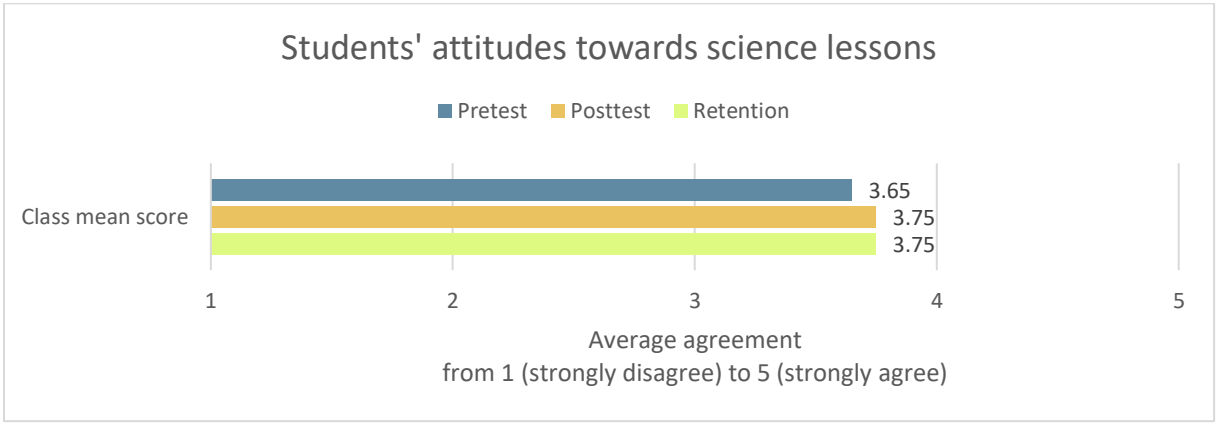

Figure 5: Students' attitudes about their science lessons (pre test, post test & retention test data)

Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
The items for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree) were:

- I usually to well in science
- Science is harder for me than for many of my classmates (reverse)
- I am just not good at science (reverse)
- I learn things quickly in science
- My teacher tells me I am good at science
- Science is harder for me than any other subject (reverse)
- Science makes me confused (reverse)

Are you surprised by the results? Which factors could have promoted or inhibited development?

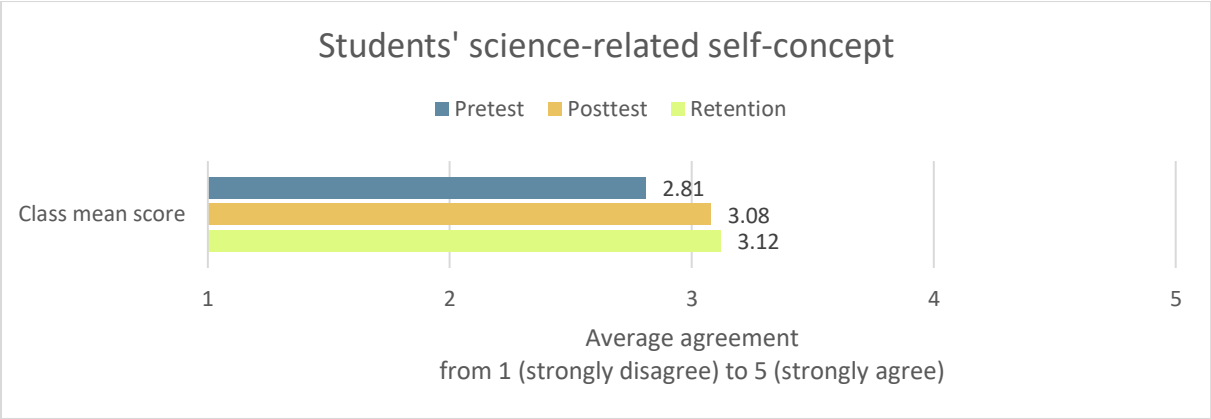

Figure 6: Students' science-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 17 students[1])

In the pre test, the average score in your class is 54,20 % of correct answers.

In the post test, your students scored an average of 71,43 % of correct answers.

In the retention test, your class average is 71,01 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Science

Individual Teacher Feedback for:
2T382

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate science teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.

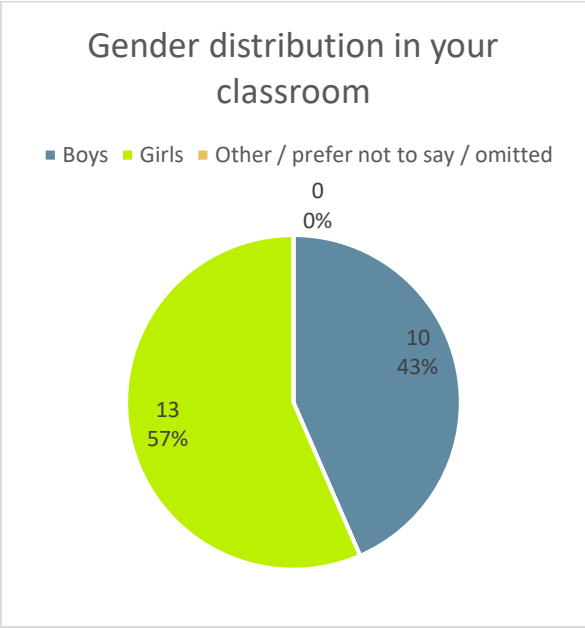

Figure 1: Gender distribution in your classroom

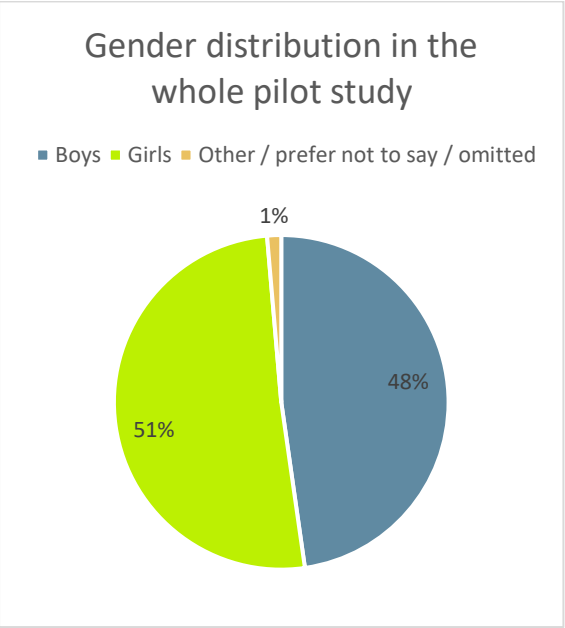

Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 33 of the 58 participating countries show no gender gap in science performance? Only in 7 countries did boys outperform the girls (Mullis et al., 2020). In 18 countries, girls had higher average achievement than boys.

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' science performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in science on average. The 5% of students who "never" speak the test language at home scored the lowest in science (ibid.). To learn more about the correlation between the children's language prerequisites and their science performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).

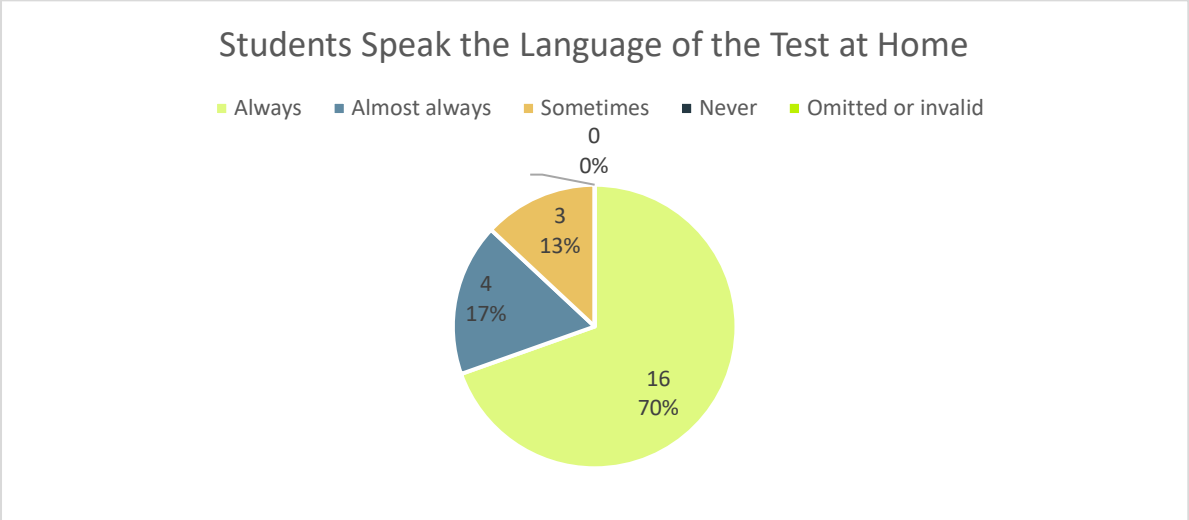

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

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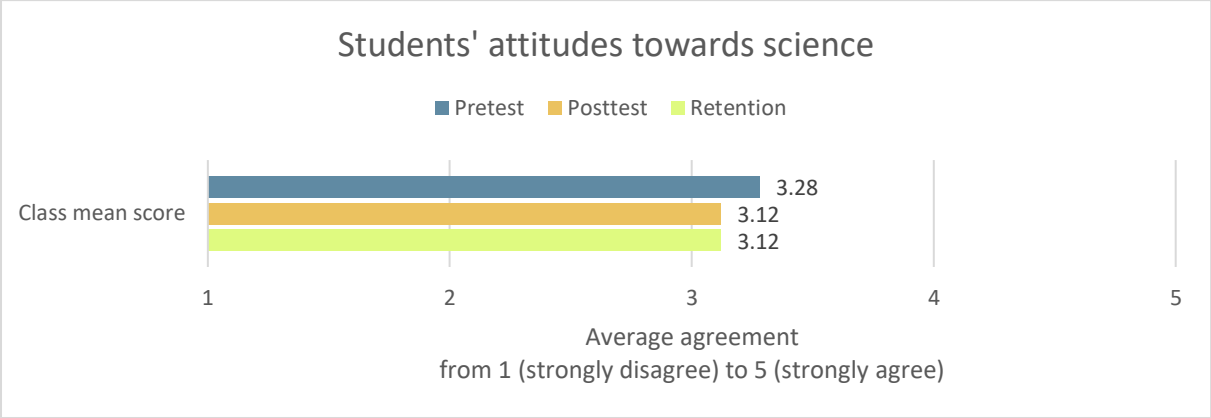

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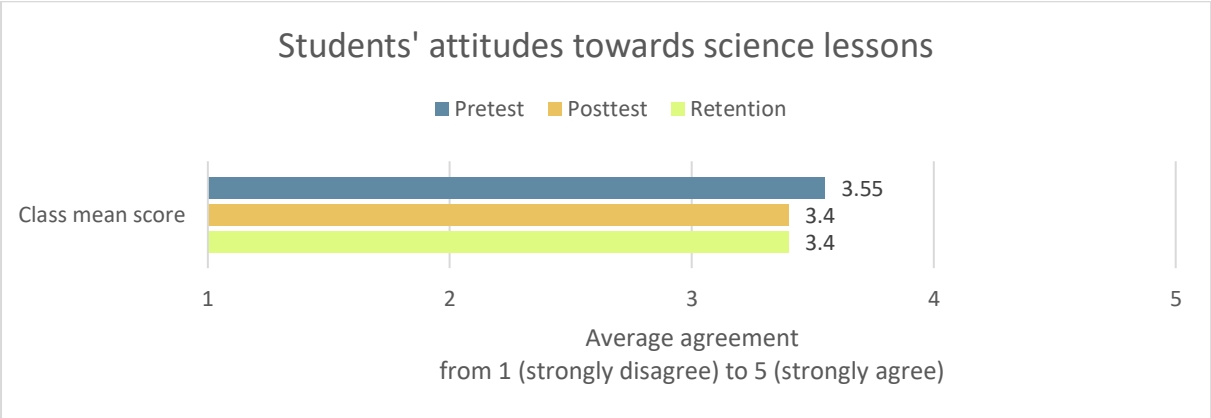

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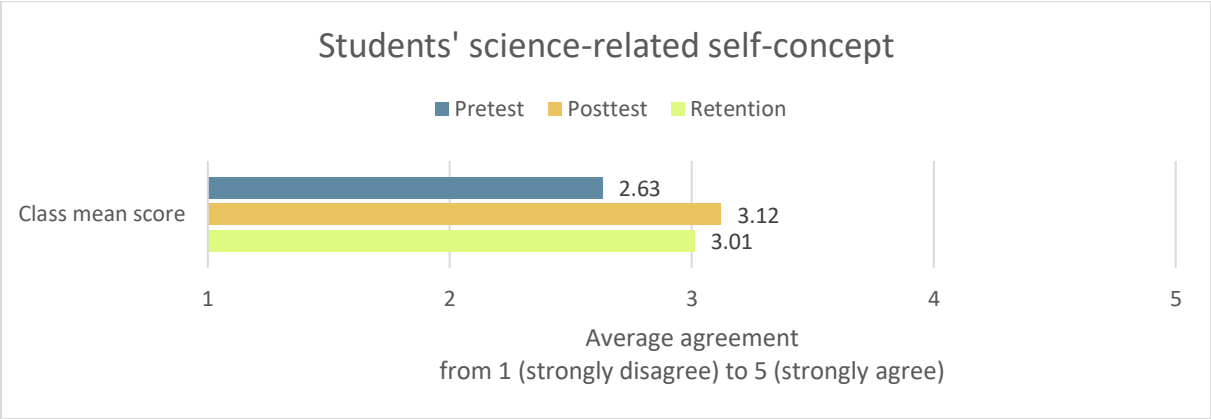

Figure 6: Students' science-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 23 students[1])

In the pre test, the average score in your class is 54,04 % of correct answers.

In the post test, your students scored an average of 55,59 % of correct answers.

In the retention test, your class average is 65,22 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

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ARETE Pilot Study · Pilot 2 · Science

Individual Teacher Feedback for:
2T451

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate science teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

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When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.

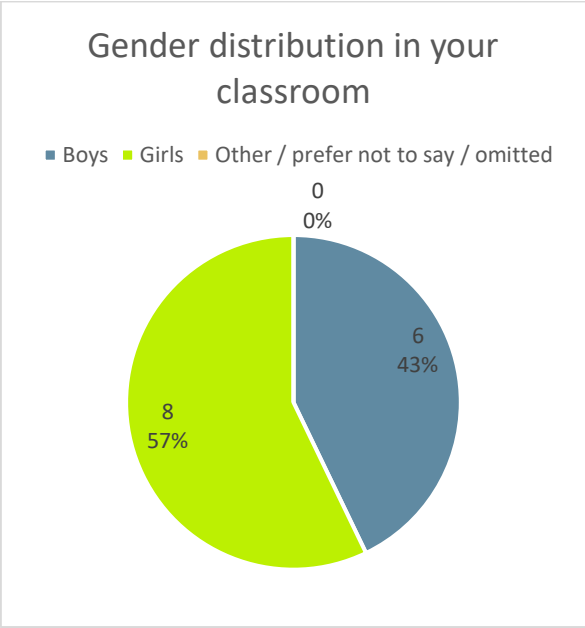
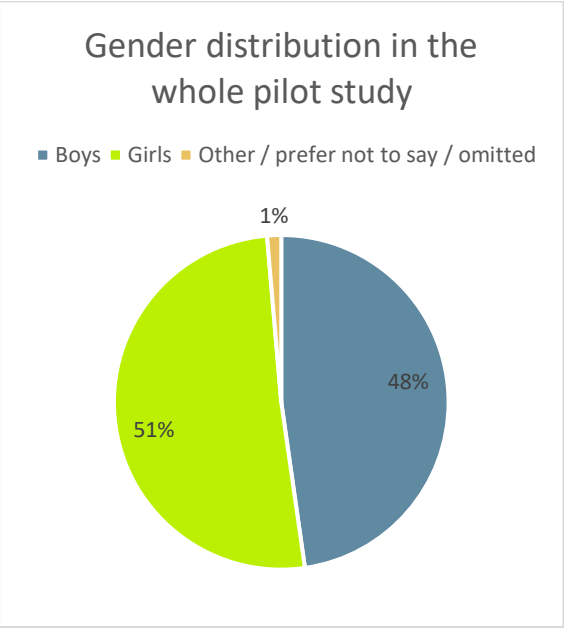


Figure 1: Gender distribution in your classroom



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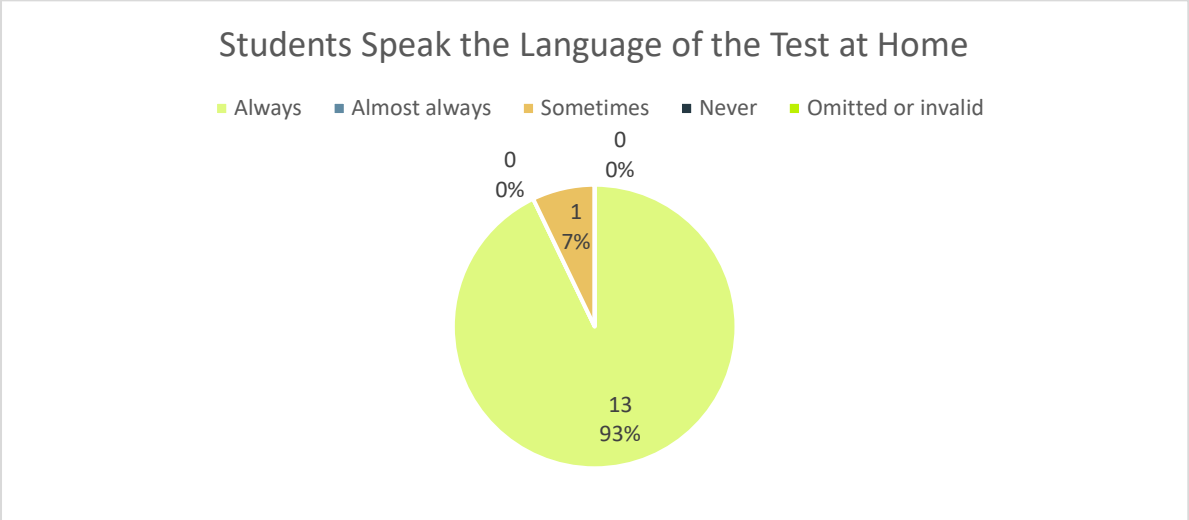

Figure 3: Students speak the language of the test at home (data from pre test context questionnaire).

Students' Attitudes

Research has shown that the motivation to learn on the part of the students can contribute quite decisively to learning success. Conversely, a lack of motivation can contribute to significantly poorer performance (Deci & Ryan 2009). Motivation also plays an essential role in the formation of an attitude towards a school subject (Mata et al. 2012). We asked your students about their attitudes towards science as a subject.
The items, where students could agree on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I enjoy learning science
- I wish I did not have to study science (reverse)
- Science is boring (reverse)

- I learn many interesting things in science
- I like science
- I look forward to learning science in school
- Science teaches me how things in the world work
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In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

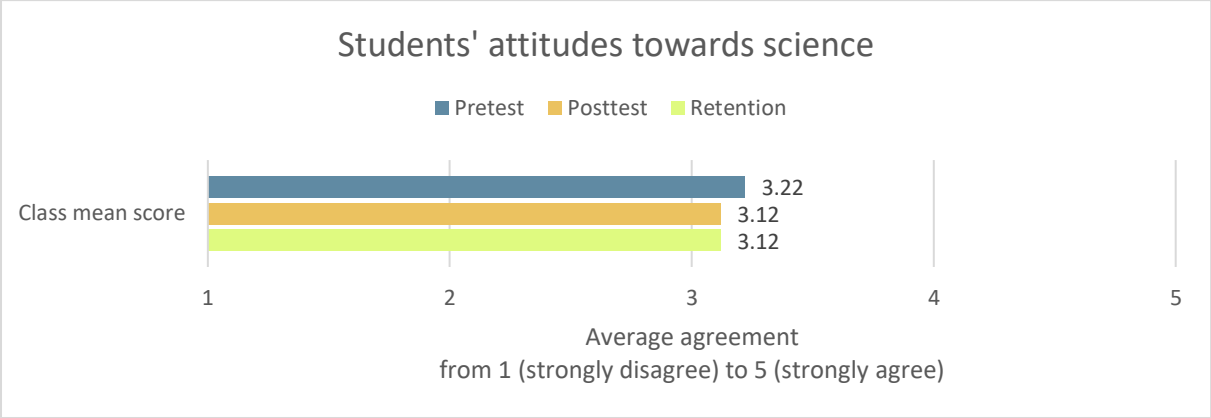

Figure 4: Students' attitudes towards science (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their science lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
- My teacher is easy to understand
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- My teacher gives me interesting things to do
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- My teacher is good at explaining science
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students' subjective attitudes toward your subject do not constitute an evaluation of your qualities as a teacher.

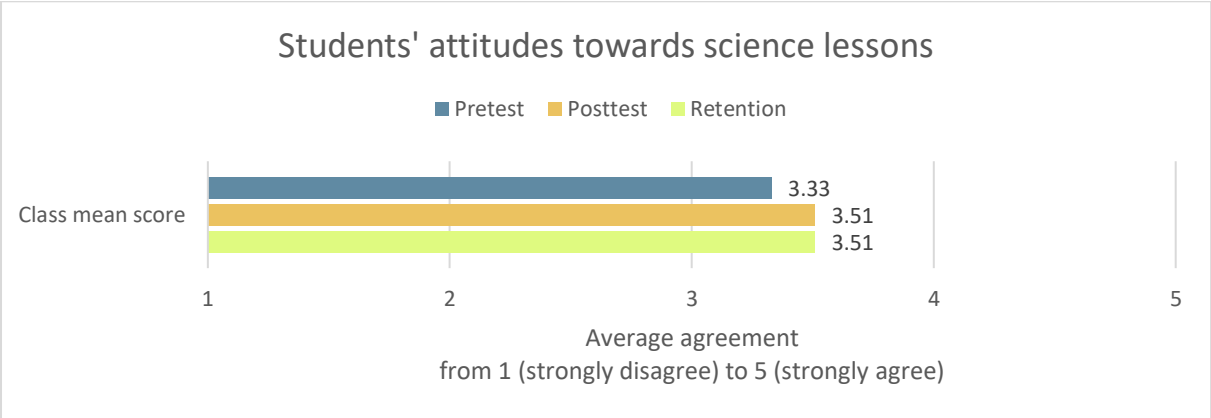

Figure 5: Students' attitudes about their science lessons (pre test, post test & retention test data)

Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
The items for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree) were:

- I usually to well in science
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- Science makes me confused (reverse)

Are you surprised by the results? Which factors could have promoted or inhibited development?

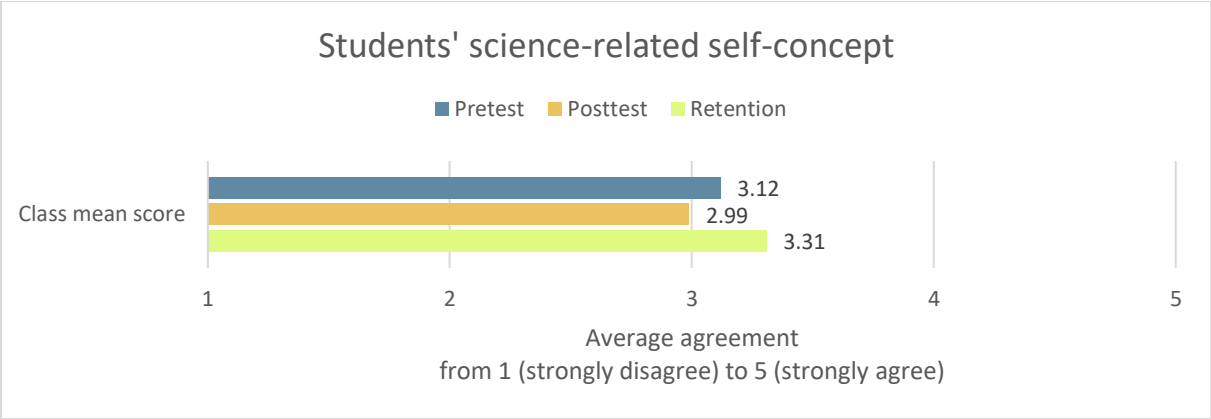

Figure 6: Students' science-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 14 students[1])

In the pre test, the average score in your class is 65,82 % of correct answers.

In the post test, your students scored an average of 72,45 % of correct answers.

In the retention test, your class average is 74,49 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

References

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ARETE

ARETE Pilot Study · Pilot 2 · Science

Individual Teacher Feedback for:
2T452

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate science teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

Socio-Demographic Information (according to pre test)

When completing the testing, all students were asked to select the gender they identify with. Figures 1 and 2 give you an idea about the gender distribution in your classroom relative to the distribution within the ARETE pilot study 2 at large. All data in this chapter are taken from the pre test surveys.

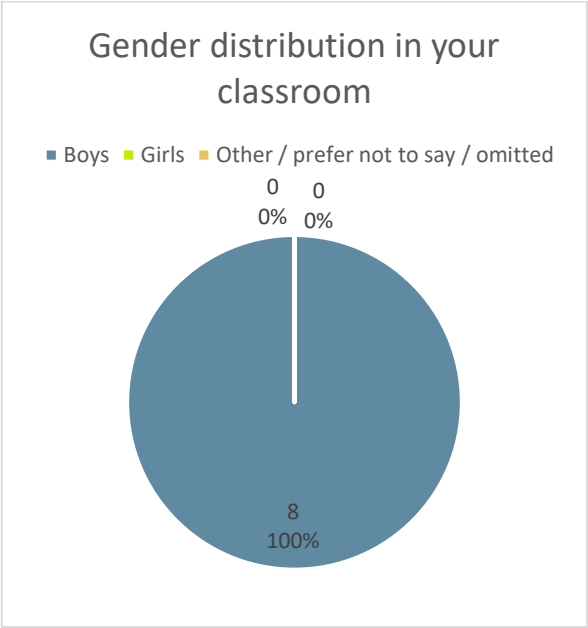


Figure 1: Gender distribution in your classroom

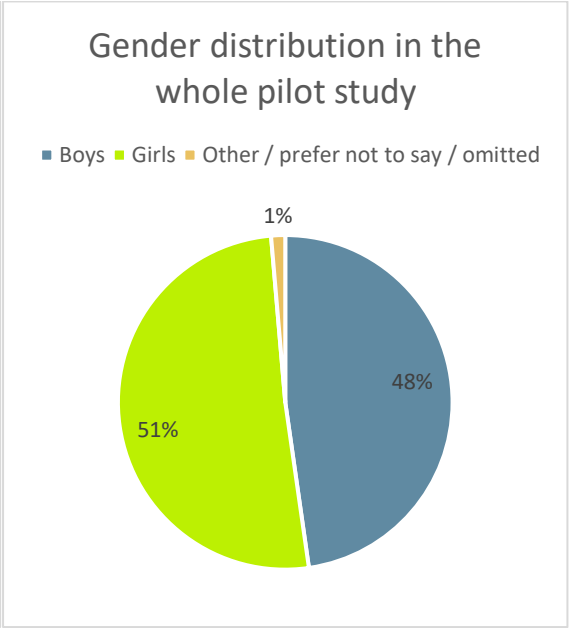


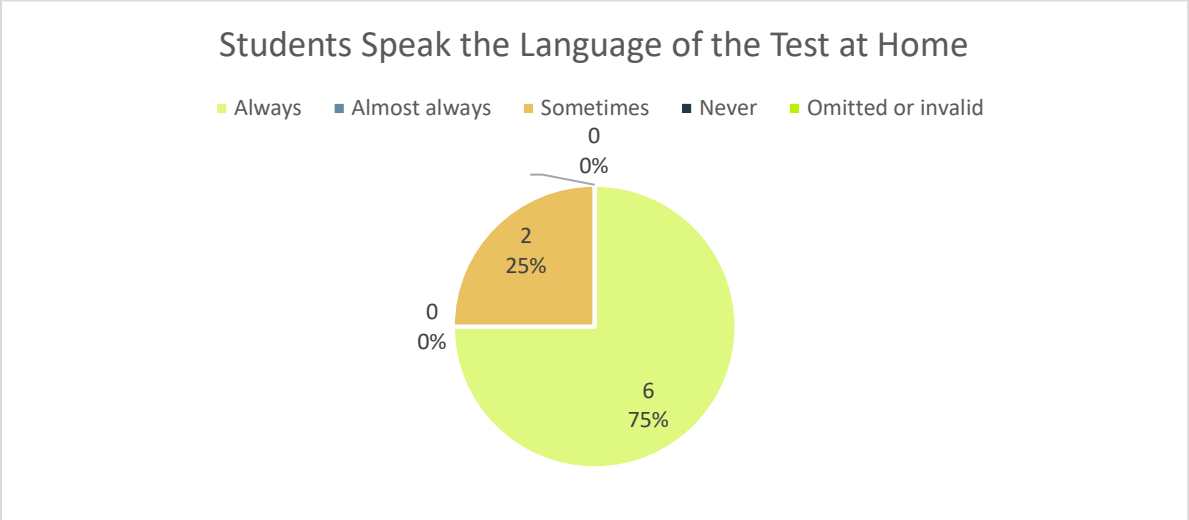
Figure 2: Gender distribution in the whole pilot study

Why Could Gender Distribution Matter?

Did you know that in the 2019 TIMSS international survey of fourth graders, 33 of the 58 participating countries show no gender gap in science performance? Only in 7 countries did boys outperform the girls (Mullis et al., 2020). In 18 countries, girls had higher average achievement than boys.

Students Speak the Language of the Test at Home

We asked students how often they speak the language of the test at home as results from previous TIMSS studies suggest that it can be worthwhile to look at students' science performance from this perspective as well. In the 2019 representative study of 300,000 fourth graders from 58 states (Mullis et al., 2020), 63% of the children "always" spoke the language of the test at home. The 14% who reported "almost always speaking the test language at home", but basically live bilingually, scored the highest in science on average. The 5% of students who "never" speak the test language at home scored the lowest in science (ibid.). To learn more about the correlation between the children's language prerequisites and their science performance in your country, you can have a look at the detailed TIMSS 2019 (Mullis et al., 2020, Exhibit 5.7). To allow you to relate these representative results to your own context, we have visualized your students' response distribution for you below (Figure 3).



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Students' Attitudes

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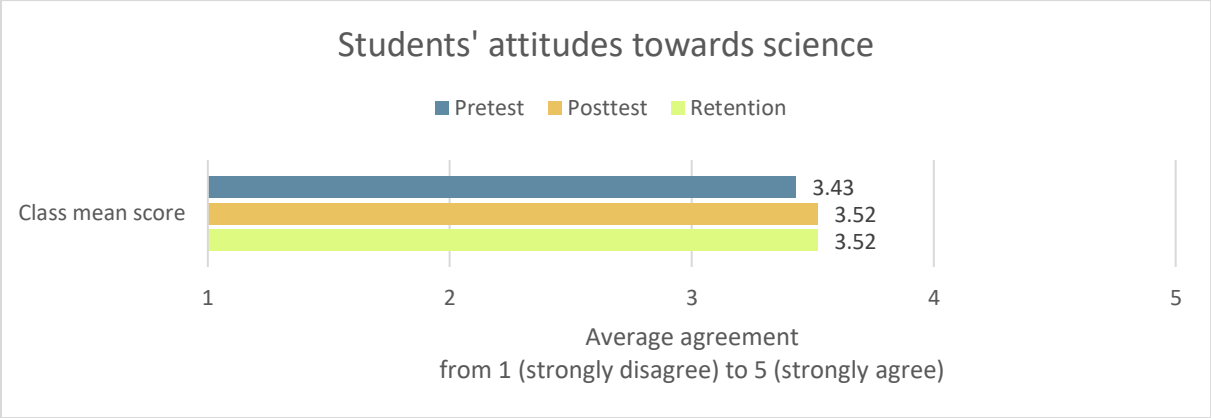

Figure 4: Students' attitudes towards science (pre test, post test & retention test data)

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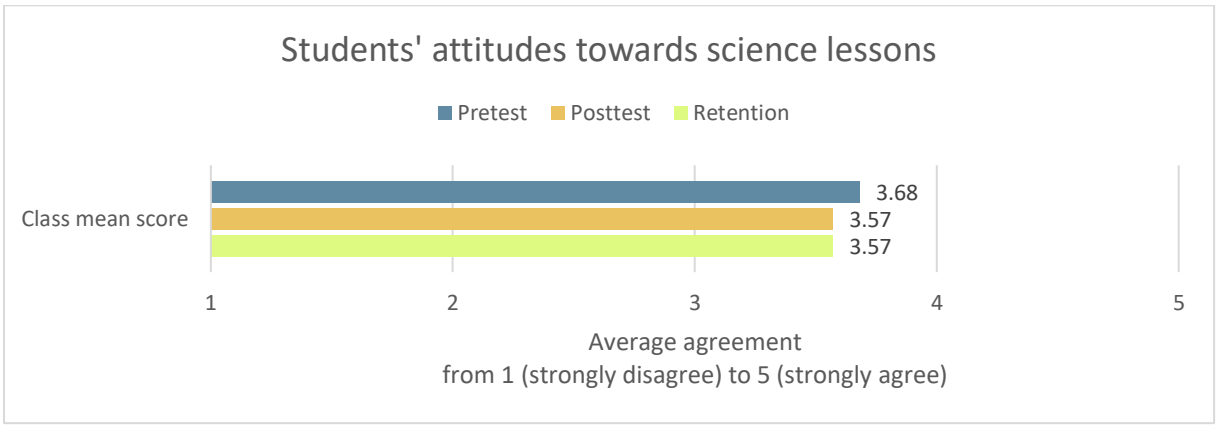

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Are you surprised by the results? Which factors could have promoted or inhibited development?

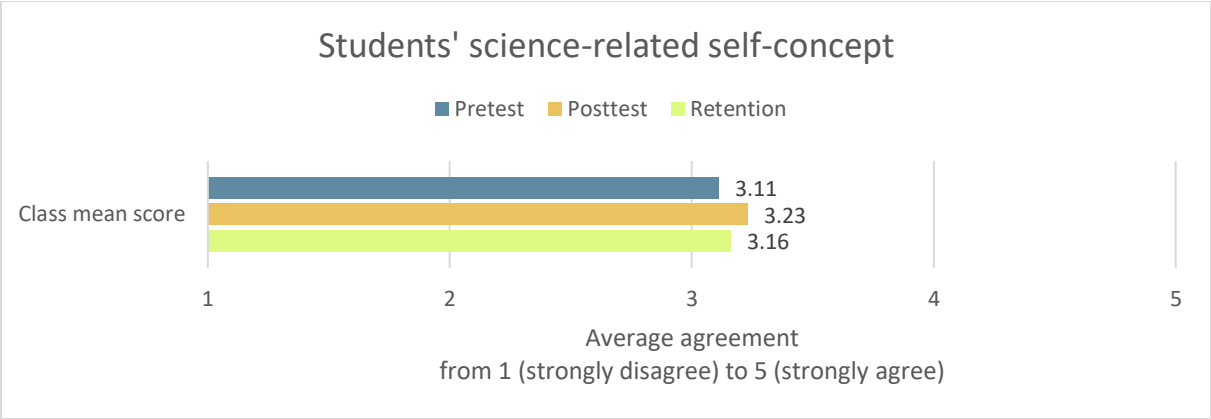

Figure 6: Students' science-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 8 students[1])

In the pre test, the average score in your class is 55,36 % of correct answers.

In the post test, your students scored an average of 61,61 % of correct answers.

In the retention test, your class average is 67,86 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

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References

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ARETE Pilot Study · Pilot 2 · Science

Individual Teacher Feedback for:
2T561

Dear ARETE pilot teacher,

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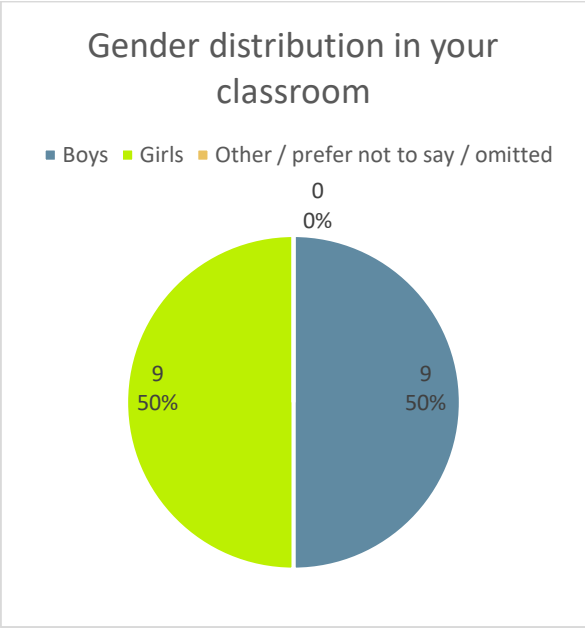

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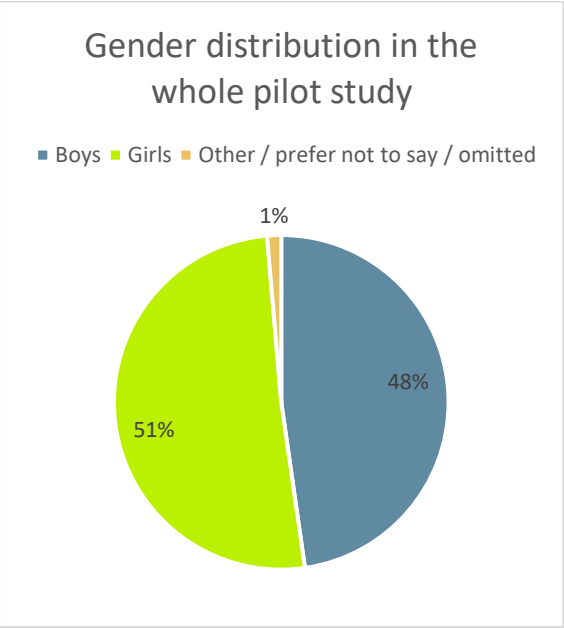

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Why Could Gender Distribution Matter?

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Students Speak the Language of the Test at Home

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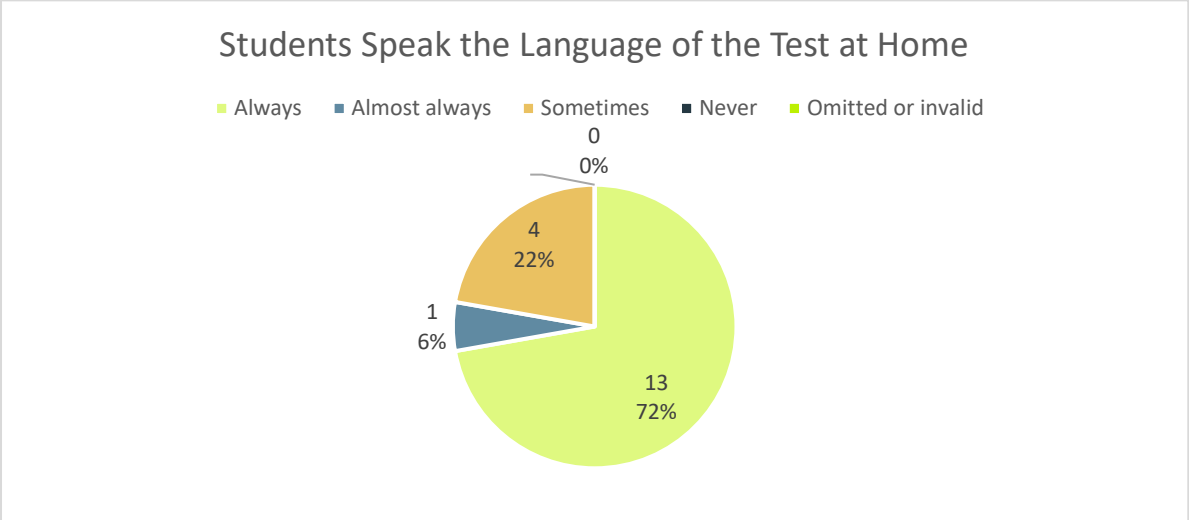

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Students' Attitudes

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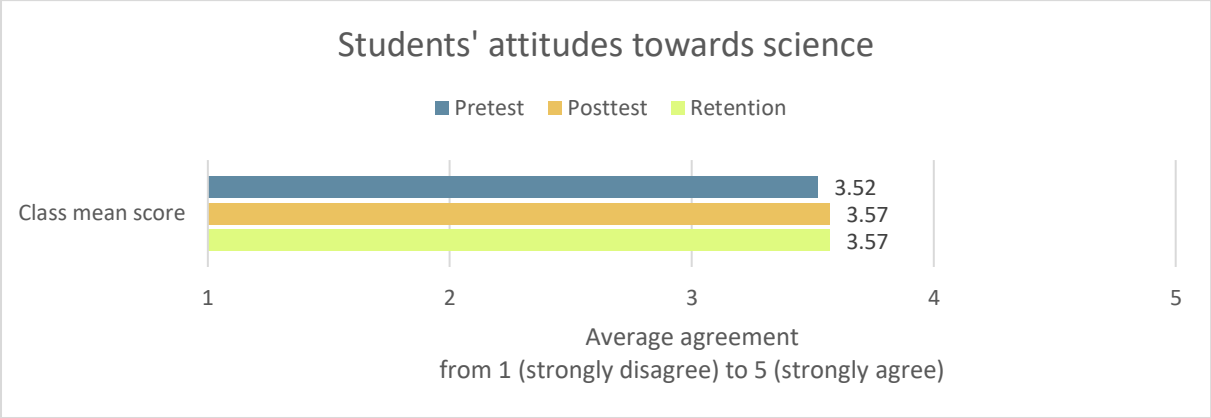

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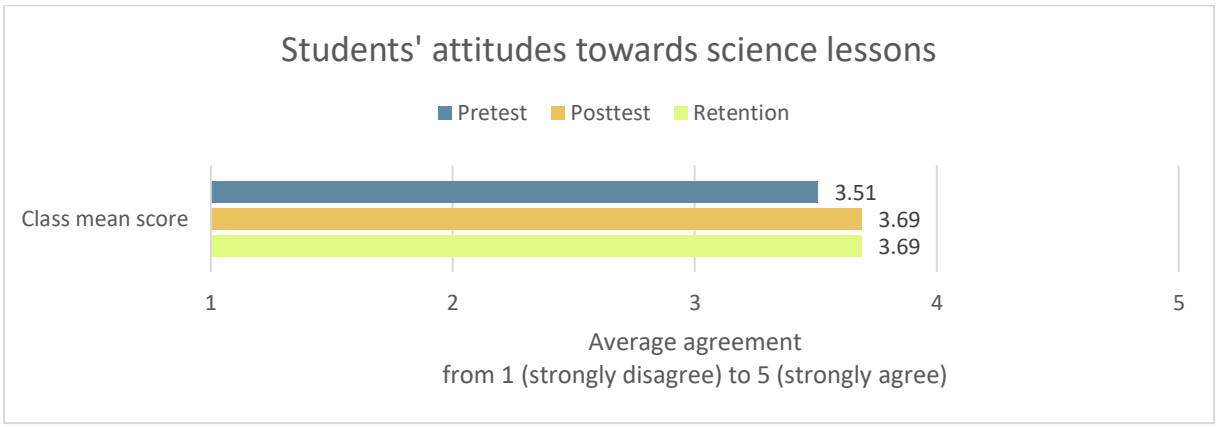

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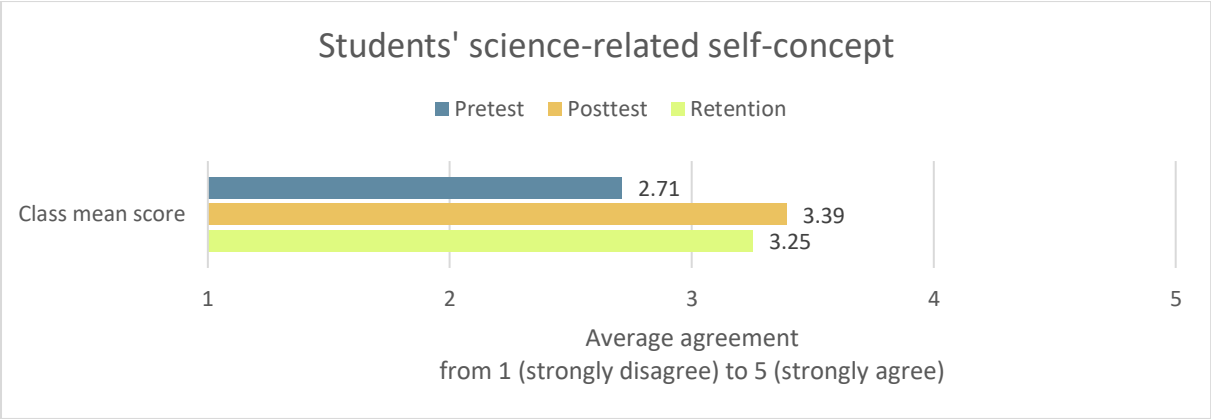

Figure 6: Students' science-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 18 students[1])

In the pre test, the average score in your class is 45,56 % of correct answers.

In the post test, your students scored an average of 52,22 % of correct answers.

In the retention test, your class average is 54,81 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

The ARETE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856533.

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ARETE Pilot Study · Pilot 2 · Science

Individual Teacher Feedback for:
2T562

Dear ARETE pilot teacher,

Thank you for your engagement in our study on the use of augmented reality to facilitate science teaching and learning in the primary school classroom. The ARETE team very much appreciates the time you took beforehand, but also within your classes. As a token of our appreciation, we would like to share with you the results of the testing with your students. We hope that your individual feedback will provide you with valuable insights and impulses for your work with your students.

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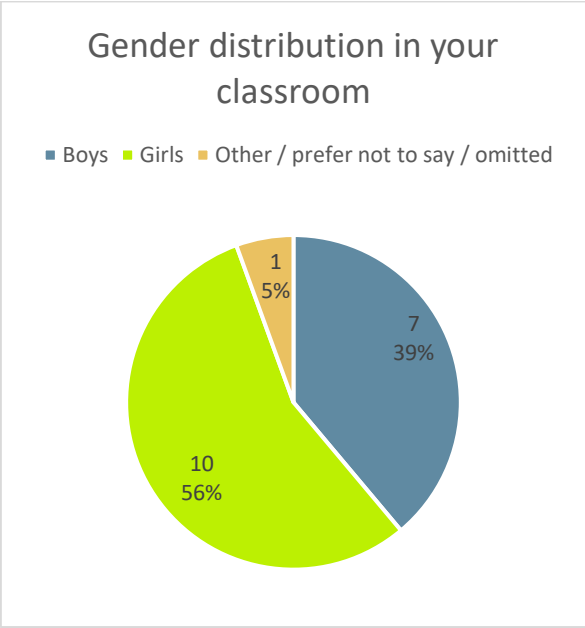

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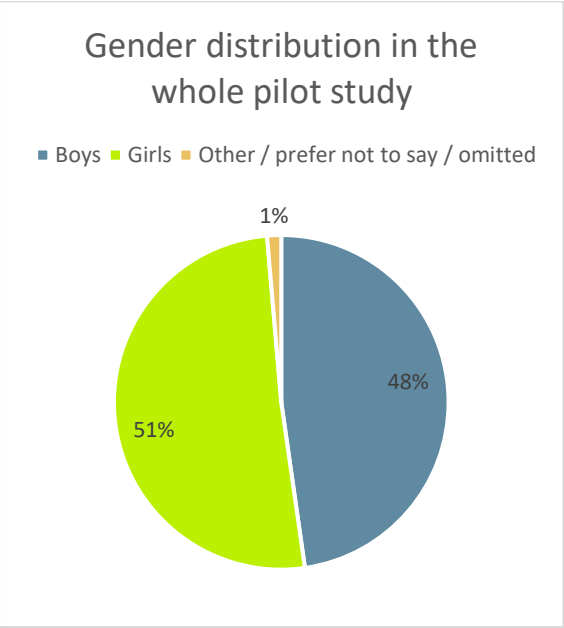

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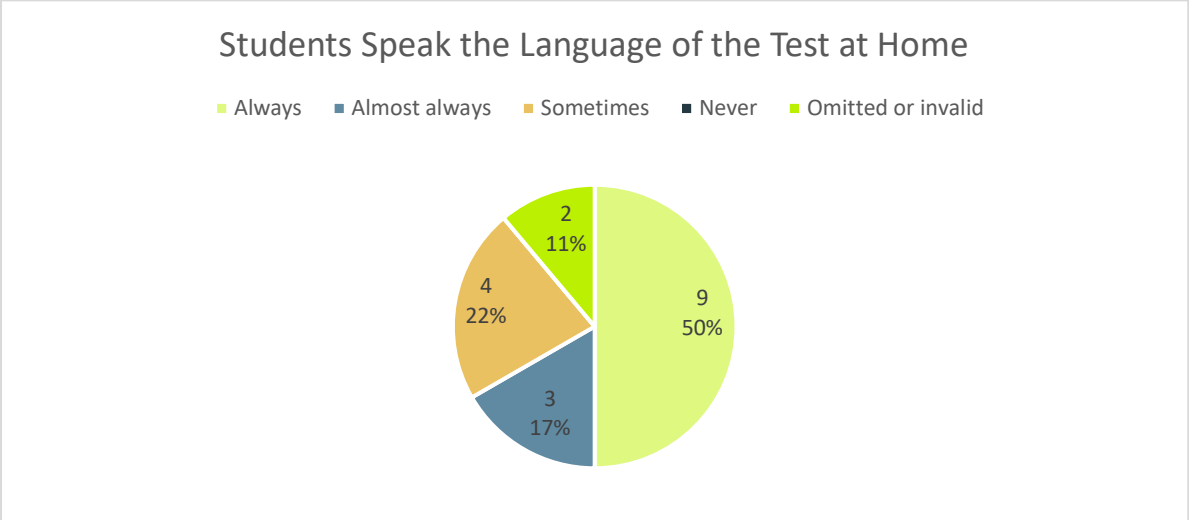

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- Science is one of my favorite subjects

In Figure 4, we have compiled the average scores of your class at our three different measurement time points. You can see here if and to what extent your students' attitudes have changed. On this basis, you can further consider what might have led to these changes.

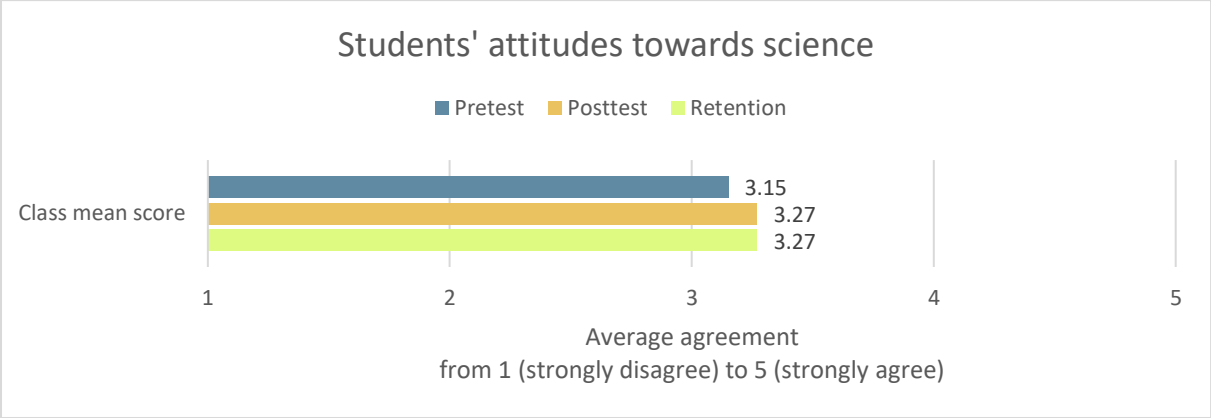

Figure 4: Students' attitudes towards science (pre test, post test & retention test data)

You can further explore these considerations by looking at your students' responses according to their attitudes toward their science lessons. In the chart below (Figure 5), you can see how these attitudes have evolved between our three measurement points.
The items, again for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree), were:

- I know what my teacher expects me to do
- My teacher is easy to understand
- I am interested in what my teacher says
- My teacher gives me interesting things to do
- My teacher has clear answers to my questions
- My teacher is good at explaining science
- My teacher lets me show what I have learned
- My teacher does a variety of things to help us learn
- My teacher tells me how to do better when I make a mistake
- My teacher listens to what I have to say

Did you know how your students feel about their science lessons? Feel free to consider now what factors might have contributed to your students' attitude changes. Please note that your

students' subjective attitudes toward your subject do not constitute an evaluation of your qualities as a teacher.

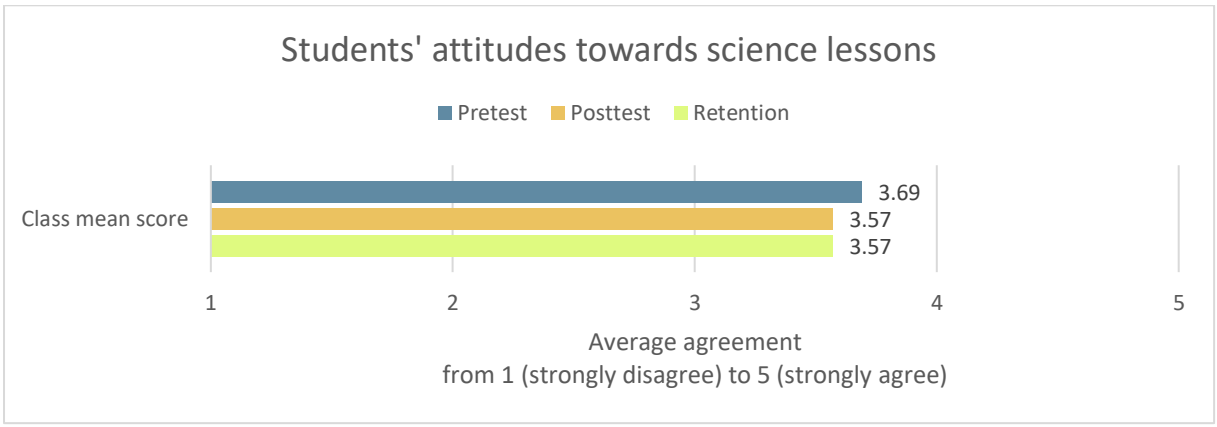

Figure 5: Students' attitudes about their science lessons (pre test, post test & retention test data)

Your students' self-concept regarding their own learning success in your school subject can also have a significant impact on performance (Deci & Ryan 2009). Do students have high or low confidence in their own performance? Do your students receive affirmation from their teacher? We also explored these and other questions. In the graph below (Figure 6), you can see the changes in your students' self-concept at our three measurement points.
The items for agreement on a scale from 1 (strongly disagree) to 5 (strongly agree) were:

- I usually to well in science
- Science is harder for me than for many of my classmates (reverse)
- I am just not good at science (reverse)
- I learn things quickly in science
- My teacher tells me I am good at science
- Science is harder for me than any other subject (reverse)
- Science makes me confused (reverse)

Are you surprised by the results? Which factors could have promoted or inhibited development?

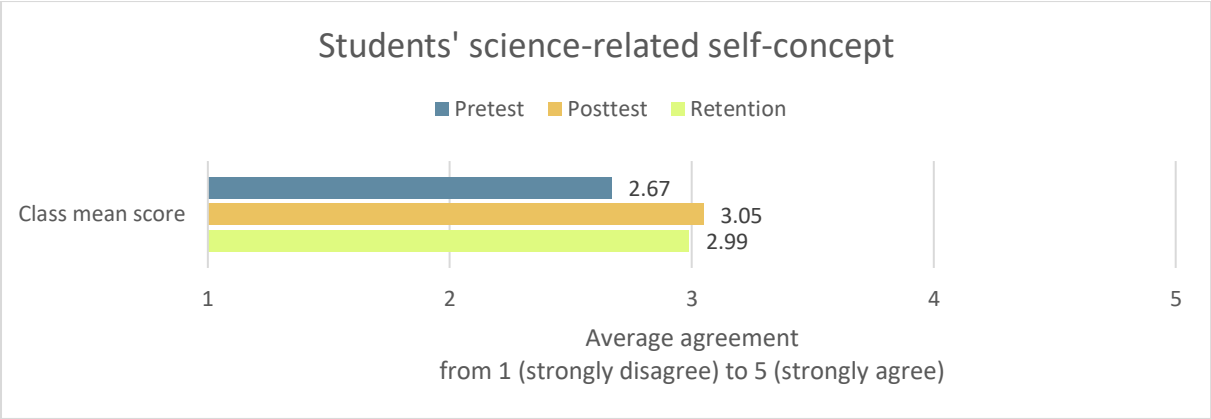

Figure 6: Students' science-related self-concept (pre test, post test & retention test data)

Mean Performance of Your Class in the knowledge test (data from 18 students[1])

In the pre test, the average score in your class is 30,74 % of correct answers.

In the post test, your students scored an average of 34,07 % of correct answers.

In the retention test, your class average is 31,85 % of correct answers.

We would like to thank you again for your participation in our study. We hope that this feedback will provide you with helpful insights!

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[1] Some students may have been excluded due to, e.g., missing or incomplete scans or missing input.

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