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Portfolio 2

Report on the results of the implementation of the DiSSI approach in Slovenian context

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DiSSI
Diversity in Science towards Social Inclusion

Univerza v Ljubljani

Contents

All the results are presented in three groups according to the aims of the DiSSI project. These groups are: (1) in-service teachers, (2) pre-service teachers and (3) lower secondary school students.

In-service teachers participated in the DiSSI project by engaging into voluntary seminars (on-line and in-person), pre-service teachers participated through their obligatory and elective courses at their university education, and lower secondary school students came to the informal educational environment at KemikUm centre at Faculty of Education University of Ljubljana.

Firstly, the interpretation of the results for in-service teachers are presented.

RESULTS OF THE IMPLEMENTATION OF THE DiSSI APPROACH INTO IN-SERVICE TEACHER EDUCATION

A total of 81 in-service teachers participated in the DiSSI project during the 2022/23 academic year by engaging in voluntary seminars (online and in-person).

Participating in-service teachers

Table 1. Gender structure of the sample

	Frequency	Percent
Male	5	6.2
Female	76	93.8
Total	81	100.0

Based on the results presented in Table 1, it can be summarized that the majority of participating in-service teachers (94%) were female, and only 5 of them were male.

Table 2. Work period of the teachers (N = 81)

Years	Frequency	Percent
1 – 5	56	69.0
6 – 10	8	9.9
11 – 15	7	8.6
16 – 20	5	6.2
21 – 25	4	4.9
26 – 30	1	1.3

The results in Table 2 show that nearly three-quarters of the in-service teachers have 1 to 5 years of professional experience. 10% of the in-service teachers fall into the category with 6 to 10 years of professional experience, while the remaining in-service teachers have more than 11 years of professional experience. Thus, it can be concluded that most teachers participating in the study are younger, and quite inexperienced science teachers.

Table 3. Subjects taught by in-service teachers (N = 81)

Subject	Frequency	Percent
Biology	10	12.3
Chemistry	11	13.6
Home economics	6	7.4
Biology, Home economics	22	27.2
Biology, Chemistry	16	19.7
Biology, Chemistry, Home economics	6	7.4
Biology, Chemistry, Physics	2	2.5
Other	8	9.9

Most in-service teachers who participated in the study teach biology and home economics together (see Table 3). This is followed by a group of in-service teachers who teach biology and chemistry together. Further down we see that the percentages of in-service teachers teaching individual subjects (biology, chemistry, home economics) are smaller. An even smaller percentage of in-service teachers are those who teach three subjects together - the group that teaches biology, chemistry, and home economics. The smallest percentage of in-service teachers are those who teach biology, chemistry, and physics – all three subjects together.

Table 4. Participation in a professional training program (N = 81)

	Frequency	Percent
Proactively, whenever an opportunity presents itself	35	43.2
Twice a year	25	30.9
Once a year	20	24.7
Very rarely - once every few years	1	1.2

The results in Table 4 show that more than half of the in-service teachers participate in a professional training program at least once a year. The remaining majority of in-service teachers proactively participate in professional training program when the opportunity presents itself. It is also worth noting that there is only one in-service teacher who very rarely participates in professional training program.

The data were gathered by these instruments: (1) Pre-workshop questionnaire and (2) Post-workshop questionnaire.

Vprašalnik za učitelje

Zapišite svojo kodo	Prva črka imena matere: _____ Prva črka imena očeta: _____ Hišna številka: ____		
Starost v letih			
Spol	☐ moški	☐ ženski	☐ drugo
Koliko let že poučujete			
Katere predmete poučujete?			
Kako pogosto se udeležujete stalnega strokovnega izobraževanja iz svojega strokovnega področja?	Zelo redko – enkrat na nekaj let 1x na leto 2x na leto Samoiniciativno, vedno kadar se ponudi priložnost.		
Ali poskusite identificirati nadarjene učence za naravoslovje?	☐ da	☐ ne	
Ali z nadarjenimi učenci izvajate dodatne (obogatitvene) dejavnosti?	☐ da	☐ ne	
Če da, katere?			
Ali med običajnim poukom poskrbite za dodatne aktivnosti za nadarjene učence?	☐ da	☐ ne	
Če da, kako?			

Pred-delavnico vprašanja

1. Kako dobro poznate metodo učenja naravoslovja z raziskovanjem?
   Zelo dobro Dobro Slabo Ne poznam
2. Kako pogosto uporabljate metodo učenja naravoslovja z raziskovanjem pri pouku?
   Zelo pogosto Pogosto Redko kdaj Skoraj nikoli
3. Kako učinkovita je metoda učenja naravoslovja z raziskovanjem za povprečnega učenca?
   Zelo učinkovita Kar učinkovita Slabo učinkovita Neučinkovita
4. Kako učinkovita je metoda učenja naravoslovja z raziskovanjem za poučevanje nadarjenega učenca?
   Zelo učinkovita Kar učinkovita Slabo učinkovita Neučinkovita
5. Glede na vaše kompetence, kako se počutite pri uporabi metode učenja naravoslovja z raziskovanjem pri pouku?
   Popolnoma kompetenten Kar kompetenten slabo kompetenten Nekompetenten
6. Navedite nekaj lastnosti za naravoslovje nadarjenega učenca, ki jih opazite pri takem učencu:
   _____

Vprašanje	Pojasnilo/primeri ravnanj učitelja	Zelo pogosto	Pogosto	Redko kdaj	Skoraj nikoli
Kako pogosto spodbujate učence k postavljanju vprašanj, ki jih nato uporabite pri izvedbi pouka?	Vprašate jih, kaj bi želeli izvedeti, ali pripravite škatlo ali plakat oz. tablo za vprašanja.				
Kako pogosto pomagate učencem oblikovati vprašanja, na katera je mogoče odgovoriti z aktivnostjo?	To je mogoče pri pogovoru o raziskovalnem vprašanju, ki natančneje določa, kaj naj naredijo ali opazujejo. Kaj na primer pomeni »najboljši« pri vprašanju: »Katera tekočina je najbolj viskozna?«				
Kako pogosto spodbujate učence k napovedovanju rezultatov poskusov/opazovanj?	V določeni fazi raziskave jih vprašate: »Kaj mislite, kaj se bo zgodilo, če ..., zakaj tako mislite?«				
Kako pogosto učence vključujete v načrtovanje raziskave?	Mogoče je vnaprej pripraviti potek raziskave ali skupaj z učenci načrtovati posamezne faze raziskave. Ali upoštevate njihove zamisli, tako, da je načrtovanje tudi njihovo delo.				
Kako pogosto spodbujate učence k uporabi poštenega poskusa, kjer in ko je to potrebno?	Učence usmerite v razmislek, kaj mora ostati enako in kaj se lahko spreminja.				
Kako pogosto spodbujate učence k preverjanju rezultatov in opažanj?	Prosite jih, naj preverijo svoje rezultate, tako da ponovijo opažanja ali meritve in zagotovite natančnost pri merjenju, odčitavanju ...				
Kako pogosto pomagate učencem vzdrževati urejenost in sistematičnost pri zapiskih in podatkih?	Pokažete jim npr. kako oblikujejo tabelo podatkov ali listo za preverjanje ali opazovanje, ki jo vključijo v svoje poročilo.				
Kako pogosto zahtevate od učencev, da podajo zaključke svoje raziskave?	Pomoč učencem pri oblikovanju posplošitev, ne le pri podajanju rezultatov raziskave. Na primer, kaj so vzroki za določeno spremembo, ne le razlike v podatkih ali pogojih.				
Kako pogosto zahtevate od učencev, da preverijo ali so njihovi zaključki skladni z rezultati?	Ko učenci podajajo zaključke, naj se prepričajo, ali zaključki ustrezajo rezultatom, ki so jih dobili pri raziskavi.				
Kako pogosto poskrbite, da učenci primerjajo svoje napovedi z rezultati?	Spomnite učence na to, kaj so napovedali in naj to primerjajo z rezultati raziskave.				
Kako pogosto učenci poročajo o svoji raziskavi?	Poročanje je lahko ustno, kjer delijo svoje odkritja z drugimi, lahko pa v obliki plakata ali drugačne oblike predstavitve rezultatov in zbranih podatkov.				
Kako pogosto učenci razpravljajo med predstavitvami?	Razpravljati pomeni tudi postavljati vprašanja, ki vodijo k poglobljenemu razumevanju predstavitev sošolcev, ali izražanje strinjanja oz. nestrinjanja z njihovimi zaključki.				
Kako pogosto poskrbite, da učenci v svojih zapiskih uporabljajo različne predstavitve (zapis, risba, shema, izdelek...)?	Učenci individualno ali kot skupina na nek način dokumentirajo, beležijo svoje delo. To je lahko zapis, risba, shema, izdelek, vse, kar je primerno starosti otrok. (Če je odgovor na to vprašanje ne, potem velja odgovor ne tudi za vsa spodnja vprašanja.)				
Kako pogosto poskrbite, da zapisi učencev vključujejo končne ugotovitve?	Vsak zapis, skupinski ali individualni, vključuje splošne ugotovitve in posplošitve in ne le rezultate poskusov in opazovanj.				

Figure 1. Pre-workshop questionnaire for in-service teachers

Po-delavnici vprašanja

1. Kako dobro poznate metodo učenja naravoslovja z raziskovanjem po današnji delavnici?
   Zelo dobro Dobro Slabo Ne poznam

2. Kako učinkovita je metoda učenja naravoslovja z raziskovanjem, ki ste jo spoznali na današnji delavnici, za povprečnega učenca?
   Zelo učinkovita Kar učinkovita Slabo učinkovita Neučinkovita

3. Kako učinkovita je metoda učenja naravoslovja z raziskovanjem, ki ste jo spoznali na današnji delavnici, za nadarjenega učenca?
   Zelo učinkovita Kar učinkovita Slabo učinkovita Neučinkovita

4. Glede na vaše kompetence, kako se počutite pri uporabi metode učenja z raziskovanjem naravoslovja pri pouku, po današnji delavnici?
   Popolnoma kompetenten Kar kompetenten slabo kompetenten Nekompetenten

5. Kako pogosto nameravate uporabljati metodo učenja naravoslovja z raziskovanjem pri pouku, po današnji delavnici?
   Zelo pogosto Pogosto Redko kdaj Skoraj nikoli

6. Kako pogosto nameravate uporabljati metodo učenja naravoslovja z raziskovanjem pri naravoslovnih dejavnostih za nadarjene učence?
   Zelo pogosto Pogosto Redko kdaj Skoraj nikoli

7. Določite stopnjo strinjanja s trditvami o današnji delavnici:

Trditev	**Popolnoma se strinjam**	**Se strinjam**	**Neodločen**	**Ne strinjam se**	**Popolnoma se ne strinjam**
Aktivnosti delavnice so spodbudile moje razmišljanje o metodi učenja naravoslovja z raziskovanjem.					
Vsebina delavnice se mi je zdela relevantna za moje delo.					
Spoznanja pridobljena na delavnici mi bodo pomagala učinkoviteje poučevati naravoslovje.					
Delavnica je bila dobro organizirana.					
Aktivnosti na delavnici so stalno vzdrževale moje zanimanje za vsebino.					
Delavnica je dosegla svoj namen.					

Figure 2. Post-workshop questionnaire for in-service teachers.

How in-service teachers stimulate gifted lower secondary school students for science?

Table 1. Implementation of additional activities for gifted students (*N* = 81)

	Frequency	Percent
Yes	49	60.5
No	32	39.5

The results in Table 1 show us the responses to the question, "Do in-service teachers implement additional activities for gifted students?" The good news is that 60% of teachers do and 40% do not.

Table 2. Additional activities for gifted students that teachers usually provide

	Frequency
Preparation for the chemistry competition	18
Project work (IBL)	15
Additional tasks	11
Experimental work	10
Additional lessons	8
Workshops, camps	7
Projects	5
Fieldwork	2
Visit to scientific and research institutions	3

**Teachers can provide more than one activity.*

Table 2 contains descriptions of additional activities for gifted students. Each in-service teacher could write down more additional activities. From the results obtained, it can be concluded that among the additional activities for the gifted, the activity "preparation for chemistry competition" reached the highest percentage, followed by "project work with an IBL approach," "additional tasks", "additional lessons", "workshops", and "camps". Other activities listed in Table 5 were represented in a smaller proportion.

Table 3. Implementation of activities for gifted students during regular classes (*N* = 81)

	Frequency	Percent
Yes	51	63.0
No	30	37.0

The results show that more than 60% of in-service teachers in regular classes implement activities for gifted students. The percentage of teachers who do not (37%) still seems high.

Table 4. Description of activities for gifted students during regular classes (N = 81)

	Frequency
Additional tasks	26
More demanding tasks	9
Experimental work	8
Explanation to classmates	8
Help with experimental work	5
Additional literature	4

**Everyone could write more things.*

Table 4 contains descriptions of activities for gifted students during regular classes. Each in-service teacher could write down more additional activities. From the results obtained, it can be concluded that among the activities for the gifted, the activity "additional tasks" reached the highest percentage, followed by "demanding tasks," "experimental work", "explanation to classmates", "help with experimental tasks", and the last one "additional literature".

How well in-service primary school teachers know IBSE – pre-workshop results

Table 1. In-service primary school teachers' familiarity with the IBSE approach (N = 81)

		Very familiar	Familiar	Not familiar	Not familiar at all
How familiar are you with IBSE?	*f*	7	63	10	1
	f%	9	78	12	1

Table 1 shows that slightly less than 90% of in-service primary school teachers were familiar or very familiar with the IBSE approach to science education before the DiSSI workshop implementation.

Table 2. In-service primary school teachers' frequency of using IBSE in the past (N = 81)

		Very often	Often	Rarely	Almost never
How often have you used IBSE in the past?	*f*	2	34	40	5
	f%	3	42	49	6

The results in Table 2 show that the IBSE approach was used in the past by slightly less than half of the in-service teachers participating in the study. The in-service primary school teachers mentioned using the IBSE approach often or even very often. However, there is still a fairly large percentage of in-service teachers who have rarely or almost never used the IBSE approach in their classrooms.

Table 3. In-service primary school teachers' effectiveness with the IBSE approach for an average student (N = 81)

		Very effective	Effective	Not effective	Not effective at all
How effective is IBSE for an average student?	*f*	12	67	2	0
	f%	15	82	3	0

From the results obtained (see Table 3), it can be concluded that almost all in-service primary school teachers believe that the IBSE approach is effective or very effective for students in their classrooms and it is not necessary for them to be gifted. Only 3% of in-service teachers believe that the IBSE approach is not effective for the average student.

Table 4. In-service primary school teachers' effectiveness with the IBSE approach for a gifted student (N = 81)

		Very effective	Effective	Not effective	Not effective at all
How effective is IBSE for a gifted student?	*f*	63	18	0	0
	f%	78	22	0	0

From the results in Table 4, it can be concluded that in-service primary school teachers are even more convinced of the effectiveness of the IBSE approach for gifted students compared to average students. All respondents believe that the IBSE approach is very effective or effective for gifted students.

Table 5. In-service primary school teachers' competency of using IBSE in the class (N = 81)

		Very competent	Competent	Poorly competent	Incompetent
How competent do you feel about using IBSE in your class?	*f*	4	64	12	1
	f%	5	79	15	1

Based on the results (Table 5), it can be summarized that 84% of the in-service primary school teachers consider themselves competent or very competent in using the IBSE approach in their class. Most of the other in-service teachers consider themselves poorly competent in applying the IBSE approach in their using and only 1% of the in-service teachers consider themselves as incompetent in using the IBSE approach in their classroom.

Table 6. In-service primary school teachers' frequency encourages their students to ask questions (N = 81)

		Very often	Often	Rarely	Almost never
How often do you encourage your students to ask questions that you then incorporate into the lesson?	*f*	23	46	11	1
	f%	28	57	14	1

Table 6 shows us the in-service primary school teachers' opinions on the question, "How often do you encourage your students to ask questions that you then use in class?" From the results obtained, we can conclude that 85% of teachers often or very often encourage their students to ask questions. 14% of teachers rarely do so and 1% of teachers almost never encourage students to ask questions.

Table 7. In-service primary school teachers help their students formulate questions (N = 81)

		Very often	Often	Rarely	Almost never
How often do you help your students formulate questions that can be answered by an activity?	*f*	5	40	35	1
	f%	6	50	43	1

The results in Table 7 show that nearly 60% of in-service primary school chemistry teachers often or very often help their students ask questions that can be answered by the activity. Slightly more than 40% of the in-service teachers mostly leave the asking of questions to the students themselves, as they rarely help them ask questions. 1% of in-service teachers almost never help students ask questions that can be answered by an activity. It can be concluded that 1% of the teachers leave the students completely independent in the activities.

Table 8. In-service primary school teachers encouraging students to predict the results of experiments/observations (N = 81)

		Very often	Often	Rarely	Almost never
How often do you encourage your students to predict the results of experiments/observations?	*f*	23	48	10	0
	f%	29	59	12	0

Comparing the results in Table 7 with the results in Table 8, we can say that in-service primary school chemistry teachers more often encourage students to predict the results of experimental work/observations during activities than help them ask questions. As many as 88% of in-service primary school teachers do this often or very often, while 12% of in-service teachers rarely encourage students to predict the results of experimental work/observations.

Table 9. In-service primary school teachers involving students in research design (N = 81)

		Very often	Often	Rarely	Almost never
How often do you involve your students in the design of the research?	*f*	3	35	38	5
	f%	4	43	47	6

Table 9 shows that almost half of the in-service primary school chemistry teachers (47%) often or even very often involve their students in designing research. The same percentage of in-service primary school teachers rarely do so, while 6% of in-service teachers almost never involve their students in designing research.

Table 10. In-service primary school teachers encourage students to do fair experiments (N = 81)

		Very often	Often	Rarely	Almost never
How often do you encourage your students to do fair experiment where and when appropriate?	*f*	8	41	30	2
	f%	10	50	37	3

From the results in Table 10, it can be concluded that 60% of in-service primary school chemistry teachers often or very often encourage their students to do a fair experiment wherever and whenever necessary. Nearly 40% of in-service primary school teachers rarely encourage their students to do fair experiment, while 3% of in-service teachers almost never encourage their students to do so.

Table 11. In-service primary school teachers encourage students to review results and observations (N = 81)

		Very often	Often	Rarely	Almost never
How often do you encourage students to check their results and observations?	*f*	12	55	14	0
	f%	15	68	17	0

The results in Table 11 show that 83% of in-service primary school chemistry teachers often or very often encourage their students to check results and observations. Other in-service teachers rarely encourage their students to check their results and observations. Among the in-service primary school teachers who participated in the study, there is no one who did not encourage their students to check their results and observations.

Table 12. In-service primary school teachers help their students organize and systematically manage their notes and data (N = 81)

		Very often	Often	Rarely	Almost never
How often do you help your students organize and systematically manage their notes and data?	*f*	26	42	13	0
	f%	32	52	16	0

The results show (see Table 12) that 84% of in-service primary school chemistry teachers often or very often help their students maintain order and systematicity in notes and data. There is not a single in-service teacher who does not do this. However, the 16% of in-service teachers who rarely help their students maintain order and systematicity in their notes and data is noteworthy.

Table 13. In-service primary school teachers require their students to state the conclusions of their research (N = 81)

		Very often	Often	Rarely	Almost never
How often do you require your students to state the conclusions of their research?	*f*	26	42	13	0
	f%	32	52	16	0

The percentage distribution of in-service primary school chemistry teachers indicating how often they ask their students to state the conclusions of their research (see Table 13) is very similar to the percentage distribution of the frequency distribution in Table 18. Again, 16% of in-service primary school teachers rarely prompt their students to do so, while 84% of in-service primary school teachers often, or very often, ask students to do so.

Table 14. In-service primary school teachers require their students to verify that their conclusions are consistent with the results (N = 81)

		Very often	Often	Rarely	Almost never
How often do you require students to verify that their conclusions are consistent with the results?	*f*	18	45	17	0
	f%	22	56	21	0

From the results in Table 14, we can conclude that a good 20% of primary school chemistry teachers require students very often to verify whether their conclusions are consistent with the results. 56% of the in-service primary school teachers do this often, while 21% of the in-service primary school teachers do it rarely. It should be noted that among the teachers who participated in the research, there is not even one who did not require students to do this.

Table 15. In-service primary school teachers care that students compare their predictions with results (N = 81)

		Very often	Often	Rarely	Almost never
How often do you have students compare their predictions to the results?	*f*	17	47	15	2
	f%	21	58	18	3

Table 15 shows that almost a quarter of in-service primary school chemistry teachers very often care that students compare their predictions with the results. An even larger percentage of in-service teachers (58%) take care of this often. Among all in-service teachers who participated in the study, there are still 18% who rarely care and 3% who unfortunately almost never care.

Table 16. In-service primary school teachers care that students report on their research (N = 81)

		Very often	Often	Rarely	Almost never
How often do students report on their research?	*f*	10	46	23	2
	f%	12	57	28	3

From the results (see Table 16), it can be concluded that as many as 69% of in-service primary school chemistry teachers often or very often ensure that students report on their research. Just over a quarter of the in-service primary school teachers rarely do so, and 3% of the in-service teachers almost never do so.

Table 17. In-service primary school teachers care that students discuss during presentations (N = 81)

		Very often	Often	Rarely	Almost never
How often do students discuss during presentations?	*f*	12	39	27	3
	f%	15	48	23	4

From the results in Table 17, it can be concluded that 63% of in-service primary school chemistry teachers often or very often care that students also discuss during the presentation. Among the in-service primary school teachers who participated in the study, 23% rarely took care of this, while 4% never took care of it.

Table 18. In-service primary school teachers care that students use different representations in their notes (*N* = 81)

		Very often	Often	Rarely	Almost never
How often do you make sure that students use different representations in their notes (note, drawing, diagram, product...)?	*f*	21	47	12	1
	f%	26	58	15	1

In summary, 84% of in-service primary school chemistry teachers often or very often ensure that students use different representations in their notes. 15% of in-service primary school teachers rarely care, while 1% of in-service primary school teachers almost never care.

Table 19. In-service primary school teachers care that students notes contain final results (*N* = 81)

		Very often	Often	Rarely	Almost never
How often do you ensure that student notes contain final results?	*f*	22	50	8	1
	f%	27	62	10	1

It can be summarized that 89% of in-service primary school chemistry teachers often or very often take care, that student notes contain final results. Only 10% of in-service primary school teachers are those who take care of this rarely, and 1% are those who take care of it almost never.

How well in-service primary school teachers know IBSE – post-workshop results

Table 1. In-service primary school teachers' familiarity with the IBSE approach (*N* = 81)

		Very familiar	Familiar	Not familiar	Not familiar at all
How familiar are you with IBSE?	*f*	31	47	3	0
	f%	38	58	4	0

The results in Table 1 show that almost all in-service primary school teachers are familiar or very familiar with IBSE approach. Only 4% of in-service teachers feel that they are not familiar with the IBSE approach.

Table 2. In-service primary school teachers' effectiveness with the IBSE approach for an average student (*N* = 81)

		Very effective	Effective	Not effective	Not effective at all
How effective is IBSE for an average student?	*f*	33	42	6	0
	f%	41	52	7	0

Table 2 shows in-service primary school teachers' opinions about how effective the IBSE approach is for the average student. The results show that most in-service teachers who participated in the study believe that the IBSE approach is effective or very effective for the average student. Only 7% of in-service teachers feel that the IBSE approach is not effective for the average student.

Table 3. In-service primary school teachers' effectiveness with the IBSE approach for a gifted student (N = 81)

		Very effective	Effective	Not effective	Not effective at all
How effective is IBSE for a gifted student?	*f*	64	16	1	0
	f%	79	20	1	0

Table 3 shows in-service primary school teachers' opinions about the effectiveness of the IBSE approach for gifted students. The results show that only 1% of in-service primary school teachers believe that the IBSE approach is not effective for a gifted student. All other in-service teachers agree that the IBSE approach is effective or very effective for gifted students.

Table 4. In-service primary school teachers' competencies about using IBSE approach in the classroom (N = 81)

		Very competent	Competent	Poorly competent	Incompetent
How competent do you feel about using IBSE in your class?	*f*	21	58	2	0
	f%	26	71	3	0

The results in Table 4 show that only 3% of the in-service primary school chemistry teachers consider themselves poorly competent to use the IBSE approach in the classroom. All other in-service teachers feel that they are competent or even very competent to use the IBSE approach in the classroom.

Table 5. In-service primary school teachers' frequency of planning IBSE approach in the classroom (N = 81)

		Very often	Often	Rarely	Almost never
How often do you plan on using IBSE in your class?	*f*	8	64	9	0
	f%	10	79	11	0

From the present results (see Table 5), it can be concluded that most in-service primary school teachers plan to use the IBSE approach often in their classrooms. 10% of the in-service primary school teachers plan to use the IBSE approach very often, while 11% plan to use it rarely. There are no in-service teachers who plan to use the IBSE approach almost never in their classrooms.

Table 6. In-service primary school teachers' frequency of planning IBSE approach with gifted students in the classroom (N = 81)

		Very often	Often	Rarely	Almost never
How often do you plan on using IBSE with gifted students?	*f*	24	51	6	0
	f%	30	63	7	0

From the results in Table 6, we can conclude that the percentage of in-service primary school teachers who use the IBSE approach very often with gifted students is higher. Comparing the results of the frequency of using the IBSE approach in the classroom (Table 10) with the results of using the IBSE approach with gifted students, the percentage of those who use the IBSE approach often is also higher. Only slightly more than 5% of in-service primary school teachers rarely use the IBSE approach with gifted students. It is commendable that there are none among the in-service primary school teachers surveyed who do not use the IBSE approach with gifted students.

What is in-service primary school teachers' opinion about the DiSSI workshop – post-workshop results?

Table 7. In-service primary school chemistry teachers' agreement among teachers on selected statements after workshop implementation.

Statement		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Today's workshop was thought provoking.	*f*	40	33	5	1	2
	f%	49	41	6	1	3
Today's workshop was relevant to me.	*f*	41	31	6	0	3
	f%	51	38	7	0	4
Today's workshop will help me teach more effectively.	*f*	38	36	4	1	2
	f%	47	44	5	1	3
Today's workshop engaged and kept my interest.	*f*	40	35	3	2	1
	f%	49	43	4	3	1
Today's workshop met its stated objectives.	*f*	40	37	3	0	1
	f%	49	46	4	0	1

From the results in Table 7, it can be summarized that almost all in-service primary school chemistry teachers (90%) agreed or totally agreed that the workshop was thought-provoking. Very similar results are observed in the evaluation of the second statement, where most in-service primary school chemistry teachers agreed or totally agreed (89%) that the content of the workshop was relevant to them. Therefore, it can be concluded that the content of the workshop conducted is interesting and current, as it seems to be important for in-service primary school chemistry teachers.

In evaluating the statement *"Today's workshop will help me teach more effectively,"* it can be summarized that a high percentage of in-service primary school chemistry teachers agree or completely agree with this statement (91%).

The in-service primary school teachers expressed extremely high or very high agreement also with the fact that the workshop engaged them and kept them interested. Here one can see that the IBL approach engaged and sustained interest.

In evaluating the statement *"Today's workshop met its stated objectives,"* it can be summarized that the workshop achieved the set goals for the improvement of all in-service chemistry teachers in primary schools, with the exception of 5%. It can also be concluded that the workshop was conducted with high quality and that the teachers enjoyed it.

RESULTS OF THE IMPLEMENTATION OF THE DISSI APPROACH INTO PRE-SERVICE CHEMISTRY TEACHER EDUCATION

1. Report on pre-service chemistry teachers' activities in preparing DiSSI modules and additional exercises for gifted students chemistry learning.

As part of a project for gifted students, pre-service chemistry teachers were actively involved in developing DiSSI learning modules and contextual chemistry problem tasks following the approaches of inquiry-based science education (IBSE).

DiSSI learning modules with IBSE approach

Pre-service chemistry teachers (N = 55; academic year 2019/2020 and 2020/2021) developed 55 DiSSI modules targeted to deal with gifted students at lower and upper secondary school from different topic e.g.: 1) forensic chemistry, 2) chemistry in the gastronomy, 3) environmental chemistry, 4) green chemistry, and 5) chemistry of natural compounds. Students entered their DiSSI learning modules into the course's Moodle online classroom.

Enrichment problems for gifted students

Pre-service chemistry teachers (N = 34; academic year 2019/2020 and 2020/2021) developed a set of chemistry problems as an enrichment activity for gifted students. They worked to formulate contextual chemistry problems that aligned with the specified operational learning objectives and knowledge standards set forth in the primary and secondary school chemistry curriculum. Using this approach, they developed a wide range of tasks covering various aspects of general chemistry, inorganic chemistry, and organic chemistry. Students entered their DiSSI learning modules into the course's Moodle online classroom.

Other DISSI activities with IBSE approach

1) Research projects (year 2021 and 2022): pre-service chemistry teachers (N = 3) prepared three different research projects on the topic of chemistry of natural compounds:
   a) Study of the antioxidant capacity of piperine and other piperidine alkaloids in radical reactions in bovine liver cells,
   b) Repurposing citrus peel at chemistry class in secondary school
   c) Insecticidal effects of aqueous extracts of piperidine alkaloids and other secondary metabolites of various species of pepper on the regulation and control of brown marbled stink bug (*Halyomorpha halys* L.).

2. Report on primary school teacher education – course "Teaching Science"

Altogether 74 pre-service primary school teachers (3rd year of university education at the faculty of Education, University of Ljubljana) participated in the implementation of IBSE into their education - course "Teaching Science" – laboratory work in academic year 2021/22 and 2022/23.

Sample of pre-service primary school teachers

Table 1. Gender structure of the sample.

	Frequency	Percent
Male	3	4.1
Female	71	95.9
Total	74	100.0

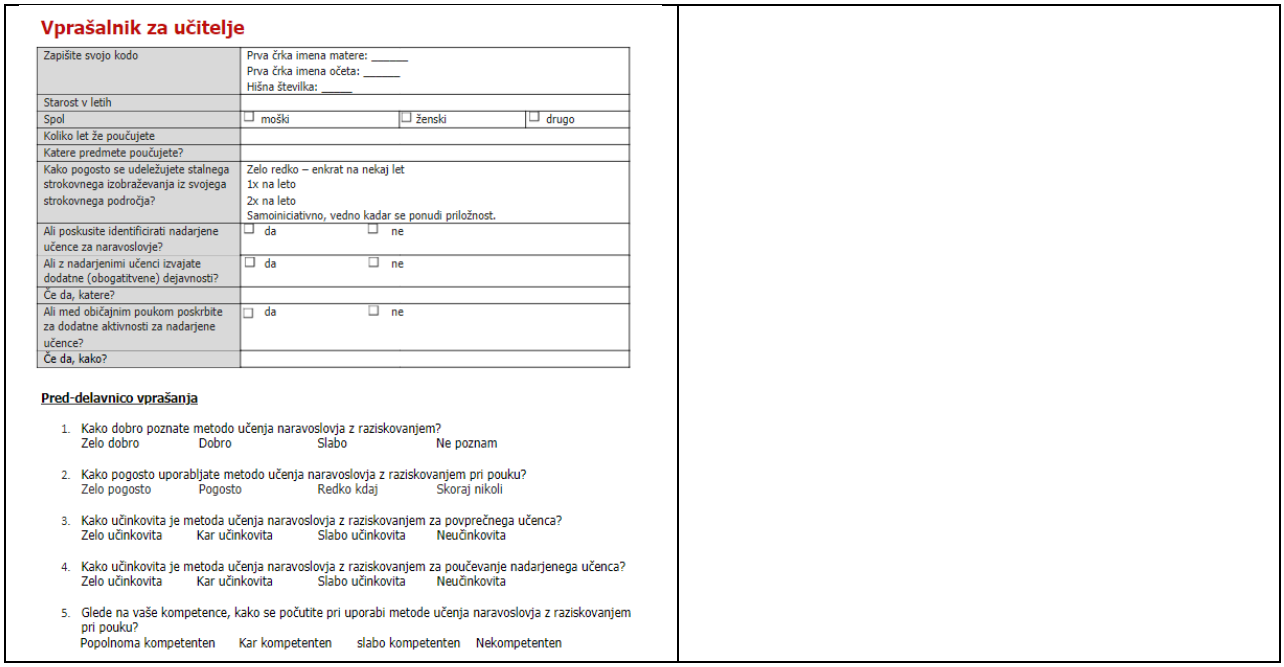
Based on the results presented in Table 1, it can be summarized that the majority of participating pre-service teachers (96%) were female. Less than 5% of the participating teachers in the sample were male.

Table 2. Pre-service primary school teachers' self-report about their identification being gifted in previous schooling.

	Frequency	Percent
Yes	28	37.8
No	46	62.2
Total	74	100.0

Pre-service primary school teachers were also asked if they were identified as gifted in previous schooling – primary school and lower and upper secondary school. It is shown in table 2, that about 38% of students were identified as gifted according to their self-report (see Table 2).

The data were gathered by these instruments:



Vprašalnik za učitelje

Zapišite svojo kodo	Prva črka imena matere: _____ Prva črka imena očeta: _____ Hišna številka: _____
Starost v letih	
Spol	☐ moški ☐ ženski ☐ drugo
Koliko let že poučujete	
Katere predmete poučujete?	
Kako pogosto se udeležujete stalnega strokovnega izobraževanja iz svojega strokovnega področja?	Zelo redko – enkrat na nekaj let 1x na leto 2x na leto Samoiniciativno, vedno kadar se ponudi priložnost.
Ali poskusite identificirati nadarjene učence za naravoslovje?	☐ da ☐ ne
Ali z nadarjenimi učenci izvajate dodatne (obogatitvene) dejavnosti?	☐ da ☐ ne
Če da, katere?	
Ali med običajnim poukom poskrbite za dodatne aktivnosti za nadarjene učence?	☐ da ☐ ne
Če da, kako?	

Pred-delavnico vprašanja

1. Kako dobro poznate metodo učenja naravoslovja z raziskovanjem?
   Zelo dobro Dobro Slabo Ne poznam
2. Kako pogosto uporabljate metodo učenja naravoslovja z raziskovanjem pri pouku?
   Zelo pogosto Pogosto Redko kdaj Skoraj nikoli
3. Kako učinkovita je metoda učenja naravoslovja z raziskovanjem za povprečnega učenca?
   Zelo učinkovita Kar učinkovita Slabo učinkovita Neučinkovita
4. Kako učinkovita je metoda učenja naravoslovja z raziskovanjem za poučevanje nadarjenega učenca?
   Zelo učinkovita Kar učinkovita Slabo učinkovita Neučinkovita
5. Glede na vaše kompetence, kako se počutite pri uporabi metode učenja naravoslovja z raziskovanjem pri pouku?
   Popolnoma kompetenten Kar kompetenten slabo kompetenten Nekompetenten

Figure 1. Pre-workshop questionnaire.

Po-delavnici vprašanja

1. Kako dobro poznate metodo učenja naravoslovja z raziskovanjem po današnji delavnici?
   Zelo dobro Dobro Slabo Ne poznam
2. Kako učinkovita je metoda učenja naravoslovja z raziskovanjem, ki ste jo spoznali na današnji delavnici, za povprečnega učenca?
   Zelo učinkovita Kar učinkovita Slabo učinkovita Neučinkovita
3. Kako učinkovita je metoda učenja naravoslovja z raziskovanjem, ki ste jo spoznali na današnji delavnici, za nadarjenega učenca?
   Zelo učinkovita Kar učinkovita Slabo učinkovita Neučinkovita
4. Glede na vaše kompetence, kako se počutite pri uporabi metode učenja z raziskovanjem naravoslovja pri pouku, po današnji delavnici?
   Popolnoma kompetenten Kar kompetenten slabo kompetenten Nekompetenten
5. Kako pogosto nameravate uporabljati metodo učenja naravoslovja z raziskovanjem pri pouku, po današnji delavnici?
   Zelo pogosto Pogosto Redko kdaj Skoraj nikoli
6. Kako pogosto nameravate uporabljati metodo učenja naravoslovja z raziskovanjem pri naravoslovnih dejavnostih za nadarjene učence?
   Zelo pogosto Pogosto Redko kdaj Skoraj nikoli
7. Določite stopnjo strinjanja s trditvami o današnji delavnici:

Trditev	Popolnoma se strinjam	Se strinjam	Neodločen	Ne strinjam se	Popolnoma se ne strinjam
Aktivnosti delavnice so spodbudile moje razmišljanje o metodi učenja naravoslovja z raziskovanjem.					
Vsebina delavnice se mi je zdela relevantna za moje delo.					
Spoznanja pridobljena na delavnici mi bodo pomagala učinkoviteje poučevati naravoslovje.					
Delavnica je bila dobro organizirana.					
Aktivnosti na delavnici so stalno vzdrževale moje zanimanje za vsebino.					
Delavnica je dosegla svoj namen.					

Figure 2. Post-workshop questionnaire.

How well pre-service primary school teachers know IBSE – pre-workshop results.

Table 1. Pre-service primary school teachers' familiarity with the IBSE approach.

		Very familiar	Familiar	Not familiar	Not familiar at all
How familiar are you with IBSE?	*f*	0	35	38	1
	f%	0	47	51	2

It can be seen in the table that not even 50% of pre-service primary school teachers are not familiar with the IBSE approach in science education prior to the DiSSI workshop implementation.

Table 2. Pre-service primary school teachers' frequency of using IBSE in the past.

		Very often	Often	Rarely	Almost never
How often have you used IBSE in the past?	*f*	0	19	46	9
	f%	0	26	62	12

The results in Table 2 indicate that in the past, only a little over a quarter of teachers frequently used the IBSE approach. Significantly more than half of the pre-service primary school teachers used the IBSE approach rarely (62%), while around 10% mostly never used it.

Table 3. Pre-service primary school teachers' competency of using IBSE in the class.

		Very competent	Competent	Poorly competent	Incompetent
How competent do you feel about using IBSE in your class?	*f*	0	31	38	5
	f%	0	42	51	7

Based on the obtained results (Table 3), it can be summarized that a little over half of the pre-service primary school teachers consider themselves poorly competent in using the IBSE approach in their classrooms. Among the pre-service primary school teachers, the prevailing group believes they are adequately competent in using the IBSE approach, while 7% of pre-service primary school teachers consider themselves incompetent in using the IBSE approach in their classrooms. The table of results also indicates that no pre-service primary school teachers expressed the opinion of being very competent in using the IBSE approach in the classroom.

What is pre-service primary school teachers' opinion about the DiSSI workshop – post-workshop results?

Table 1. Pre-service primary school teachers' familiarity with the IBSE approach.

		Very familiar	Familiar	Not familiar	Not familiar at all
How familiar are you with IBSE?	*f*	34	40	0	0
	f%	46	54	0	0

It can be concluded that the familiarity of the IBSE approach significantly improves after attending a pre-service primary school teachers' workshop. Almost half of them now perceive the content as very familiar. The percentage of pre-service primary school teachers who consider themselves familiar with the content of the IBSE approach has also increased. It is worth emphasizing that an important result is that none of the pre-service primary school teachers find the content of the IBSE approach not familiar or not familiar at all after attending the workshop.

Table 2. Pre-service primary school teachers' effectiveness with the IBSE approach for an average student.

		Very effective	Effective	Not effective	Not effective at all
How effective is IBSE for an average student?	*f*	38	35	1	0
	f%	51	47	2	0

From the results obtained, it can be concluded that more than half of the pre-service primary school teachers believe that the IBSE approach is very effective for the average student. The remaining slightly less than half also believe that the IBSE approach is effective for the average student. Only 2% of pre-service primary school teachers believe the IBSE approach is not effective for the average student.

Table 3. Pre-service primary school teachers' effectiveness with the IBSE approach for a gifted student.

		Very effective	Effective	Not effective	Not effective at all
How effective is IBSE for a gifted student?	*f*	44	27	3	0
	f%	60	36	4	0

From the results in Table 3, it can be concluded that pre-service primary school teachers are even more convinced of the effectiveness of the IBSE approach for gifted students compared to average students. In fact, 96% of the respondents believe that the IBSE approach is very effective or effective for gifted students. Only 4% of respondents believe that the IBSE approach is not effective for gifted students. Among the teachers surveyed, there is no one who believes that the IBSE approach is not at all effective for gifted students.

Table 4. Pre-service primary school teachers' competencies about using IBSE approach in the classroom.

		Very competent	Competent	Poorly competent	Incompetent
How competent do you feel about using IBSE in your class?	*f*	10	62	2	0
	f%	13	84	3	0

The results in Table 4 show that only slightly more than 10% of the surveyed pre-service primary school teachers believe that they use the IBSE approach with high competence. The majority of pre-service primary school teachers (84%) believe they are competent in using the IBSE approach. Less than 5% of the teachers surveyed consider themselves to be poorly competent in implementing the IBSE approach in the classroom. It is noteworthy that none of the pre-service primary school teachers surveyed felt that they were incompetent in applying the IBSE approach in the classroom.

Table 5. Pre-service primary school teachers' frequency of planning IBSE approach in the classroom.

		Very often	Often	Rarely	Almost never
How often do you plan on using IBSE in your class?	*f*	8	60	5	1
	f%	11	81	7	1

Based on the present results, it can be concluded that the majority of pre-service primary school teachers plan to use the IBSE approach often in their classrooms. About 10% of the pre-service primary school teachers plan to use the IBSE approach very often, while less than 10% plan to use it rarely. Unfortunately, among the pre-service primary school teachers surveyed, there are also those (1%) who almost never plan to incorporate the IBSE approach in their classrooms.

Table 6. Pre-service primary school teachers' frequency of planning IBSE approach with gifted students in the classroom.

		Very often	Often	Rarely	Almost never
How often do you plan on using IBSE with gifted students?	*f*	22	47	5	0
	f%	30	63	7	0

From the results in Table 6, we can conclude that the percentage of pre-service primary school teachers who use the IBSE approach very often with gifted students is significantly higher. Comparing the results of the frequency of using the IBSE approach in the classroom (Table 5) with the results of using the IBSE approach with gifted students, the percentage of those who use the IBSE approach often is also higher. Only slightly more than 5% of pre-service primary school teachers rarely use the IBSE approach with gifted students. It is commendable that there are none among the pre-service primary school teachers surveyed who do not use the IBSE approach with gifted students.

Table 7. Pre-service primary school teachers' agreement among teachers on selected statements after workshop implementation.

Statement		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Today's workshop was thought provoking.	*f*	34	37	2	1	0
	f%	46	50	3	1	0
Today's workshop was relevant to me.	*f*	39	32	2	1	0
	f%	53	43	3	1	0
Today's workshop will help me teach more effectively.	*f*	35	36	2	1	0
	f%	47	49	3	1	0
Today's workshop engaged and kept my interest.	*f*	28	38	7	1	0
	f%	38	51	10	1	0

From the results in Table 7, it can be summarized that the surveyed pre-service primary school teachers largely agree or totally agree with all the statements. The highest percentage of the surveyed pre-service primary school teachers (10%) neither agree nor disagree with the statement "*Today's workshop engaged and kept my interest.*". It is important to note that none of the pre-service primary school teachers surveyed strongly disagreed with any of the statements.

RESULTS OF THE IMPLEMENTATION OF THE DiSSI APPROACH INTO INFORMAL LOWER SECONDARY SCHOOL STUDENTS' CHEMISTRY EDUCATION

Sample of lower secondary school students

The data were gathered by these instruments:

Vprašalnik za učence pred laboratorijsko dejavnostjo

Draga/i učenka/učenec,

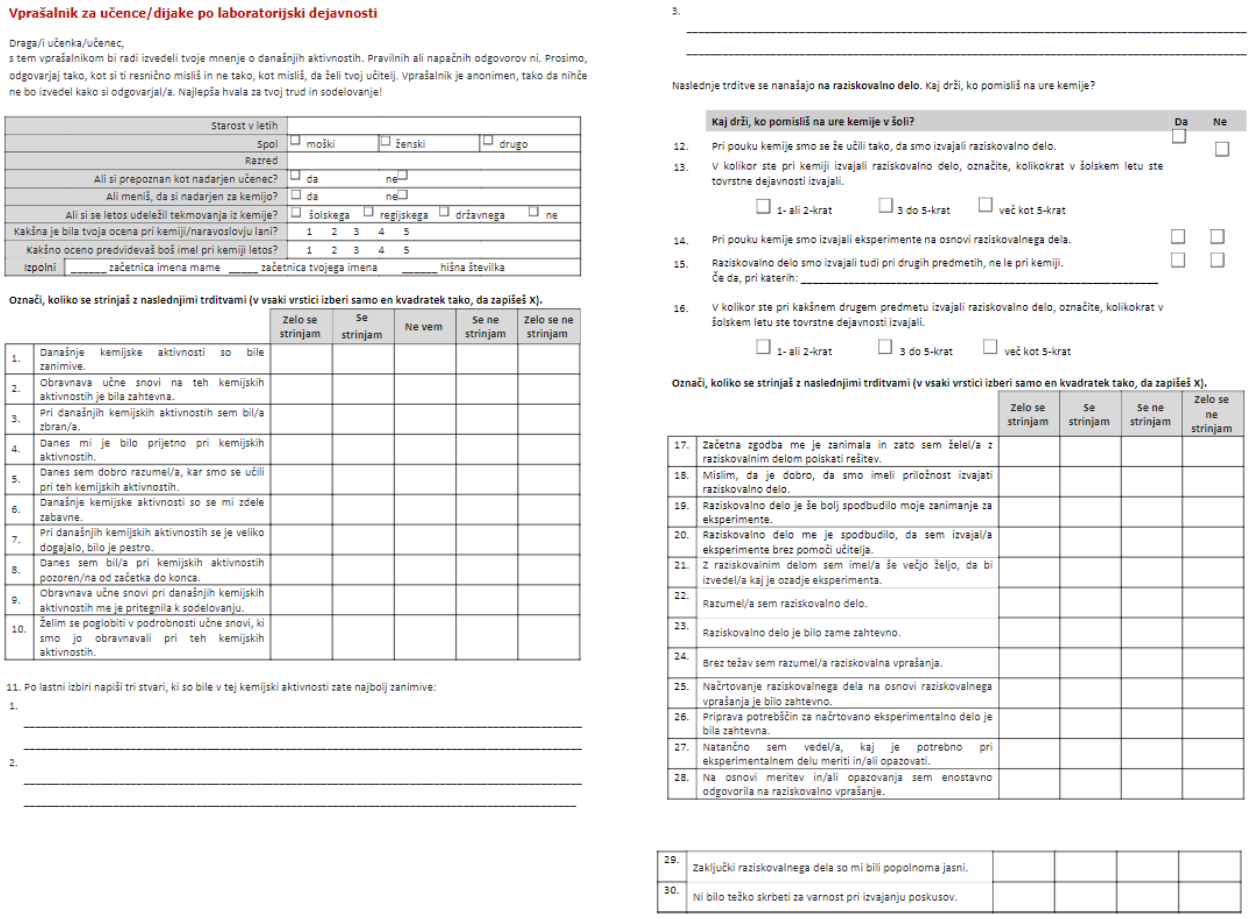
s tem vprašalnikom bi radi izvedeli tvoje mnenje o kemiji. Pravilnih ali napačnih odgovorov ni. Prosimo, odgovarjaj tako, kot ti resnično misliš in ne tako, kot misliš, da želi tvoj učitelj. Vprašalnik je anonimen, tako da nihče ne bo izvedel kako si odgovarjal/a. Najlepša hvala za tvoj trud in sodelovanje!

Starost v letih			
Spol	☐ moški	☐ ženski	☐ drugo
Razred			
Ali si prepoznan kot nadarjen učenec?	☐ da	ne ☐	
Ali meniš, da si nadarjen za kemijo?	☐ da	ne ☐	
Kakšna je bila tvoja ocena pri kemiji/naravoslovju lani?	1 2 3 4 5		
Kakšno oceno predvidevaš boš imel pri kemiji letos?	1 2 3 4 5		
Izpolni	_____ začetnica imena mame	_____ začetnica tvojega imena	_____ hišna številka

Označi, koliko se strinjaš z naslednjimi trditvami (v vsaki vrstici izberi samo en kvadratek tako, da zapišeš X).

		Zelo se strinjam	Se strinjam	Ne vem	Se ne strinjam	Zelo se ne strinjam
1.	Uživam ob učenju kemijskih vsebin.					
2.	Rad berem o kemiji.					
3.	Rad rešujem kemijske probleme.					
4.	Rad pridobivam novo kemijsko znanje.					
5.	Zanima me učenje kemije.					
6.	Nameravam opravljati poklic, pri katerem bom moral uporabljati kemijsko znanje.					
7.	Menim, da mi bo uspeh pri kemiji pomagal pri zaposlitvi.					
8.	Starši bi bili zadovoljni, če bi imel poklic, kjer bi uporabljal kemijsko znanje.					
9.	Zanimajo me poklici, ki uporabljajo kemijo.					
10.	Imam vzornika, ki opravlja ali je opravljal poklic, ki uporablja kemijo.					
11.	V pogovoru s človekom, ki opravlja poklic, ki uporablja kemijo, bi se počutil lagodno.					
12.	Imam sorodnika, ki opravlja poklic, ki uporablja kemijo.					
13.	Učenje zahtevnih kemijskih vsebin mi ne povzroča večjih težav.					
14.	Vedno dobro odgovorim na vprašanja pri pisnih preizkusih znanja pri kemiji.					
15.	Hitro se naučim snov pri kemiji.					
16.	Kemijske vsebine se mi zdijo enostavne.					

Figure 1. Pre-workshop questionnaire for lower secondary students.



Vprašalnik za učence/dijake po laboratorijski dejavnosti

Draga/i učenka/učenec,
s tem vprašalnikom bi radi izvedeli tvoje mnenje o današnjih aktivnostih. Pravilnih ali napačnih odgovorov ni. Prosimo, odgovarjaj tako, kot si ti resnično misliš in ne tako, kot misliš, da želi tvoj učitelj. Vprašalnik je anonimen, tako da nihče ne bo izvedel kako si odgovarjal/a. Najlepša hvala za tvoj trud in sodelovanje!

Starost v letih	
Spol	☐ moški ☐ ženski ☐ drugo
Razred	
Ali si prepoznan kot nadarjen učenec?	☐ da ☐ ne
Ali meniš, da si nadarjen za kemijo?	☐ da ☐ ne
Ali si se letos udeležil tekmovanja iz kemije?	☐ šolskega ☐ regijskega ☐ državnega ☐ ne
Kakšna je bila tvoja ocena pri kemiji/naravoslovju lani?	1 2 3 4 5
Kakšno oceno predvidevaš boš imel pri kemiji letos?	1 2 3 4 5
Izpolni	_____ začetnica imena mame _____ začetnica tvojega imena _____ hišna številka

Označi, koliko se strinjaš z naslednjimi trditvami (v vsaki vrstici izberi samo en kvadratek tako, da zapišeš X).

		Zelo se strinjam	Se strinjam	Ne vem	Se ne strinjam	Zelo se ne strinjam
1.	Današnje kemijske aktivnosti so bile zanimive.					
2.	Obravnava učne snovi na teh kemijskih aktivnostih je bila zahtevna.					
3.	Pri današnjih kemijskih aktivnostih sem bil/a zbran/a.					
4.	Danes mi je bilo prijetno pri kemijskih aktivnostih.					
5.	Danes sem dobro razumel/a, kar smo se učili pri teh kemijskih aktivnostih.					
6.	Današnje kemijske aktivnosti so se mi zdele zabavne.					
7.	Pri današnjih kemijskih aktivnostih se je veliko dogajalo, bilo je pestro.					
8.	Danes sem bil/a pri kemijskih aktivnostih pozoren/na od začetka do konca.					
9.	Obravnava učne snovi pri današnjih kemijskih aktivnostih me je pritegnila k sodelovanju.					
10.	Želim se poglobiti v podrobnosti učne snovi, ki smo jo obravnavali pri teh kemijskih aktivnostih.					

11. Po lastni izbiri napiši tri stvari, ki so bile v tej kemijski aktivnosti zate najbolj zanimive:

1. _____
_____
2. _____
_____
3. _____
_____

Naslednje trditve se nanašajo **na raziskovalno delo**. Kaj drži, ko pomisliš na ure kemije?

	Kaj drži, ko pomisliš na ure kemije v šoli?	Da	Ne
12.	Pri pouku kemije smo se že učili tako, da smo izvajali raziskovalno delo.	☐	☐
13.	V kolikor ste pri kemiji izvajali raziskovalno delo, označite, kolikokrat v šolskem letu ste tovrstne dejavnosti izvajali. ☐ 1- ali 2-krat ☐ 3 do 5-krat ☐ več kot 5-krat		
14.	Pri pouku kemije smo izvajali eksperimente na osnovi raziskovalnega dela.	☐	☐
15.	Raziskovalno delo smo izvajali tudi pri drugih predmetih, ne le pri kemiji. Če da, pri katerih: _____	☐	☐
16.	V kolikor ste pri kakšnem drugem predmetu izvajali raziskovalno delo, označite, kolikokrat v šolskem letu ste tovrstne dejavnosti izvajali. ☐ 1- ali 2-krat ☐ 3 do 5-krat ☐ več kot 5-krat		

Označi, koliko se strinjaš z naslednjimi trditvami (v vsaki vrstici izberi samo en kvadratek tako, da zapišeš X).

		Zelo se strinjam	Se strinjam	Se ne strinjam	Zelo se ne strinjam
17.	Začetna zgodba me je zanimala in zato sem želel/a z raziskovalnim delom poiskati rešitev.				
18.	Mislim, da je dobro, da smo imeli priložnost izvajati raziskovalno delo.				
19.	Raziskovalno delo je še bolj spodbudilo moje zanimanje za eksperimente.				
20.	Raziskovalno delo me je spodbudilo, da sem izvajal/a eksperimente brez pomoči učitelja.				
21.	Z raziskovalnim delom sem imel/a še večjo željo, da bi izvedel/a kaj je ozadje eksperimenta.				
22.	Razumel/a sem raziskovalno delo.				
23.	Raziskovalno delo je bilo zame zahtevno.				
24.	Brez težav sem razumel/a raziskovalna vprašanja.				
25.	Načrtovanje raziskovalnega dela na osnovi raziskovalnega vprašanja je bilo zahtevno.				
26.	Priprava potrebščin za načrtovano eksperimentalno delo je bila zahtevna.				
27.	Natančno sem vedel/a, kaj je potrebno pri eksperimentalnem delu meriti in/ali opazovati.				
28.	Na osnovi meritev in/ali opazovanja sem enostavno odgovorila na raziskovalno vprašanje.				

29.	Zaključki raziskovalnega dela so mi bili popolnoma jasni.				
30.	Ni bilo težko skrbeti za varnost pri izvajanju poskusov.				

Figure 2. Post-workshop questionnaire for lower secondary students.

Analysis of the individual interest influencing students' attitudes towards IBSE, their situational interest, and their interest in science carers

To explore how students' individual interest effects their attitude towards IBSE, their situational interest, and their interest in science carers, one-way ANOVA was used. Students were divided into three groups based on their individual interest for chemistry (Group 1: low interest, Group 2: medium interest, Group three: high interest). The difference in students' attitude towards IBSE between the three groups is statistically significant ($F(2, 258) = 26.084$; $p < .050$). Post hoc comparisons using Tukey HSD showed that there is a statistically significant difference ($p \leq .000$) between the mean scores for Group 1 ($M = 19.02$; $SD = 3.00$) and Group 3 ($M = 23.03$; $SD = 2.48$), between Group 2 ($M = 20.81$; $SD = 2.83$) and Group 3 ($p < .050$), and also between Group 1 and Group 2 ($p < .050$).

When comparing students' interest in science carers it was found that there is a significant difference between the three groups ($F(2, 256) = 44.489$; $p < .050$). Tukey HSD post hoc test showed a statistically significant difference ($p \leq .000$) between the mean scores for Group 1 ($M = 17.54$; $SD = 5.12$) and Group 3 ($M = 26.21$; $SD = 3.79$), between Group 2 ($M = 21.13$; $SD = 4.81$) and Group 3, and also between Group 1 and Group 2.

Significant difference was also found when comparing situational interest between the three groups ($F(2, 254) = 24.344$; $p < .050$). Tukey HSD post hoc test showed a statistically significant difference ($p < .050$) between the mean scores for Group 1 ($M = 33.68$; $SD = 6.16$) and Group 3 ($M = 41.54$; $SD = 4.08$), between Group 2 ($M = 37.92$; $SD = 5.72$) and Group 3 ($p < .050$), and also between Group 1 and Group 2 was not significant ($p < .050$).

Table 1: ANOVA between the three groups based on their individual interest for learning chemistry and their attitude towards IBSE, profession interest and situational interest.

	df, df	*F*	*p*
Attitude towards IBSE	2, 258	26.084	< .050
Interest in science carers	2, 256	44.489	< .050
Situational interest[a]	2, 254	24.344	< .050

[a]The test of homogeneity of variances was statistically significant ($F(2, 258) = 3.923$; $p < 0.050$), so the Welch test of equality of means was applied.

Analysis of the autonomous motivation influencing students' attitudes towards IBSE, their situational interest, and their interest in science carers

To explore how students' autonomous motivation for learning chemistry effects their attitude towards IBSE, their situational interest, and their interest in science carers, one-way ANOVA was used. Students were divided into three groups based on their autonomous motivation for learning chemistry (Group 1: low autonomous motivation, Group 2: average autonomous motivation, Group three: high autonomous motivation). The difference in students' attitude towards IBSE between the three groups is statistically significant ($F(2, 259) = 21.805$; $p < .050$). Post hoc comparisons using Tukey HSD showed that there is a statistically significant difference ($p < .050$) between the mean scores for Group 1 ($M = 19.00$; $SD = 3.10$) and Group 3 ($M = 23.18$; $SD = 2.09$), between Group 2 ($M = 21.02$; $SD = 2.90$) and Group 3 ($p < .050$), and also between Group 1 and Group 2 ($p < .050$).

When comparing students' interest in science carers it was found that there is a significant difference between the three groups ($F(2, 257) = 35.513$; $p < .050$). Tukey HSD post hoc test showed a statistically significant difference ($p < .050$) between the mean scores for Group 1 ($M = 17.44$; $SD = 5.22$) and Group 3 ($M = 26.46$; $SD = 4.63$), between Group 2 ($M = 21.53$; $SD = 4.73$) and Group 3, and also between Group 1 and Group 2.

Significant difference was also found when comparing situational interest between the three groups ($F(2, 255) = 14.557$; $p < .050$). Tukey HSD post hoc test showed a statistically significant difference ($p < .050$) between the mean scores for Group 1 ($M = 34.73$; $SD = 3.11$) and Group 3 ($M = 41.66$; $SD = 3.56$), between Group 2 ($M = 38.03$; $SD = 5.80$) and Group 3 ($p < .050$) and also between Group 1 and Group 2 ($p < .050$).

Table 2: ANOVA between the three groups based on their autonomous motivation for learning chemistry and their attitude towards IBSE, profession interest and situational interest.

	df, df	*F*	*p*
Attitude towards IBSE	2, 259	21.805	< .050
Interest in science carers	2, 257	35.513	< .050
Situational interest[a]	2, 255	14.557	< .050

[a]The test of homogeneity of variances was statistically significant ($F(2, 255) = 4.993$; $p < 0.050$), so the Welch test of equality of means was applied.

Analysis of the controlled motivation influencing students' attitudes towards IBSE, their situational interest, and their interest in science carers

To explore how students' controlled motivation for learning chemistry effects their attitude towards IBSE, their situational interest, and their interest in science carers, one-way ANOVA was used. Students were divided into three groups based on their controlled motivation for learning chemistry (Group 1: low controlled motivation, Group 2: average controlled motivation, Group three: high controlled motivation). There was no significant difference when comparing students' attitude towards IBSE ($F(2, 260) = 2.071$; $p = .128$).
When comparing students' interest in science carers t it was found that there is a significant difference between the three groups ($F(2, 258) = 4.710$; $p < .050$). Tukey HSD post hoc test showed a statistically significant difference ($p < .050$) between the mean scores for Group 1 ($M = 18.97$; $SD = 6.54$) and Group 3 ($M = 22.68$; $SD = 4.70$), and also between Group 1 and Group 2 ($M = 21.83$; $SD = 5.23$). There was no significant difference between mean scores for Group 2 and Group 3.
There was no significant difference comparing situational interest between the three groups ($F(2, 256) = .777$; $p = .461$).

Table 3: ANOVA between the three groups based on their controlled motivation for learning chemistry and their attitude towards IBSE, profession interest and situational interest.

	df, df	*F*	*p*
Attitude towards IBSE	2, 260	2.071	.128
Interest in science carers	2, 258	4.710	< .050
Situational interest	2, 256	.545	.580

The analysis of the differences between students' attitudes towards IBSE, attitude towards IBSE phases, their situational interest before and after DiSSI modules adaptations

No significant differences were found between students who attended our workshops before and after adaptations in their attitude towards IBSE ($t = -.437$, $df = 134$, $p = .663$), attitude towards IBSE phases ($t = -1.750$, $df = 133$, $p = .082$), their situational interest ($t = -.696$, $df = 131$, $p = .488$).

The analysis of the students' gender influencing their attitudes towards IBSE, situational interest, individual interest, autonomous motivation, controlled motivation

No significant differences were found between boys and girls in their attitude towards IBSE (t = -1.466, df = 257, p = .144), situational interest (t = -.425, df = 196.7, p = .671), individual interest (t = 1.589, df = 226.368, p = .113), autonomous motivation (t = .893, df = 236.324, p = .373) and controlled motivation (t = .160, df = 258, p = .873).

The analysis of the students' giftedness influencing their attitudes towards IBSE, situational interest, individual interest, autonomous motivation, controlled motivation

When comparing gifted and non-gifted students, significant difference was found between the groups in their autonomous motivation (t = 3.514, df = 260, p < .050). The gifted had a higher mean score (M = 19.56, SD = 2.98) than the non-gifted (M = 18.41, SD = 3.50). Significant difference was also found in their individual interest (t = 4.599, df = 259, p < .050), where the gifted showed more interest (M = 19.53, SD = 3.72) than the non-gifted (M = 17.26, SD = 4.09). Significant difference was found in their attitude towards IBSE (t = 2.365, df = 260, p < .050), where the gifted showed a more positive attitude towards IBSE (M = 21.55, SD = 2.57) than the non-gifted (M = 20.65, SD = 3.31) and also in their situational interest (t = 2.507, df = 256, p < .050) where the gifted showed higher interest (M = 39.16, SD = 5.29) than the non-gifted (M = 37.29, SD = 6.29).
On the other hand, no significant differences were found between the gifted and non-gifted students in their controlled motivation (t = 4.599, df = 246.6, p = .542).

The analysis of the students' giftedness for chemistry influencing their attitudes towards IBSE, situational interest, individual interest, autonomous motivation, controlled motivation

When comparing students who think they're are gifted for chemistry and those who don't, significant difference was found between the groups in their autonomous motivation (t = 5.196, df = 260, p < .050). Those who think they're gifted for chemistry had a higher mean score (M = 20.18, SD = 2.80) than those who don't (M = 18.15, SD = 2.80). Significant difference was also found in their individual interest (t = 7.311, df = 259, p < .050), where those who think they're gifted for chemistry showed more interest (M = 20.11, SD = 3.51) than those who don't (M = 16.71, SD = 3.89). Significant difference was also found in their situational interest (t = 3.454, df = 257, p < .050) where those who think they're gifted for chemistry showed more interest (M = 39.44, SD = 5.50) than those who don't (M = 36.92, SD = 6.08). Significant difference was also found in their attitude towards IBSE (t = 3.724, df = 260, p < .050), where those who think they're gifted for chemistry showed a more positive attitude (M = 21.79, SD = 2.68) than those who don't (M = 20.42, SD = 3.18).
No significant differences were found between the groups in their controlled motivation (t = -.682, df = 261, p = .496).

The analysis of the students' previous experiences with IBSE in school influencing their attitudes towards IBSE, situational interest, individual interest, autonomous motivation, controlled motivation

When comparing students who had previous experience with IBSE in school and those who didn't, significant difference was found between the groups in their autonomous motivation ($t = 2.240$, $df = 260$, $p < .050$). Students who had previous experience with IBSE in school had a higher mean score ($M = 19.31$, $SD = 3.04$) than those who didn't ($M = 17.88$, $SD = 4.29$). Significant difference was also found in their individual interest ($t = 2.839$, $df = 259$, $p < .050$), where the gifted showed more interest ($M = 18.57$, $SD = 3.85$) than the non-gifted ($M = 16.78$, $SD = 4.71$).
On the other hand, no significant differences were found between the two groups in their attitude towards IBSE ($t = .931$, $df = 261$, $p = .353$), situational interest ($t = .520$, $df = 256$, $p = .604$), and controlled motivation ($t = 1.344$, $df = 261$, $p = .180$).

Table 4. Pre-workshop students' agreements with selected items.

Statement		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
I generally have fun when I am learning chemistry	*f*	50	136	56	15	7
	f%	18.9	51.5	21.2	5.7	2.7
I like to read about chemistry.	*f*	22	101	81	47	13
	f%	8.3	38.3	30.7	17.8	4.9
I am happy doing chemistry problems.	*f*	48	95	73	38	8
	f%	18.3	36.3	27.9	14.5	3.1
I enjoy acquiring new knowledge in chemistry.	*f*	78	125	44	12	5
	f%	29.5	47.3	16.7	4.5	1.9
I am interested in learning about chemistry.	*f*	57	111	58	28	10
	f%	21.6	42.0	22.0	10.6	3.8
I plan to use chemistry in my future career.	*f*	24	40	117	50	32
	f%	9.1	15.2	44.5	19.0	12.2
If I do well in chemistry classes, it will help me in my future career.	*f*	34	66	106	38	19
	f%	12.9	25.1	40.3	14.4	7.2
My parents would like it if I choose a career related to chemistry.	*f*	33	63	129	25	14
	f%	12.5	23.9	48.9	9.5	5.3
I am interested in careers that use chemistry.	*f*	30	87	72	53	22
	f%	11.4	33.0	27.3	20.1	8.3
I have a role model in a chemistry career.	*f*	30	41	51	89	52
	f%	11.4	15.6	19.4	33.8	19.8
I would feel comfortable talking to people who work in chemistry careers.	*f*	28	104	93	28	11
	f%	10.6	39.4	35.2	10.6	4.2
I know of someone in my family who uses chemistry in their career.	*f*	58	47	38	70	51
	f%	22.0	17.8	14.4	26.5	19.3
Learning advanced chemistry topics would be easy for me.	*f*	37	110	59	39	18
	f%	14.0	41.7	22.3	14.8	6.8
I can usually give good answers to test questions on chemistry topic.	*f*	36	108	71	42	7
	f%	13.6	40.9	26.9	15.9	2.7
I learn chemistry topics quickly.	*f*	65	117	42	28	12
	f%	24.6	44.3	15.9	10.6	4.5
Chemistry topics are easy for me.	*f*	30	99	72	46	17
	f%	11.4	37.5	27.3	17.4	6.4
When I am being taught chemistry, I can understand the concepts very well.	*f*	48	140	42	29	5
	f%	18.2	53.0	15.9	11.0	1.9

I can easily understand new ideas in chemistry.	*f*	38	110	70	37	9
	f%	14.4	41.7	26.5	14.0	3.4
I participate actively in chemistry class because I feel like it's a good way to improve my understanding of the material.	*f*	90	121	40	10	3
	f%	34.1	45.8	15.2	3.8	1.1
I participate actively in chemistry class because others might think badly of me if I didn't.	*f*	9	19	47	118	71
	f%	3.4	7.2	17.8	44.7	26.9
I participate actively in chemistry class because a solid understanding of chemistry is important to my intellectual growth	*f*	62	126	52	18	5
	f%	23.6	47.9	19.8	6.8	1.9
I am likely to follow my instructor's suggestions for studying chemistry because I would get a bad grade if I didn't do what she suggests.	*f*	50	110	55	37	12
	f%	18.9	41.7	20.8	14.0	4.5
I am likely to follow my instructor's suggestions for studying chemistry because I am worried that I am not going to perform well in the course.	*f*	26	116	60	51	11
	f%	9.8	43.9	22.7	19.3	4.2
I am likely to follow my instructor's suggestions for studying chemistry because it's easier to follow her suggestions than come up with my own study strategies.	*f*	38	80	85	46	15
	f%	14.4	30.3	32.2	17.4	5.7
I am likely to follow my instructor's suggestions for studying chemistry because she seems to have insight about how best to learn the material.	*f*	74	110	61	16	3
	f%	28.0	41.7	23.1	6.1	1.1
	f	59	114	63	22	6

The reason that I work to expand my knowledge of chemistry is because it's interesting to learn more about the nature of chemistry.	*f%*	22.3	43.2	23.9	8.3	2.3
The reason that I work to expand my knowledge of chemistry is because it's a challenge to really understand how to answer chemistry questions.	*f*	32	109	74	43	6
	f%	12.1	41.3	28.0	16.3	2.3
The reason that I work to expand my knowledge of chemistry is because I want others to see that I am intelligent when discussing chemistry topics.	*f*	25	56	59	83	41
	f%	9.5	21.2	22.6	31.4	15.5

It can be summarised from the Table 4 that students disagreed mostly or were not decided with statements that they want to use chemistry in their future careers. The also disagreed that they participated actively in chemistry class because others might think badly of them if they didn't and similarly they expressed disagreement with statemen that indicate students' expending chemistry knowledge because they want others to see that they are intelligent when discussing chemistry topics.

Table 5. Post-workshop students' agreements with items measuring situational interest.

Statement		Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
The lesson in today's chemistry class was interesting.	*f*	126	116	13	5	4
	f%	47.7	43.9	4.9	1.9	1.5
Dealing with the subject matter was challenging today.	*f*	9	26	69	135	25
	f%	3.4	9.8	26.1	51.1	9.1
I was focused at this lesson.	*f*	45	150	46	18	3
	f%	17.2	57.3	17.6	6.9	1.1
I enjoyed chemistry lessons today.	*f*	110	112	32	7	2
	f%	41.8	42.6	12.2	2.7	0.8
Today I understood well what we learned in class.	*f*	75	143	29	12	3
	f%	28.6	54.6	11.1	4.6	1.1
Today's class was fun for me.	*f*	110	113	25	12	4
	f%	41.7	42.8	9.5	4.5	1.5
There was a lot going on at today's class, it was varied.	*f*	78	114	40	30	2
	f%	29.5	43.2	15.2	11.4	0.8
I was attentive in todays' class, from the beginning to the end.	*f*	58	134	46	19	7
	f%	22.0	50.8	17.4	7.2	2.7
Today's material at the class attracted me, so I participated.	*f*	78	119	52	12	3
	f%	29.5	45.1	19.7	4.5	1.1
I want to delve into the details of the material we discussed at today's class.	*f*	29	72	113	41	9
	f%	11.0	27.3	42.8	15.5	3.4

Table 5 shows that students evaluated in-formal educational setting at Centre KemikUm as interesting, challenging and in general they like it. Not much students' evaluated the workshops as boring.

Table 6. Post-workshop students' agreements with items about the workshop and IBSE.

Statement		Strongly agree	Agree	Disagree	Strongly disagree
I was interested in the initial story and therefore wanted to find a solution through inquiry-based work.	*f*	69	152	38	4
	f%	26.2	57.8	14.4	1.5
I think it is good that we had the opportunity to do inquiry-based work.	*f*	138	116	9	0
	f%	52.5	44.1	3.4	0
Because of the inquiry-based learning, I was more interested in the experiments.	*f*	83	136	35	9
	f%	31.6	51.7	13.3	3.4
Inquiry-based learning encouraged me to carry out experiments without the help of a teacher.	*f*	75	143	41	4
	f%	28.5	54.4	15.6	1.5
With inquiry-based learning, I had an even greater desire to find out the background of the experiment.	*f*	68	141	49	5
	f%	25.9	53.6	18.6	1.9
I understood the inquiry-based learning activities.	*f*	84	164	11	4
	f%	31.9	62.4	4.2	1.5
Inquiry-based learning was difficult for me.	*f*	8	28	170	57
	f%	3.0	10.6	64.6	21.7
I had no problem understanding the research questions.	*f*	59	167	32	5
	f%	22.4	63.5	12.2	1.9
Planning the inqury-based learning based on research questions was challenging.	*f*	10	63	164	25
	f%	3.8	24.0	62.5	9.5
Preparing the supplies for the planned experimental work was challenging.	*f*	9	32	155	65
	f%	3.4	12.2	59.3	24.9
I knew exactly what needed to be measured and/or observed during experimental work.	*f*	57	167	36	3
	f%	21.7	63.5	13.7	1.1
Based on measurements and/or observations, I had no problem answering the research questions.	*f*	59	169	33	1
	f%	22.5	64.5	12.6	0.4

The conclusions of the inquiry-based learning were completely clear to me.	*f*	84	147	30	2
	f%	31.9	55.9	11.4	0.8
It was not difficult to worry about safety when conducting experiments.	*f*	111	136	13	3
	f%	42.2	51.7	4.9	1.1

It can be concluded from table 6 that students found IBSE as an interesting activity. In general, they haven't been overwhelmed by the activities and they evaluated all parts of the IBSE process as simple enough that the can follow and lean from it.

In conclusion, it can be said that IBSE in context activities that were offered to the students in the informal educational environment at the University of Ljubljana, Faculty of Education were successful activities for students to develop research competences and to learn new concepts from environmental chemistry, forensic sciences and chemistry of the natural compounds.