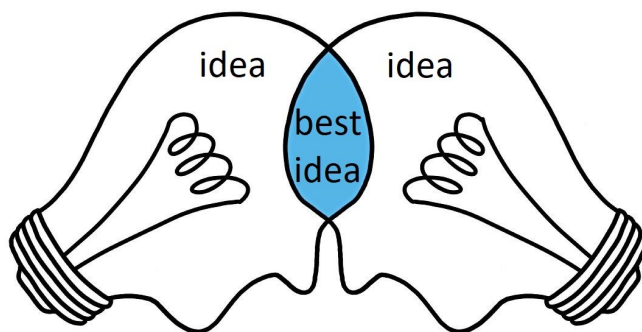


C O R E L A

Methodology analyses for collaborative learning platform with integrated remote laboratory environment in vocational education and training



Erasmus+



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Contents

Introduction.....	5
Methodology.....	7
Statistical tools.....	8
Research hypothesis.....	9
H1: Students will perceive that collaborative learning improves their understanding of study methods and concepts.....	9
H2: Students will perceive that collaborative learning enhances communication of electrotechnical concepts and team-building skills.....	12
H3: Students are likely to perceive the learning experience as positive, enjoyable, and sociable as a result of collaborative learning.....	15
H4: Student perceptions concerning other student’s perceptions of them, changed as a result of collaborative learning exposure.....	18
H1: Teachers perceive that collaborative learning improves students understanding of study methods and concepts.....	22
H2: Teachers will perceive that collaborative learning enhances communication of electrotechnical concepts and team-building skills among the students.....	23
H3: Teachers are likely to perceive the learning experience as positive, enjoyable, and sociable as a result of collaborative learning with support of the colleagues.....	23

Introduction

The term collaboration is derived from the Latin words co-with and laborare-work, which means cooperation of many individuals for the realization of a particular goal. Collaborative learning is a learning process where the pupils / students are gathering information from multiple sources and connects/unifies them in one whole unit. The term Collaborative learning refers to an instruction method in which learners at various performance levels work together in small groups toward a common goal. Today, collaborative learning is a very important component of modern education. The best example of a collaborative learning program is the online encyclopedia - Wikipedia.



Three approaches to collaborative learning can be identified:

- Project-based learning,
- Problem-based learning and
- Learning-based learning.

All three approaches are closely related to the information processing process and correspond to environments that are based on modern technology, where the focus is not only on the hardware and the software, but on the learning experience itself.

METHODOLOGY

The purpose of this work was to study student and professors perceptions of group work in an effort to understand either the reticence or enthusiasm for this particular pedagogical instructional strategy. In general, teachers have anecdotal information as to which aspects of small group learning elicit strong student attitudes. There is little research and data that thoroughly explore student attitudes, especially at secondary school level and in the electrotechnical program. Therefore, the intent of this questionnaire was to reliably tap areas of small group distance learning that include student views and concerns, group dynamics theory and explore how attitudes are related to behavioural and learning outcomes. Finally, this study was designed to highlight problematic areas of small group learning, which may lead to general recommendations being made.

This study employed one methodology to determine student attitudes and perceptions to collaborative learning. The method involved a questionnaire (one for students and one for professors), which prompted the participants to respond with respect to collaborative group learning to questions concerning their self-image, their relationship to the group, their pre-existing attitudes, and their perceptions of the learning process.

The questionnaire for students consisted of 65 questions, and the questionnaire for professors consisted of 44 questions including attitude statements (e.g., When I work in a group I am able to share my ideas), perception issues (e.g., I feel working in groups is a waste of time), and background questions (e.g., gender). Students indicated their responses on a five-point Likert scale ranging from *strongly agree* to *strongly disagree*.

	Gender			Country		
	M	F	Prefer not to say	Croatia	North Macedonia	Slovenia
Students	133	12	8	35	62	56
Teachers	23	20	/	19	13	11

Most of the students are studying electrotechnical program, 66 of them are in the first year of study, 39 of them are in the second, 33 in the third year of study and 7 of them are in the fourth year of study. 57 of the students are with excellent grade success, 84 of them are with good grade success and 11 of them are with satisfactory grade success.

Most of the teachers teach electrotechnical program, and have long-term teaching experience.

Referring to language and communication skills, the majority of the teachers use native language (39 from 43 respondents), but are accepting the challenge to teach in English (27 from 43, 12 are restrained) and at the same time are commutable using English in real-time communication (37 respondents of 43 respondents).

Student's respondents, in relation to language and communication skills, are similar to the responses of the teachers, majority of them would accept the challenge to learn and communicate in English, (97 of 152 respondents), 86% are comfortable in using English language in real time conversation, but at the same time, they would prefer to have a teacher support in verbal/written English communication.

Referring to the type of communication they think is the most suitable in international collaborative learning, there are also similarities between respondents:

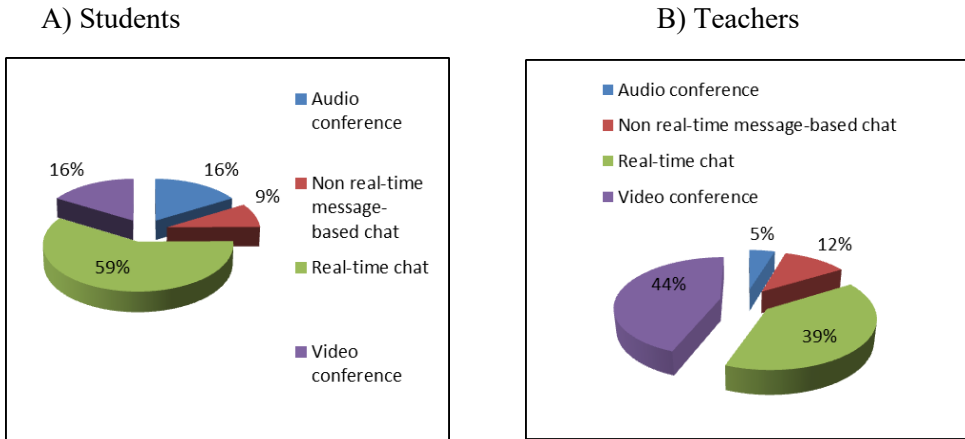


Figure 1: Type of communication

It should be mentioned that the most of the students choose group work and collaboration, problem solving, logic questions, debates, speeches, most of them focus better when there is melody or music in the background, some prefer working on their own, being independent, and are the least interested in graphs and oral presentations.

Statistical tools

An ANOVA statistical method was used for statistical analyses of the hypothesis. Hence, each sample is looked at and the difference between its mean and total mean is calculated to calculate the variability. If the distributions overlap or are close, the total mean will be similar to the individual means whereas if the distributions are far apart, the difference between means and total mean would be large. The group variability is calculated in a form of standard deviation. Then, each squared deviation is weighted by the size of the sample. In other words, a deviation is given greater weight if it is from a larger sample. Hence, each squared deviation is multiplied by each sample size and then summed up. This is called the sum-of-squares (SS) for between-group variability, which is given with the following equation:

$$SS_{\text{between}} = n_1(\bar{x}_1 - \bar{x}_G)^2 + n_2(\bar{x}_2 - \bar{x}_G)^2 + n_3(\bar{x}_3 - \bar{x}_G)^2 + \dots + n_k(\bar{x}_k - \bar{x}_G)^2$$

In order to derive a good measure of between-group variability we find the sum of each squared deviation and divide it by the degrees of freedom. For our group variability, we find each squared deviation, weigh them by their sample size, sum them up, and divide by the degrees of freedom (df). The degree of freedom is the number of sample (k) means minus one. The mean of squares (MS) is given with the following equation:

$$MS_{\text{between}} = \frac{n_1(\bar{x}_1 - \bar{x}_G)^2 + n_2(\bar{x}_2 - \bar{x}_G)^2 + n_3(\bar{x}_3 - \bar{x}_G)^2 + \dots + n_k(\bar{x}_k - \bar{x}_G)^2}{k-1}$$

The hypothesis is analysed by comparison between the F statistic and the F critical parameters. The F statistic points out if the means of different samples are significantly different or not (referred to as the F-Ratio). The lower the F-Ratio, the more similar are the sample means. In that case, we cannot reject the null hypothesis.

The F-statistic calculated with ANOVA is compared with the F-critical value for making a hypothesis conclusion. If the value of the calculated F-statistic is more than the F-critical value (for a specific α /significance level), then we reject the null hypothesis and can say that the treatment had a significant effect. All statistical analyses within this paper are performed by using a significant level $\alpha=0.05$.

RESEARCH HYPOTHESIS (methodologies to determine students' and teachers' attitudes and perceptions to collaborative learning).

Collaborative learning strategies, which focus the student in an active and participatory method of group interaction for learning, does not necessarily mean that greater academic achievement, greater enthusiasm (or other attitudinal perceptions), or higher learning occurs. In an effort to understand how collaborative learning strategies can improve the learning process, the following secondary student centred research hypotheses, performed at the secondary school level, were formulated:

H1: Students will perceive that collaborative learning improves their understanding of study methods and concepts. Students will also perceive that collaborative learning enhances their critical-thinking skills (i.e., recognition, formulation, analysis, and interpretation of electrotechnical problems, as well as their ability to apply knowledge to any electrotechnical problem).

To determinate whether there are differences between University and Secondary school students referring to H1, we used ANOVA test (table 1):

Conclusion is that there was no significant difference between University and high school students referring to **H1**, i.e. both respondents have same perception that collaborative learning improves their understanding of study methods and concepts.

Table I: ANOVA test for comparison between University and Secondary school students for H1

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
University	15	6,5	0,433333	0,095685
Secondary school	135	43	0,318519	0,093684

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,177963	1	0,177963	1,895773	0,170631	3,90506
Within Groups	13,89329	148	0,093874			
Total	14,07125	149				

Referring to differences between secondary students related to their nationality and H1, we found no statistical important differences. (Table II). Which means that North Macedonian, Slovenian and Croatian students have no differences about the way they perceive that collaborative learning improves their understanding of study methods and concepts. Students will also perceive that collaborative learning enhances their critical-thinking skills (i.e., recognition, formulation, analysis, and interpretation of electrotechnical problems, as well as their ability to apply knowledge to any electrotechnical problem).

Table II: ANOVA test for comparison between secondary school students regarding to their nationality

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
North Macedonia	49	16	0,326531	0,096235
Slovenia	49	12,25	0,25	0,095052
Croatia	34	13,625	0,400735	0,087859

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,462799	2	0,231399	2,470842	0,088505	3,066391
Within Groups	12,08112	129	0,093652			
Total	12,54392	131				

If we take their year of study, we will also find that there is no difference between their age and H1 (table III):

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
First year	69	12,83333	0,18599	0,073968
Second year	39	8,833333	0,226496	0,066502
Third year	37	9,5	0,256757	0,056473
Forth year	8	0,666667	0,083333	0,055556

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,259058	3	0,086353	1,28939	0,280236	2,665315
Within Groups	9,978778	149	0,066972			
Total	10,23784	152				

Which means that students of all ages of study have no differences about the way they perceive collaborative learning as a way to improve their understanding of study methods and concepts.

If we take their average grade success, we will conclude that their average grade success doesn't change the way they perceive collaborative learning. (table IV)

Table IV: ANOVA test for comparison between secondary school students regarding to their average grade success

SUMMARY

Groups	Count	Sum	Average	Variance
excellent	50	13,625	0,2725	0,059114
good	77	25,375	0,329545	0,118795
satisfactory	11	4,75	0,431818	0,051136

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0,256147	2	0,128073	1,390273	0,252549	3,063204
Within Groups	12,43634	135	0,092121			
Total	12,69248	137				

In the pictures below, there are graphics that are showing the responses of some of the crucial questions that are reflecting H1:

Q1: When I work in a group, I do better quality work.

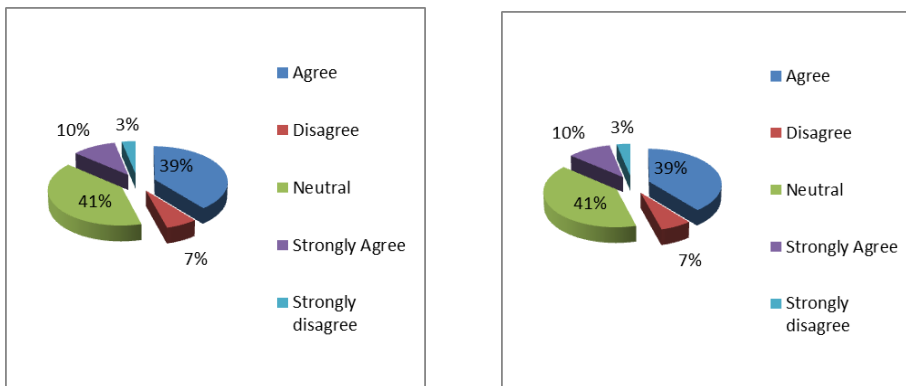


Fig. 2 Graphs representing answers to question Q1

Q2: The material is easier to understand when I work with other students.

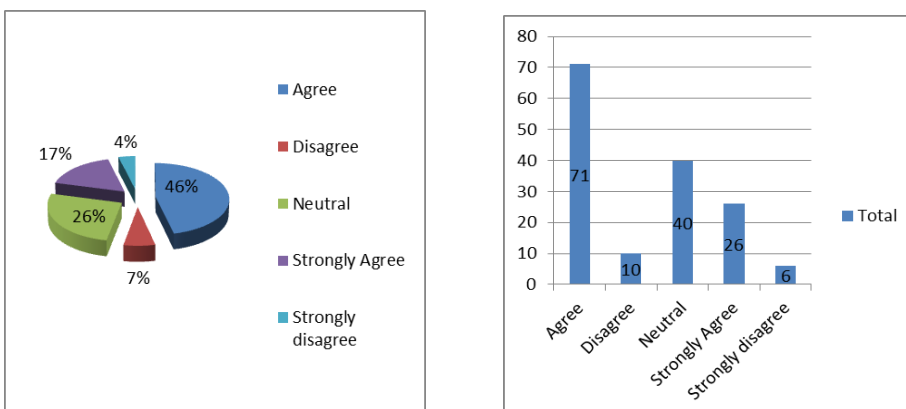


Fig. 3 Graphs representing answers to question Q2

Q3: I expect that my group members will help explain things that I do not understand.

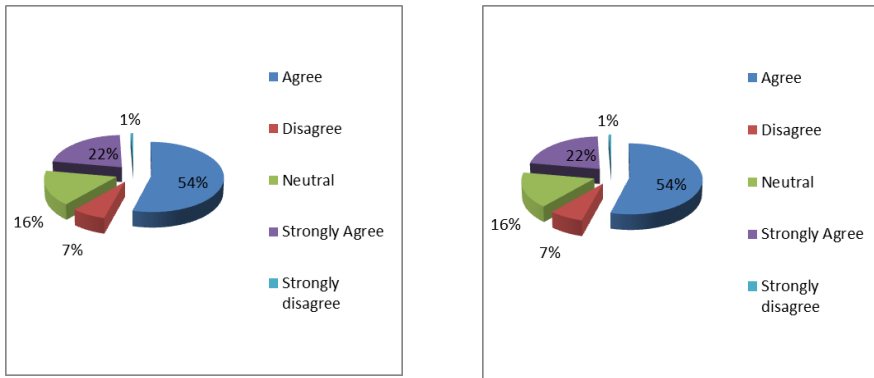


Fig. 4 Graphs representing answers to question Q3

Q4: I will learn more information, when I work with other students.

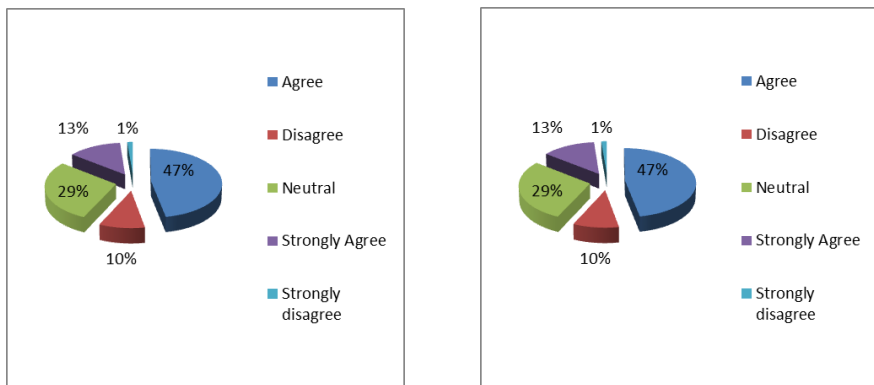


Fig. 5 Graphs representing answers to question Q4

H2: Students will perceive that collaborative learning enhances communication of electrotechnical concepts and team-building skills. The second hypothesis, H2 was measured by students sharing of opinions and ideas.

Our first interest is whether there is a statistic important difference between university and secondary students referring to H2 (table V):

Table V: ANOVA test for comparison between secondary school students and University students regarding to H2

SUMMARY

Groups	Count	Sum	Average	Variance
University	15	2,5	0,166666667	0,047619
High school	135	28,66667	0,212345679	0,071074

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0,028169	1	0,028168724	0,409102	0,523414	3,90506
Within Groups	10,19053	148	0,068854966			
Total	10,2187	149				

As we can see on the above table, there is no statistical significant difference between University and high school responses referring to H2, which means that both categories perceive that collaborative learning enhances communication of electrotechnical concepts and team-building skills.

Referring to differences between secondary students related to their nationality and H2, we found no statistical important differences. (Table VI).

Table VI: ANOVA test for comparison between secondary school students regarding to their nationality and H2

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
North Macedonia	62	15,83333	0,255376	0,080799
Croatia	35	10,5	0,3	0,037255
Slovenia	56	5,5	0,098214	0,05331

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	1,110362	2	0,555181	9,123791	0,000182	3,056366
Within Groups	9,127474	150	0,06085			
Total	10,23784	152				

Regarding to the relation between the year of study and H2, we found the following results (table VII):

Table VII: ANOVA test for comparison between the year of study within secondary school students regarding to H2

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
First year	69	19,25	0,278986	0,041018
Second year	39	12,25	0,314103	0,105432
Third year	37	11,16667	0,301802	0,046046
Forth year	8	1,916667	0,239583	0,032614

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,056218	3	0,018739	0,321618	0,809729	2,665315
Within Groups	8,681618	149	0,058266			
Total	8,737836	152				

Which means that students of all ages of study have no differences about the way they perceive that collaborative learning enhances communication of electrotechnical concepts and team-building skills.

If we take their average grade success, we will find the following results (table VIII):

Table VIII: ANOVA test for comparison between secondary school students regarding to their grade success and H2

SUMMARY

Groups	Count	Sum	Average	Variance
Excellent	50	13,625	0,2725	0,059114
Good	77	25,375	0,329545	0,118795
Satisfactory	11	4,75	0,431818	0,051136

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0,256147	2	0,128073	1,390273	0,252549	3,063204
Within Groups	12,43634	135	0,092121			
Total	12,69248	137				

Their average grade success doesn't change the way they perceive that collaborative learning enhances communication of electrotechnical concepts and team-building skills. In the pictures below, there are graphics that are showing the responses of some of the crucial questions, which are reflecting H2:

Q5: I find it will be hard to express my thoughts, when I work in a group.

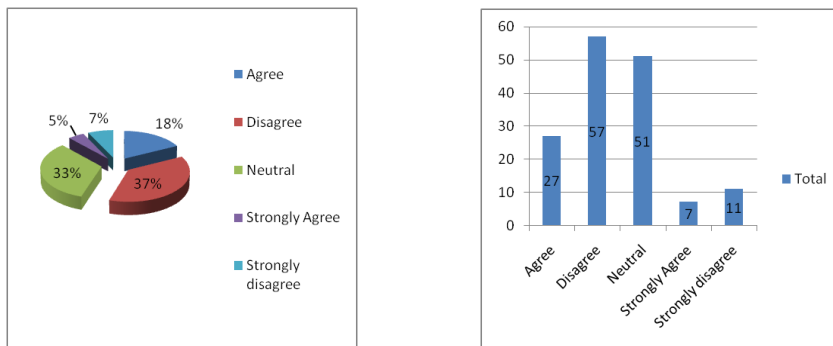


Fig. 6 Graphs representing answers to question Q5

Q6: When I work in a group, there are opportunities to express your opinions.

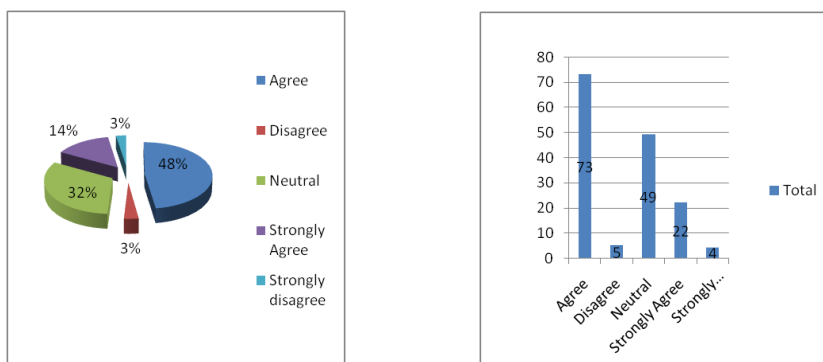


Fig. 7 Graphs representing answers to question Q6

Q7: Everyone's ideas are needed if we are going to be successful.

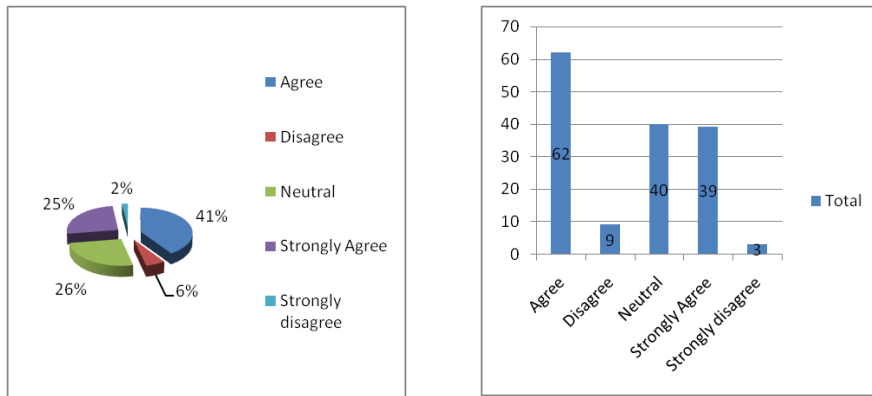


Fig. 8 Graphs representing answers to question Q7

H3: Students are likely to perceive the learning experience as positive, enjoyable, and sociable as a result of collaborative learning.

Our first interest is whether there is a statistic important difference between university and secondary students referring to H3 (table IX):

Table IX: ANOVA test for comparison between University and secondary school students regarding to H3

SUMMARY

Groups	Count	Sum	Average	Variance
University	15	4,333333	0,288889	0,042526
High school	135	39,83333	0,295062	0,060195

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0,000514	1	0,000514	0,00879	0,925432	3,90506
Within Groups	8,661523	148	0,058524			
Total	8,662037	149				

There are no statistical differences between University and high school respondents referring to H3, which means that both categories perceive that the learning experience is positive, enjoyable, and sociable as a result of collaborative learning.

Referring to differences between secondary students in terms of their nationality and H3, we found no statistical important differences (table X).

Table X: ANOVA test for comparison between secondary school students in terms of their nationality and H3

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
North Macedonia	62	21,66667	0,349462	0,060756
Croatia	35	11,25	0,321429	0,051529
Slovenia	56	11,66667	0,208333	0,048232

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,626981	2	0,31349	5,797608	0,003756	3,056366
Within Groups	8,110855	150	0,054072			
Total	8,737836	152				

Although P-value is smaller than significant level $\alpha=0.05$, we interpret the results as accepting the H3, because we can only reject the hypothesis 3 if two conditions are fulfilled: $F_{crit} > F$ and $P\text{-value} < \alpha = 0.05$, which means that all respondents are likely to perceive the learning experience as positive, enjoyable, and sociable as a result of collaborative learning.

Regarding to the year of study, the results are shown on table XI:

Table XI: ANOVA test for comparison between secondary school students regarding to their year of study

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
First year	69	19,25	0,278986	0,041018
Second year	39	12,25	0,314103	0,105432
Third year	37	11,16667	0,301802	0,046046
Forth year	8	1,916667	0,239583	0,032614

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,056218	3	0,018739	0,321618	0,809729	2,665315
Within Groups	8,681618	149	0,058266			
Total	8,737836	152				

This means that there are no statistical significant differences between student's age of study and H3.

Regarding average grade success, the results show that there is no statistical difference between students with different grade success and H3 (table XII):

Table XII: ANOVA test for comparison between secondary school students regarding to their grade success and H3

SUMMARY

Groups	Count	Sum	Average	Variance
Excellent	58	16,08333	0,277299	0,051751
Good	58	20,58333	0,354885	0,058129
Satisfactory	11	4,666667	0,424242	0,040909

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0,292087	2	0,146043	2,71413	0,0702	3,069286
Within Groups	6,672261	124	0,053809			
Total	6,964348	126				

Below are the most reflecting questions that refer to H3:

Q8: The material would be more interesting when I would work with other students.

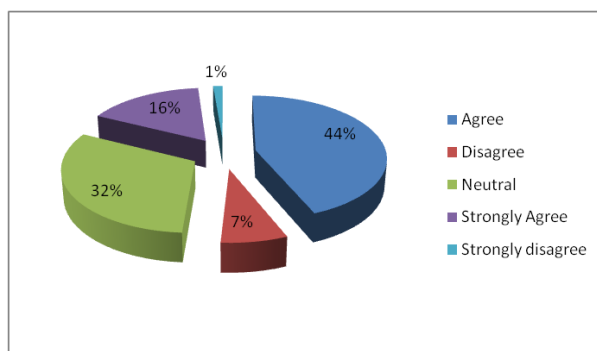


Fig. 9 Graphs representing answers to question Q8

Q9: I'm afraid that my group members will not care about my feelings.

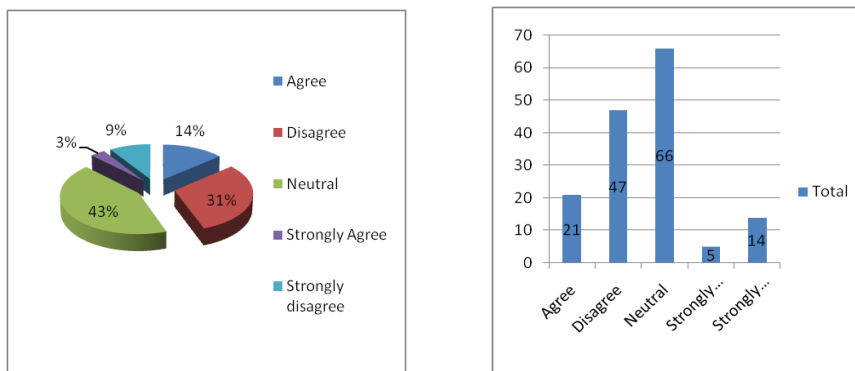


Fig. 10 Graphs representing answers to question Q9

Q 10: I would get to know my group members well.

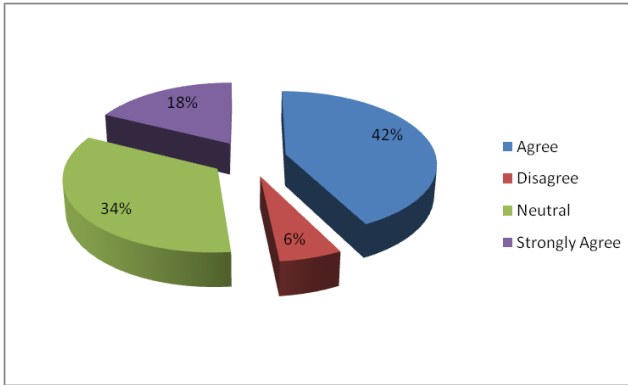


Fig. 11 Graphs representing answers to question Q10

H4: Student perceptions concerning other student’s perceptions of them, changed as a result of collaborative learning exposure.

Table XIII: ANOVA test for comparison between University and secondary school students regarding to H4

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
University	15	0,071429	0,004762	0,044072
High school	135	6,071429	0,044974	0,049858

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,021829	1	0,021829	0,442683	0,506866	3,90506
Within Groups	7,298035	148	0,049311			
Total	7,319864	149				

If we look at the above table (table XIII) we will see that there are no statistical differences between university students and secondary school students about their changes in the perceptions after being participants in a collaborative learning assignment.

The results below (table XIV) show that there are no statistical differences between nationality of the respondents and H4:

Table XIV: ANOVA test for comparison between secondary school students regarding to their nationality and H4

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
North Macedonia	62	3,357143	0,054147	0,047455
Croatia	35	0,357143	0,010204	0,057966
Slovenia	56	2,714286	0,048469	0,045103

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,046877	2	0,023438	0,478577	0,620607	3,056366
Within Groups	7,34628	150	0,048975			
Total	7,393157	152				

In addition, there is no significant statistical difference between H4 and year of study, or the average grade success of the respondents (table XV and table XVI):

Table XV: ANOVA test for comparison between secondary school students regarding to their year of study

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
First year	69	2,285714	0,033126	0,041954
Second year	39	1,785714	0,045788	0,066726
Third year	37	1,571429	0,042471	0,044064
Forth year	8	0,785714	0,098214	0,055302

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,031281	3	0,010427	0,211038	0,888633	2,665315
Within Groups	7,361876	149	0,049409			
Total	7,393157	152				

Table XVI: ANOVA test for comparison between secondary school students regarding to their average grade success and H4

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Excellent	62	3,357143	0,054147	0,047455
Good	35	0,357143	0,010204	0,057966
Satisfactory	56	2,714286	0,048469	0,045103

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,046877	2	0,023438	0,478577	0,620607	3,056366
Within Groups	7,34628	150	0,048975			
Total	7,393157	152				

Q11: I'm afraid that I'll have to work with students who are not as smart as I am.

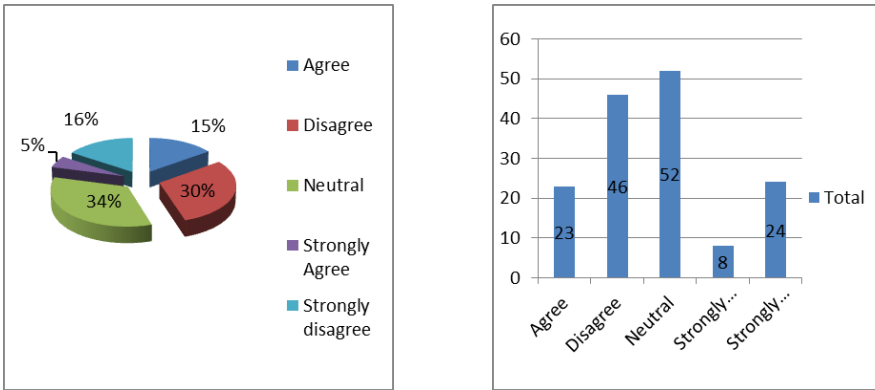


Fig. 12 Graphs representing answers to question Q11

Q12: I'm afraid that my group members do not like me.

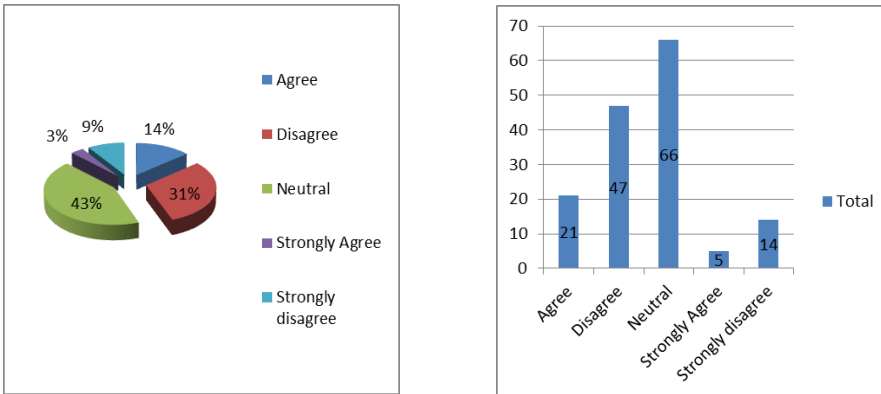


Fig. 13 Graphs representing answers to question Q12

Q13: I think that if I work in a group, the other members will not respect my opinions.

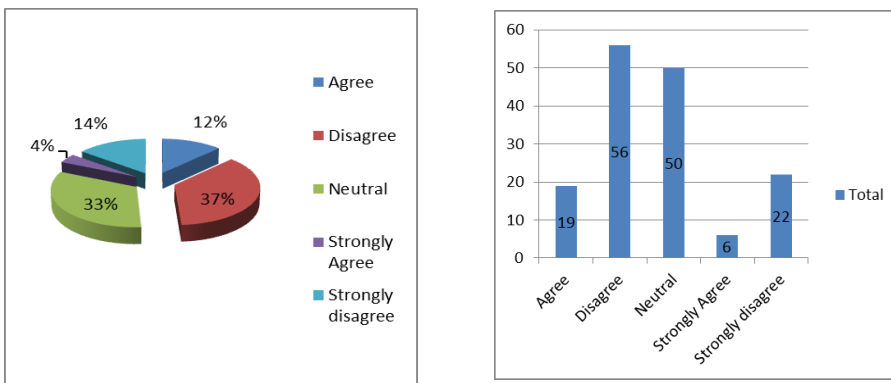


Fig. 14 Graphs representing answers to question Q13

Q14: When I would work in a group, there will be opportunities to express my opinions.

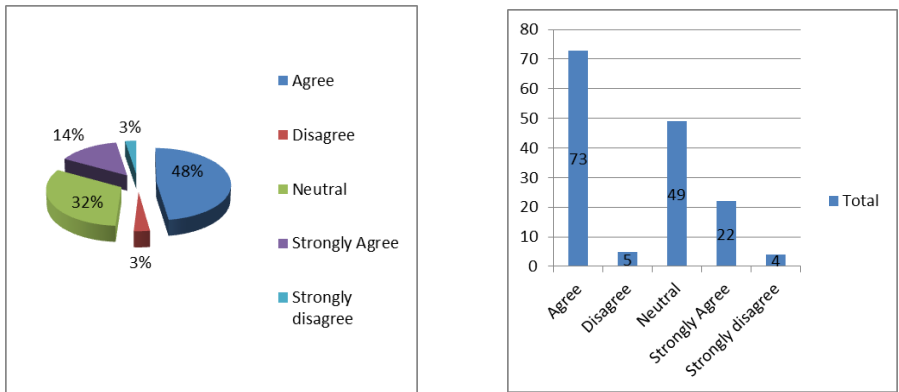


Fig. 15 Graphs representing answers to question Q14

Students perceived that collaborative learning would improve their understanding of electrotechnical methods and concepts (H1). Their perceptions shifted from somewhat disagreeing with comprehension ease within a group, to very positive perceptions. Students also perceived that collaborative learning enhanced their critical-thinking skills (i.e., recognition, formulation, analysis, and interpretation of chemistry or chemical problems), as well as their ability to apply knowledge to any problem.

Students also found that collaborative learning will help them learn more material/content, and will enable them to perform higher quality work.

It is very important to mention that 80% of the student respondents will gladly participate in a mixed nationality working group, 40,8% of them are highly motivated to meet and collaborate with foreign students, 77% are taking distance-based learning as a challenge, but at the same time, majority would feel more comfortable to have teacher support and supervision, and 22,3% feel that are not competent to participate in an international educational project.

Regarding the Professor’s attitudes towards collaborative learning, we set similar hypotheses that expresses teachers opinions and support towards international mixed students’ group using collaborative learning at distance. However, teachers participating in the study acknowledge the importance of professional development, but also admit that the requirement for professional development is based on the teacher’s needs or interest. Also, only half of them understand collaborative learning well enough to implement it successfully:

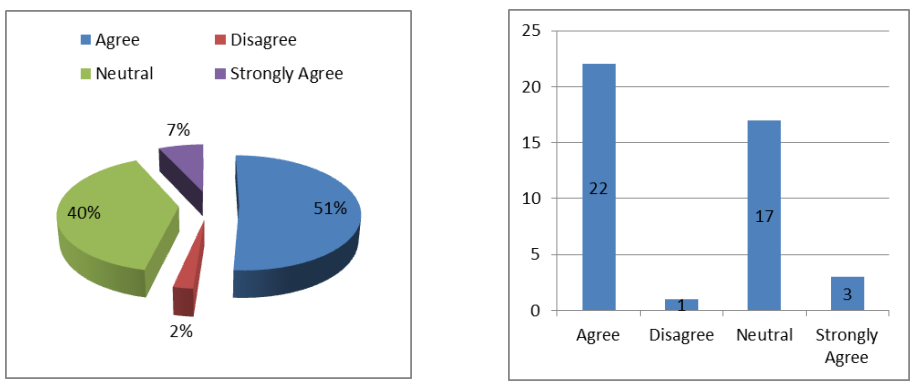


Fig. 16 Graphs representing the level of understanding of collaborative learning process for implementing it successfully

Very important fact for this project is that 86% of the respondents - teachers are comfortable to be support in verbal/written English communication between international students, although 65% of them do not hold any formal English language certificate:

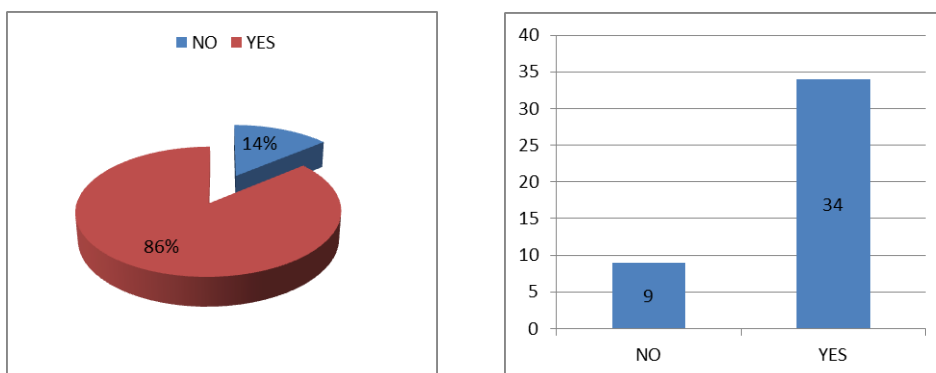


Fig. 17 Graphs representing holding a formal English language certificate among the teachers

In an effort to understand how collaborative learning strategies can improve the learning process, we formulated three hypotheses from teacher's point of view:

H1: Teachers perceive that collaborative learning improves students understanding of study methods and concepts. Collaborative learning enhances students' critical-thinking skills (i.e., recognition, formulation, analysis, and interpretation of electrotechnical problems, as well as their ability to apply knowledge to any electrotechnical problem).

To determinate whether there are differences between responses of teachers – participants from three electrotechnical secondary schools from North Macedonia, Croatia and Slovenia referring to H1, we used ANOVA test (table XVII):

Table XVII: ANOVA test for comparison between responses of teachers – participants from three electrotechnical Secondary schools from North Macedonia, Croatia and Slovenia referring to H1

SUMMARY

Groups	Count	Sum	Average	Variance
Column 1	13	4,416667	0,339744	0,035256
Column 2	19	4,916667	0,258772	0,050073
Column 3	11	2,25	0,204545	0,029672

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0,11274	2	0,05637	1,390902	0,260626	3,231727
Within Groups	1,62111	40	0,040528			
Total	1,73385	42				

Conclusion is that there was no significant difference between the teachers – respondents from the high schools in three different countries participants in the survey - referring to H1, i.e. all respondents have same perception that collaborative learning improves students' understanding of study methods and concepts.

H2: Teachers will perceive that collaborative learning enhances communication of electrotechnical concepts and team-building skills among the students. The second hypothesis, H2 was measured by the opinion and attitude of the teachers by sharing their opinions and ideas.

There are no statistical significant differences among the opinions and ideas of the teachers from Macedonia, Croatia and Slovenia about the importance of communication, co-operation and team-building skills among the students for successfully completed assignment. The results are presented in table XVIII below:

Table XVIII: ANOVA test for comparison of responses of teachers – participants from three electrotechnical secondary schools from North Macedonia, Croatia and Slovenia referring to H2

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Column 1	13	2,75	0,211538	0,036158
Column 2	19	2,75	0,144737	0,045162
Column 3	11	1,5625	0,142045	0,050852

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,041729	2	0,020864	0,47545	0,625073	3,231727
Within Groups	1,755328	40	0,043883			
Total	1,797057	42				

H3: Teachers are likely to perceive the learning experience as positive, enjoyable, and sociable as a result of collaborative learning with support of the colleagues. (table XIX)

Table XIX: ANOVA test for comparison between responses within teachers – participants from three electrotechnical Secondary school from North Macedonia, Croatia and Slovenia referring to H3

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Column 1	13	4,6	0,353846	0,025192
Column 2	19	4,05	0,213158	0,047178
Column 3	11	1,75	0,159091	0,032409

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0,254042	2	0,127021	3,443216	0,041712	3,231727
Within Groups	1,475609	40	0,03689			
Total	1,729651	42				

The results above indicate that the participants hold generally a positive view of the implementation of collaborative strategies in teaching and learning context. This is probably because when students work in groups they feel that they can depend on others for help and this gives them the confidence to solve problems and enjoy learning. However, the teachers' opinion about using the collaborative learning at distance require specific conditions and environment (fig18 and fig 19)

Q15: The physical set-up of my classroom is an obstacle for using international collaborative learning.

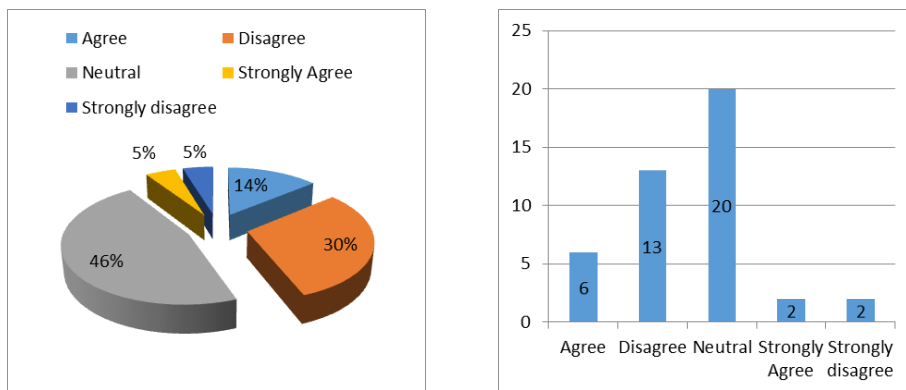


Fig 18 Graphs representing answers to question Q15

Q16: It is impossible to implement collaborative learning without specialized materials.

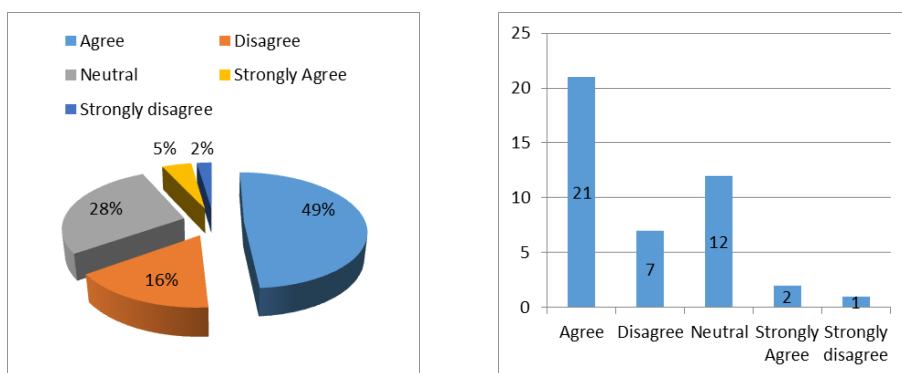


Fig 19 Graphs representing answers to question Q16

Positive attitude towards collaborative approaches may indirectly change the learners' attitude towards language learning and encourage their interest (fig 20 and fig 21)

Q17: I will gladly guide my students to work in a mixed nationality working group.

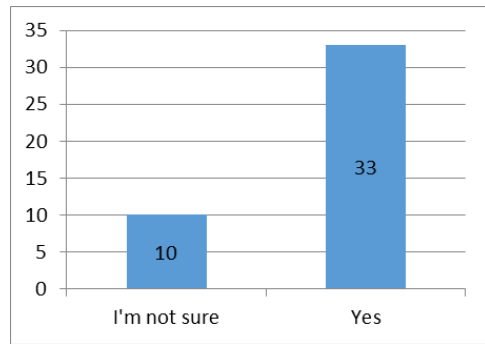
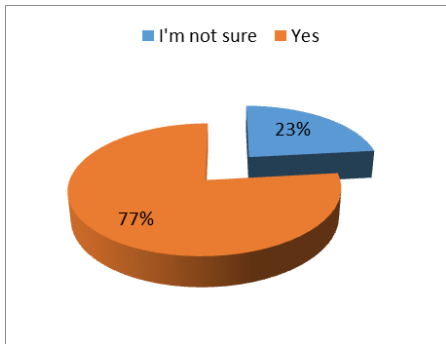


Fig 20 Graphs representing answers to question Q17

Q18: I'm highly motivated to collaborate with foreign teachers.

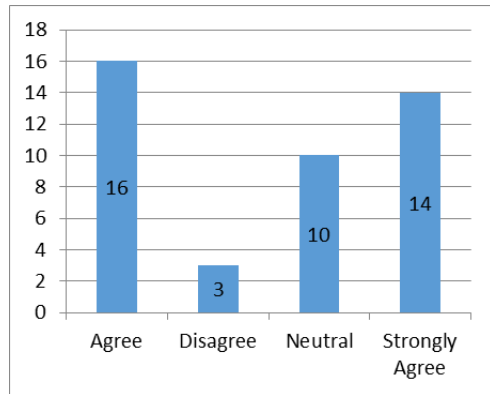
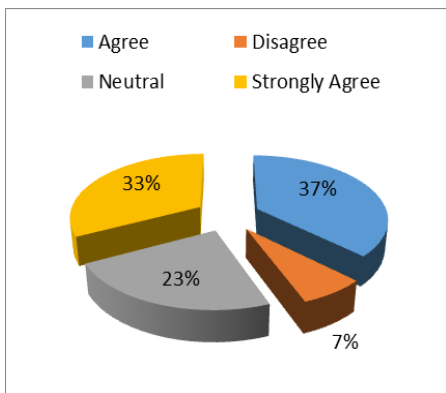


Fig 21 Graphs representing answers to question Q18

Based on findings of the study, it is necessary that teachers use collaborative learning approach side by side with linguistic (debates, lecturing, oral presentation), logical/mathematical (problem solving, logic questions, numbers), spatial/visual (photographs, maps, videos), intrapersonal (working on your own, being independent), kinaesthetic (experiential activities), musical (playing some music or melody in the background) and naturalist (outdoors, nature) learning approaches (fig 22)

Q19: International collaborative learning is a valuable instructional approach.

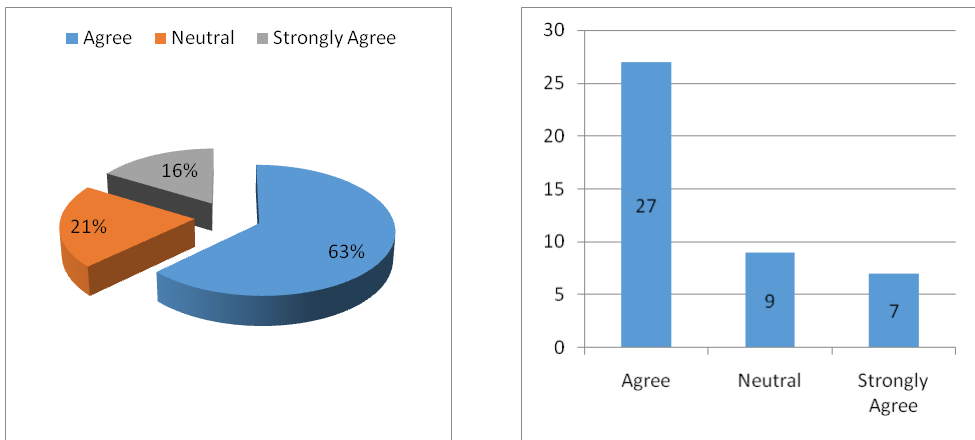


Fig 22 Graphs representing answers to question Q19

Besides professional development in the electrotechnical field, it is worth mentioning that successful implementation of collaborative learning techniques requires structurally planned teaching and learning activities. Also, it is recommended that this approach is used for skills like cognitive development, socialization, team work etc., because collaborative learning collects suggestions and ideas from different group members and contributes the concepts become easily clear. Moreover, this approach can be used also as an instruction in other skills such as listening, speaking, and writing. In addition, the literature suggests that additional reasons may motivate the instructors to use collaborative learning techniques. Increased interaction in English and easy management of large classes may be other motivating factors for implementing collaborative learning approach (fig 23).

Q20: There are too many demands for change in education today.

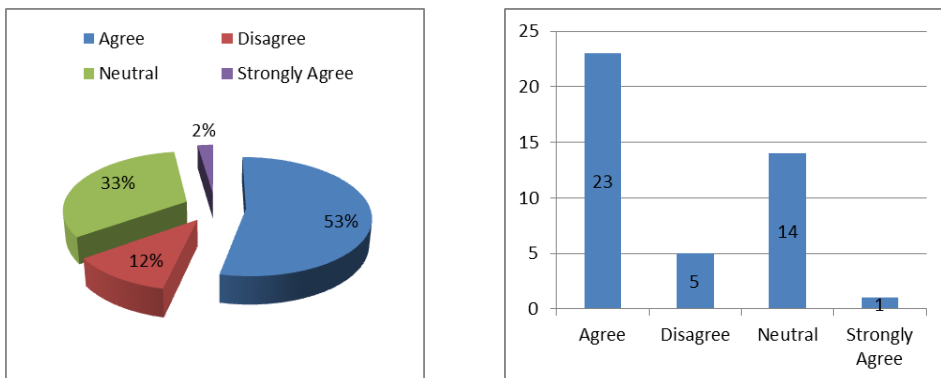


Fig 23 Graphs representing answers to question Q20

As can be seen from the figure above, teachers agree that there is a need for change in the education by incorporating new innovative teaching methodologies, as for example collaborative learning, which will introduce a higher quality education system.

As mentioned before, in collaborative learning, to achieve a common goal, students of various talents, abilities, and backgrounds need to work together, with constant support of their teachers.

Therefore, it can be said that the vast majority of the respondents believe that they are perfectly willing to participate in such learning activities. This is the statement students and teachers agree with the most.

It is safe to conclude that collaborative distance learning is perfect way to connect, mix, combine, coordinate and mend international high students from three different countries, who have for certainly one thing in common-their love and enthusiasm for electrotechnical based challenges and exercises and unconditional support from their teachers and school management.

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DTK Smart-tech (North Macedonia)



Tehnička škola Ruđera Boškovića Vinkovci (Croatia)



UNIVERZA V MARIBORU (Slovenia)



Šolski center Kranj (Slovenia)



Project: Collaborative learning platform with integrated remote laboratory environment in VET

ERASMUS+ Key Action 2: Strategic Partnership