



University of Ljubljana

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# Project-Based Learning in Times of COVID-19 - Both a Challenge and an Opportunity

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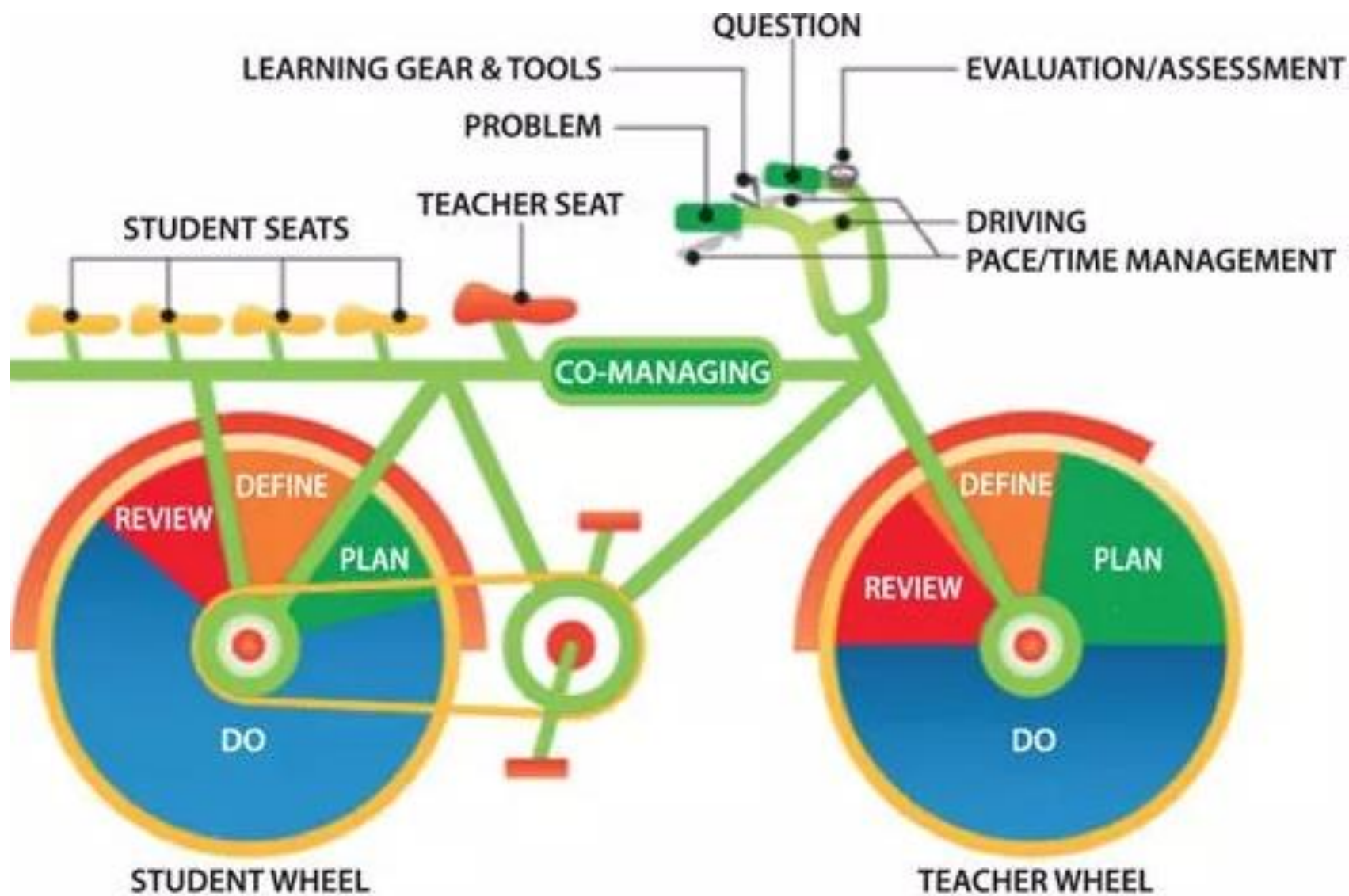






# Project-Based Learning (PBL)

The Project-Based Learning bicycle model illustrates:



- clearly set objectives (driving direction)

- learning through a sequence of meaningful activities (key steps of PBL)

- collaboration between teacher and students (on a common bike)



# Project-Based Learning - characteristics

- Relationship to students' life experiences;
- Interdisciplinary approach;
- Planned and directed activities;
- Consideration of students' interests, learning styles, and abilities;
- Developing the ability to communicate and collaborate;
- Focus on the learning process;
- Openness of the learning process;
- The evaluation of the end result as well as implementation of PBL.



# Project-Based Learning - key steps

PBL steps by Fray:

## Key steps

- initiative
- project sketching
- implementation plan
- implementation
- final step

## Intermediate steps

- guidance
- coordination



# The context of the use of PBL

**Study Programme:** first cycle university study programme at University of Ljubljana, Faculty of Education, the two-subject teacher (Chemistry), 4th year

**Name of the Subject:** Experimental and Project-Based Learning (9 ECTS)

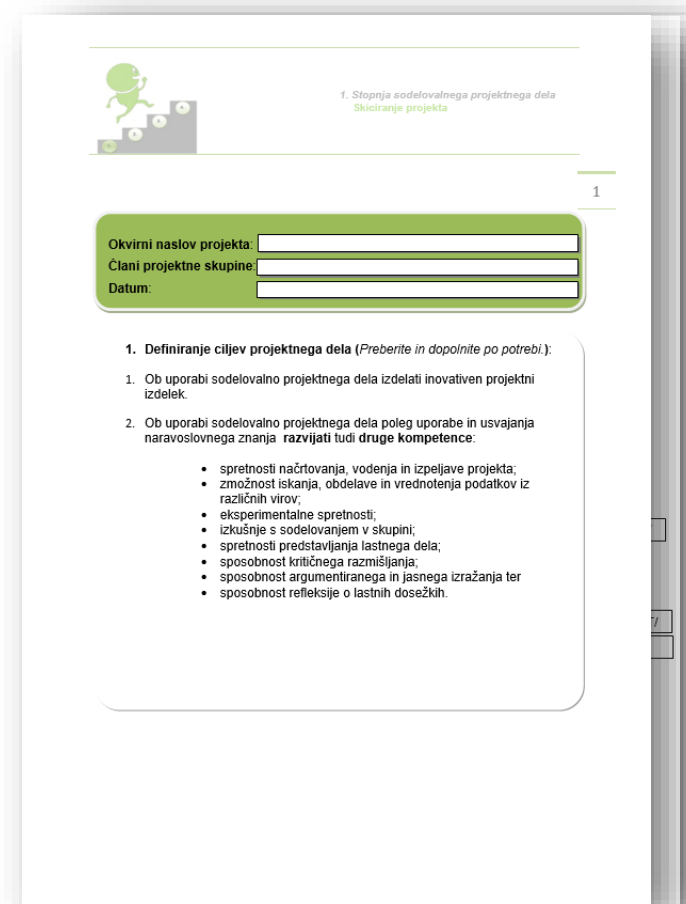
**Number of enrolled students in academic year 2020/21:** 19

		Type of PBL according to duration and scope	Type of PBL according to purpose and content
1. PBL	Project-Based Learning (with the support of an e-textbook)	Small project	Learning type project / constructive type project
2. PBL	Project-Based Learning (development of a teaching and learning tool to overcome student misconceptions in chemistry)	Big project	Constructive type project
1. E-PBL	Experimental Project-Based Learning (development and implementation of experimental workshop for primary school students)	Big project	Constructive type project
2. E-PBL	Experimental Project-Based Learning (KemikUm's New Year's event)	Small project	Constructive type project



# Project portfolio

Templates (forms) of the project portfolio to support the implementation of individual PBL step.



1. Stopnja sodelovalnega projektnega dela  
Skiciranje projekta

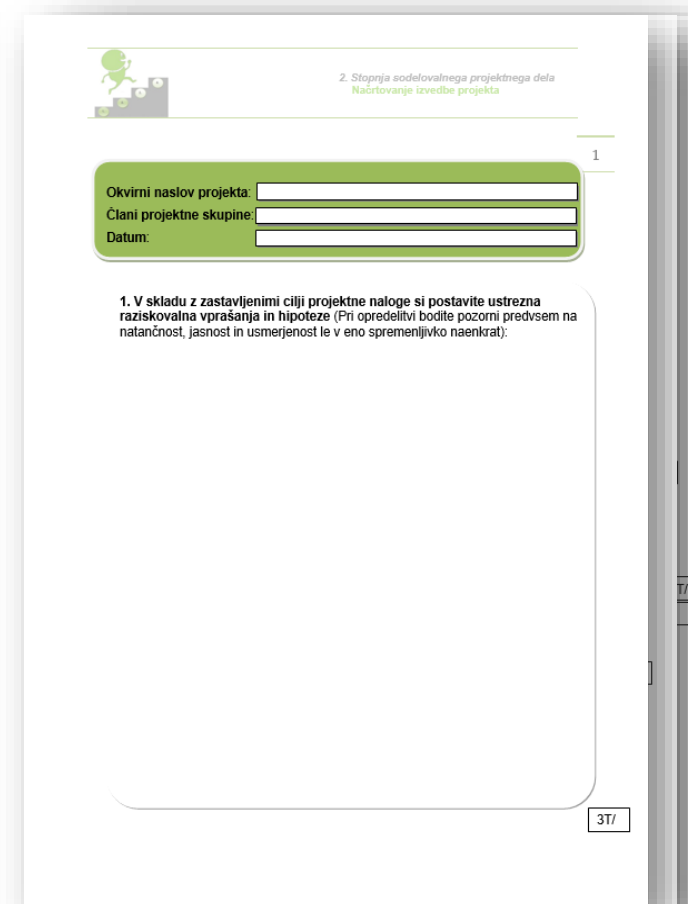
1

Okvirni naslov projekta: \_\_\_\_\_  
Člani projektne skupine: \_\_\_\_\_  
Datum: \_\_\_\_\_

1. Definiranje ciljev projektnega dela (Preberite in dopolnite po potrebi):

- Ob uporabi sodelovalno projektnega dela izdelati inovativen projektni izdelek.
- Ob uporabi sodelovalno projektnega dela poleg uporabe in usvajanja naravoslovnega znanja razvijati tudi druge kompetence:
  - spretnosti načrtovanja, vodenja in izpeljave projekta;
  - zmožnost iskanja, obdelave in vrednotenja podatkov iz različnih virov;
  - eksperimentalne spretnosti;
  - izkušnje s sodelovanjem v skupini;
  - spretnosti predstavljanja lastnega dela;
  - sposobnost kritičnega razmišljanja;
  - sposobnost argumentiranega in jasnega izražanja ter
  - sposobnost refleksije o lastnih dosežkih.

Project sketching



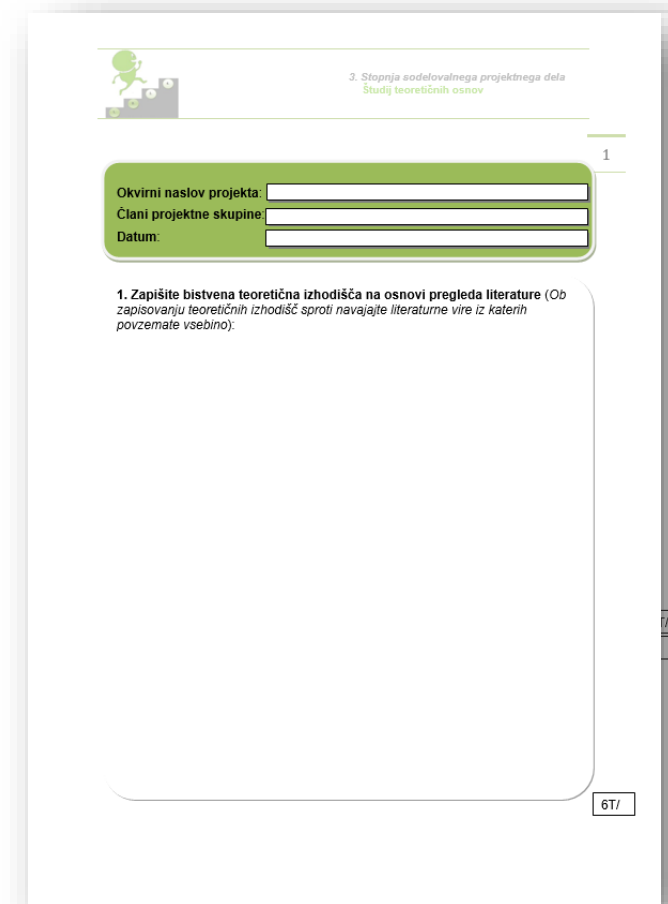
2. Stopnja sodelovalnega projektnega dela  
Načrtovanje izvedbe projekta

1

Okvirni naslov projekta: \_\_\_\_\_  
Člani projektne skupine: \_\_\_\_\_  
Datum: \_\_\_\_\_

1. V skladu z zastavljenimi cilji projektne naloge si postavite ustrezna raziskovalna vprašanja in hipoteze (Pri opredelitvi bodite pozorni predvsem na natančnost, jasnost in usmerjenost te v eno spremenljivko naenkrat).

Implementation plan



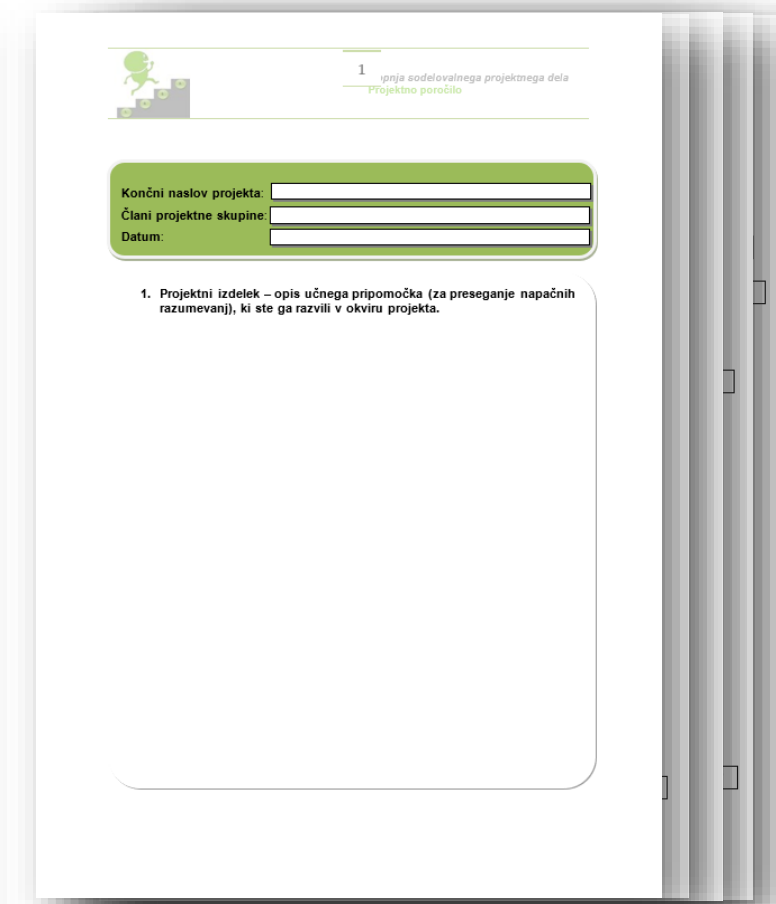
3. Stopnja sodelovalnega projektnega dela  
Študij teoretičnih osnov

1

Okvirni naslov projekta: \_\_\_\_\_  
Člani projektne skupine: \_\_\_\_\_  
Datum: \_\_\_\_\_

1. Zapišite bistvena teoretična izhodišča na osnovi pregleda literature (Ob zapisovanju teoretičnih izhodišč sproti navajajte literaturne vire iz katerih povzemate vsebino).

Implementation



1. Stopnja sodelovalnega projektnega dela  
Projektno poročilo

1

Končni naslov projekta: \_\_\_\_\_  
Člani projektne skupine: \_\_\_\_\_  
Datum: \_\_\_\_\_

1. Projektni izdelek – opis učnega pripomočka (za preseiganje napačnih razumevanj), ki ste ga razvili v okviru projekta.

Final step



# Project portfolio

## Example: Final step

1. Končna sodelovalnega projektnega dela  
Projektno poročilo

Končni naslov projekta:   
Člani projektne skupine:   
Datum:

1. Projektni izdelek – opis učnega pripomočka (za preseganje napačnih razumevanj), ki ste ga razvili v okviru projekta.

Skupno doseženih točk: 12T/12T

Podpis učitelja:

6T/ 2T/ 1T/

## The evaluation of the project portfolio

number of points of individual sets of the project portfolio form

the sum of all points at the end of the project portfolio form





# Project portfolio

## Example: Final step

1. spnja sodelovalnega projektnega dela  
Projektno poročilo

Končni naslov projekta:   
Člani projektne skupine:   
Datum:

1. Projektni izdelek – opis učnega pripomočka (za preseganje napačnih razumevanj), ki ste ga razvili v okviru projekta.

5. spnja sodelovalnega projektnega dela  
Projektno poročilo

predloge za projektno poročilo v dogovorjenem roku  
vorjeni za oddajo predloge do

1T/

Skupno doseženih točk: 12T/

Podpis učitelja: \_\_\_\_\_

je predloge pri rubriki 1:  
2T – rezultati in doseganje zastavljenih ciljev naloge ni jasno opredeljeno, doseganje zastavljenih ciljev naloge je opredeljeno z manjšimi pomankljivostmi, 6T – rezultati in doseganje zastavljenih ciljev naloge je povsem jasno opredeljeno

je predloge pri rubriki 2:  
2T – projektni izdelek ni jasno opredeljen, vsebuje bistvene strokovne pomankljivosti, 4T – projektni izdelek je opredeljen z manjšimi pomankljivostmi, vsebuje manjše strokovne pomankljivosti, 6T – projektni izdelek je povsem jasno opredeljen, brez strokovnih pomankljivosti

je predloge pri rubriki 3:  
1T – projekt posnema že poznane projekte, 2T – projekt na inovativen način pogloblja/nadgrajuje že poznane projekte, 3T – visoka inovativnost projekta – povsem sveže ideje pri zasnovi in izpeljavi projekta

je predloge pri rubriki 4:  
odpisanem roku, 1T – oddano v predpisanem roku

## The criteria with description for evaluating the project portfolio

### *Predlagan kriterij vrednotenja predloge pri rubriki 1:*

0T – ni opredeljeno, 2T – rezultati in doseganje zastavljenih ciljev naloge ni jasno opredeljeno, 4T – rezultati in doseganje zastavljenih ciljev naloge je opredeljeno z manjšimi pomankljivostmi, 6T – rezultati in doseganje zastavljenih ciljev naloge je povsem jasno opredeljeno

### *Predlagan kriterij vrednotenja predloge pri rubriki 2:*

0T – ni opredeljeno, 2T – projektni izdelek ni jasno opredeljen, vsebuje bistvene strokovne pomankljivosti, 4T – projektni izdelek je opredeljen z manjšimi pomankljivostmi, vsebuje manjše strokovne pomankljivosti, 6T – projektni izdelek je povsem jasno opredeljen, brez strokovnih pomankljivosti

### *Predlagan kriterij vrednotenja predloge pri rubriki 3:*

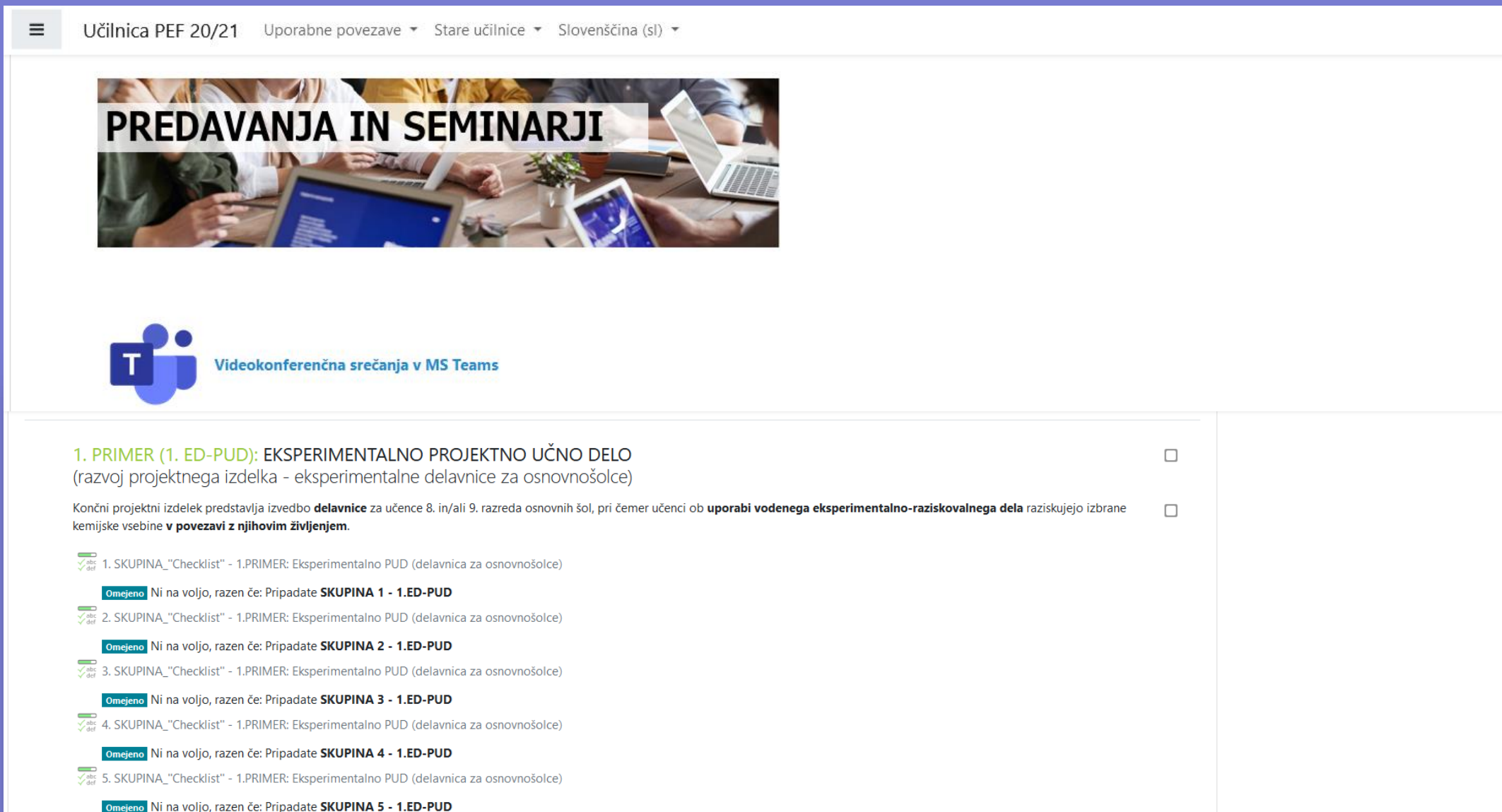
0T – ni opredeljeno, 1T – projekt posnema že poznane projekte, 2T – projekt na inovativen način pogloblja/nadgrajuje že poznane projekte, 3T – visoka inovativnost projekta – povsem sveže ideje pri zasnovi in izpeljavi projekta

### *Predlagan kriterij vrednotenja predloge pri rubriki 4:*

0T – ni oddano v predpisanem roku, 1T – oddano v predpisanem roku



# Implementation of PBL using online classroom Moodle and collaborative environment MS Teams



Učilnica PEF 20/21 Uporabne povezave Stare učilnice Slovenščina (sl)

## PREDAVANJA IN SEMINARJI

Videokonferenčna srečanja v MS Teams

**1. PRIMER (1. ED-PUD): EKSPERIMENTALNO PROJEKTNO UČNO DELO** (razvoj projektne izdelka - eksperimentalne delavnice za osnovnošolce)

Končni projektni izdelek predstavlja izvedbo **delavnice** za učence 8. in/ali 9. razreda osnovnih šol, pri čemer učenci ob **uporabi vodenega eksperimentalno-raziskovalnega dela** raziskujejo izbrane kemijske vsebine **v povezavi z njihovim življenjem**.

- 1. SKUPINA\_ "Checklist" - 1.PRIMER: Eksperimentalno PUD (delavnica za osnovnošolce)  
**Omejeno** Ni na voljo, razen če: Pripadate **SKUPINA 1 - 1.ED-PUD**
- 2. SKUPINA\_ "Checklist" - 1.PRIMER: Eksperimentalno PUD (delavnica za osnovnošolce)  
**Omejeno** Ni na voljo, razen če: Pripadate **SKUPINA 2 - 1.ED-PUD**
- 3. SKUPINA\_ "Checklist" - 1.PRIMER: Eksperimentalno PUD (delavnica za osnovnošolce)  
**Omejeno** Ni na voljo, razen če: Pripadate **SKUPINA 3 - 1.ED-PUD**
- 4. SKUPINA\_ "Checklist" - 1.PRIMER: Eksperimentalno PUD (delavnica za osnovnošolce)  
**Omejeno** Ni na voljo, razen če: Pripadate **SKUPINA 4 - 1.ED-PUD**
- 5. SKUPINA\_ "Checklist" - 1.PRIMER: Eksperimentalno PUD (delavnica za osnovnošolce)  
**Omejeno** Ni na voljo, razen če: Pripadate **SKUPINA 5 - 1.ED-PUD**

## Online Classroom (Moodle)

- General information about the subject
- Schedule of subject implementation
- Materials for PBL
- Assignment (Turnitin) and evaluation

## Collaborative Environment (MS Teams)

- Conducting videoconference meetings with all students
- Conducting videoconference meetings of project groups
- Collaborative work of project groups in specific channels

# Examples from the online classroom



Učilnica PEF 20/21 Uporabne povezave Stare učilnice Slovenščina (sl)

Katarina Mlinarec Udeleženec

**1.1. TEMATSKA PODROČJA ZA IZBOR PROJEKTNEGA UČNEGA DELA** (razvoj projektne izdelka - eksperimentalne delavnice za osnovnošolce)

Projektne skupine/pari pri 1. ED - PUD

**1.2. RAZVOJ PROJEKTNEGA IZDELKA**

**1.2.1 Inicijativa** - 13. 10. 2020

Viharjenje možganov glede vsebine in izvedbe delavnice (izmenjava idej, podaja predlogov ipd.).

**1.2.2 Skiciranje projekta** - 20. 10. 2020

Predloga za skiciranje projektne (KV)

Skiciranje projekta KV (rok za oddajo 26. 10. 2020) -> L1

**1.2.3 Načrtovanje projekta** - 20. 10. 2020

Predloga za načrtovanje projekta (KV)

Načrtovanje projekta KV (rok za oddajo 26. 10. 2020) -> L2

**1.2.4 Izvedba projekta** - 27. 10. - 1. 12. 2020

Razvoj eksperimentalnih in neeksperimentalnih aktivnosti in gradiv za delavnico.

Predloga za teoretična izhodišča (KV)

Teoretična izhodišča KV (rok za oddajo 10. 11. 2020) -> L6

Predloga za učno pripravo (KV)

Učna priprava s pripadajočimi gradivi KV - (rok za oddajo 6. 12. 2020) -> L9

**1.2.5 Sklepna stopnja projekta** - 8. 12. 2020 - 12. 1. 2021

Predloga za sklepno stopnjo projekta (KV)

Sklepna stopnja KV (rok za oddajo: 15. 1. 2021) -> L13

- Implementation of PBL by steps
- Instructions, templates for project portfolio
- Submission of portfolio (Turnitin)



# Examples from the collaborative environment



Univerza v Ljubljani

Iskanje

Vse skupine

Dejavnost

Klepnet

Ekipe

Dodeljene ...

Koledar

Datoteke

Applikacije

Pomoč

Splošno

Skupina 1\_1ED-PUD - vaje

Skupina 1\_1PUD

Skupina 1\_2PUD

Skupina 2\_1ED-PUD - vaje

Skupina 2\_1PUD

Skupina 2\_2PUD

Skupina 3\_1ED-PUD - vaje

Skupina 3\_1PUD

Skupina 3\_2PUD

Skupina 4\_1ED-PUD - vaje

Skupina 4\_1PUD

Skupina 4\_2PUD

Skupina 5\_1ED-PUD - vaje

Skupina 5\_1PUD

Skupina 5\_2PUD

Splošno

Objave

Datoteke

Zvezek za predavanja

Dodeljene naloge

Ocene

Ekipe

Sestanek

23. december 2020

Mlinarec, Katarina 12. 10. 20 20:39

Načrtovanje sestanka

Eksperimentalno in projektno delo - Predavanja in seminarji (na daljavo)

Vsak sreda @13:00 do 13. 01. 21

še 69 odgovorov od vas, Nina, Tina in še 9

Odgovor

Včeraj

Začetek: New channel meeting

Strni vse

Ferk Savec, Vesna Včeraj, 13:30

Postrske predstavitve

Razmislek v skupinah:

**Skupina A**

- ključni elementi posterja

**Skupina B**

- navodila za izdelavo posterjev za učence
- + Poster naj BO ...
- Poster naj NE (BO)...

**Skupina C**

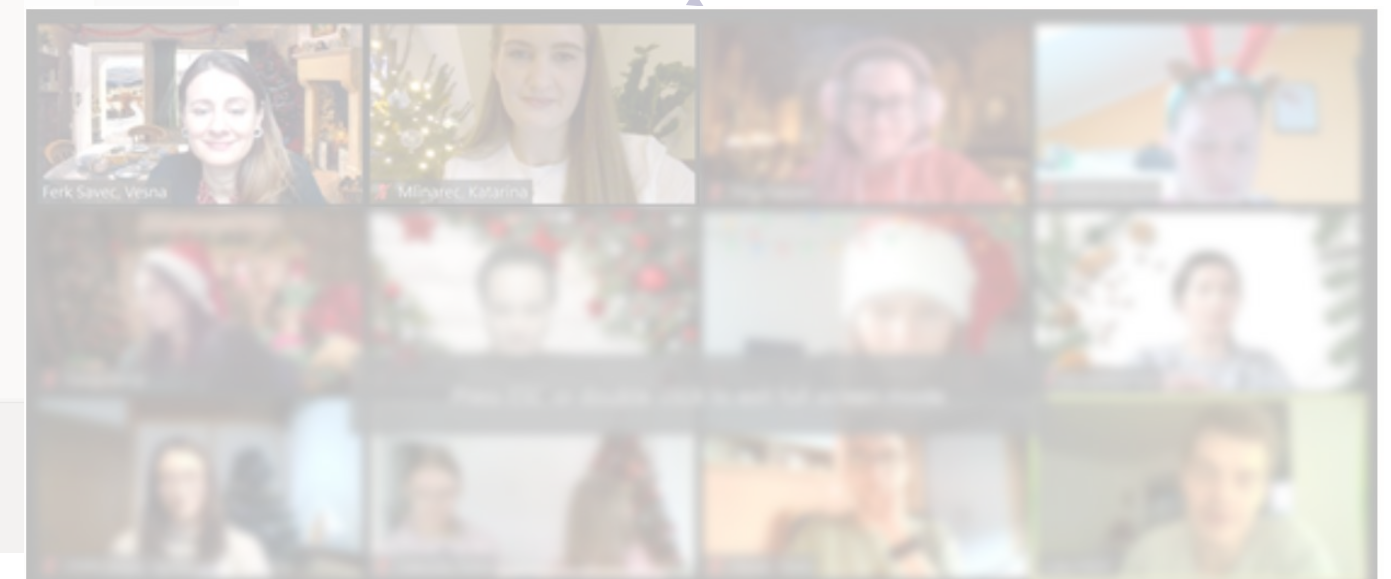
- kriteriji za vrednotenje postrske predstavitve

vidimo se 13.50 v skupnem kanalu

Nov pogovor

## General Channel

- Access for all students
- Conducting videoconference meetings with all students





# Examples from the collaborative environment



A screenshot of a Microsoft Teams channel interface. The left sidebar shows a list of channels under 'Vse skupine', including 'EPD - Eksperimentalno in projekt...', 'Skupina 1\_1ED-PUD - vaje', and several other sub-channels. The main content area shows a post from 'Skupina 1\_1ED-PUD - vaje' with a link to a Wired article about making hand sanitizer. Below it is a text post from 'MM' discussing disinfectants. At the bottom, there is a 'Nov pogovor' button.

## Specific channels

- Videoconference meetings of project groups
- Restricted access to the channel (only for members of a specific project team)





# Examples from the collaborative environment



Skupina 1\_1ED-PUD - vaje

3. 11. 20 09:54  
<https://www.wired.com/story/how-to-make-hand-sanitizer/>  
**How to DIY Your Own Hand Sanitizer**  
No Purell? No problem! When disinfecting gel sells out everywhere, you can just make some yourself with stuff you (maybe) already have at home.  
www.wired.com  
12 odgovorov from ANJA and Maša  
← Odgovor

3. 11. 20 11:21  
We often take for granted the action of disinfectants without fully understanding how they work. Not only are there differences in the action of the antimicrobial ingredients, but there are also differences depending on the concentration of chemical that is used that can impact the action of a chemical agent or physical process. In general, disinfectants have three mechanisms of action or ways that they affect or kill an organism: Cross-linking, coagulating, clumping; structure and function disruption; and oxidizing.  
Prikaži več  
← Odgovor

3. 11. 20 11:35  
<https://www.sciencedirect.com/science/article/pii/S0196655320305629>  
**Hand sanitizers: A review of ingredients, mechanisms of action, modes of delivery, and efficacy against coronav...**  
The emergence of the novel virus, SARS-CoV-2, has posed unprecedented challenges to public health around the world. Currently, strategies to deal with...  
www.sciencedirect.com

Nov pogovor

## Specific channels

Collaborative work of students of specific project groups:

- co-editing documents
- collecting materials
- product development, etc.

Ime	Spremenjeno	Spremenil
1_Skiciranje_projekta_Vaje.docx	27. oktober 2020	DEŽMAN, ANJA
3.1_Teoreticne_osnove_Vaje.docx	3. november 2020	Mijić, Maša
Dežman_Mijić_Pečar_načrtovanje_KV.docx	2. november 2020	Pečar, Hana
DL-razkužila.docx	10. november 2020	DEŽMAN, ANJA
DL-razkužila-prirejeno_za_delo_od_doma.docx	24. november 2020	DEŽMAN, ANJA
EPD-vaje-ideje.docx	17. november 2020	DEŽMAN, ANJA
Navodila_za_ucitelja_Beljakovine.pdf	17. november 2020	DEŽMAN, ANJA
opis_delavnice-razkužila.pptx	24. november 2020	DEŽMAN, ANJA
razkužila.bf.pdf	3. november 2020	Pečar, Hana
Razkužila-teoretična_izhodišča.docx	6. november 2020	DEŽMAN, ANJA
Rezultati_eksperimenta.pdf	17. november 2020	DEŽMAN, ANJA
Screenshot 2020-10-20 at 11.08.43.png	20. oktober 2020	DEŽMAN, ANJA

# Presenting the results of PBL

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## Sončne celice so zakon!

### SILICIJ

- Kemijski element, v 3. periodi in 4. skupini.
- Drugi najbolj razširjen element v zemeljski skorji takoj za kislikom.
- Termosivna polkovina, njegova najbolj znana oblika je kremen: SiO<sub>2</sub>.
- Podoben strukturi diamanta, atomi so tetraedrično razporejeni.



### H<sub>3</sub>PO<sub>4</sub>

Fosforjeva(V) kislina

**Kislina se predstavi!**

- šibka kislina
- vrelišče ima pri 100°C
- tališče pa pri 8,4°C
- polarna (meša z vodo)
- obstojna trdna snov
- ni oksidant

**Zakaj jo izbrati?**

- ✓ odstranjevanje rje (železo, nerjaveče jeklo...)
- ✓ 80% pridelane H<sub>3</sub>PO<sub>4</sub> za izdelavo gnojil
- ✓ farmacija (uporabljen kot intermedij, v zobozdravstvu - čiščenje zob)
- ✓ osebni negi (čistila, parfumi, izdelki za lase, izdelki za nego nohtov, ličila, ipd.)
- ✓ v prehrani (dodatek k marmeladi, žitnim ploščicam, predelanim mesnim izdelkom, siru, Coca-Coli ipd.)
- ✓ odstranitev mineralnih usedlin, cementnih madežev in madežev trde vode v gradbeništvu
- ✓ kemično oksidacijsko sredstvo za proizvodnjo izdelkov z aktivnim ogljem
- ✓ elektrolit v gorivnih celicah ali oksihidrogenih generatorjih
- ✓ sintetični detergenti
- ✓ čiščenje vode in kovin

**Kako jo pridobimo?**

Pridobivajo jo z dodajanjem vode fosforjevemu(V) oksidu P<sub>4</sub>O<sub>10</sub>.

### H<sub>2</sub>SO<sub>4</sub>

Žveplova(VI) kislina

**Kislina se predstavi!**

- močna kislina
- nepolarna (ne meša z vodo)
- močno higroskopska (kar pomeni, da odvzema snovem vodo)
- brezbarvna tekočina ostrega vonja
- močan oksidant
- pri razredčevanju se sprošča toplota
- vrelišče ima pri 338°C, tališče pa pri 10,4°C

**Kako jo pridobimo?**

Pridobivamo jo iz žveplovega dioksida po reakciji:

$$SO_2 + O_2 \rightarrow SO_3$$

$$SO_3 + H_2O \rightarrow H_2SO_4$$

Za katalizator lahko uporabimo dušikov dioksid:

$$SO_2 + H_2O + NO_2 \rightarrow H_2SO_4 + NO$$

$$NO + O_2 \rightarrow NO_2$$

**Zakaj jo izbrati?**

- ✓ čiščenje nečistoč iz goriv
- ✓ čiščenje kovin (železo, nerjaveče jeklo)
- ✓ dala kot elektrolit v baterijah, ki pogosto uporabljamo v motorjih
- ✓ gnojila (amonijev sulfat)
- ✓ kemijski detergenti
- ✓ sintetični detergenti
- ✓ barve in pigmenti
- ✓ eksplozivna in...

**VELIKO POVPRAČENO!**

Letno narjano več kot katere koli druge kemikalije (več kot 40 milijard ton)

#### PRIDOBIVANJE

S praženjem sulfidne rude:

$$2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g)$$

Dobljeni cinkov oksid reduciramo z ogljikom pri 950°C:

$$2ZnO(s) + C(s) \rightarrow Zn(l) + CO(g)$$

Z elektrolizo: ZnO raztopijo v H<sub>2</sub>SO<sub>4</sub> in nato izvajajo elektrolizo. Cink se izloča na katodi.

#### CINK

#### LASTNOSTI

Uvrščamo med prehodne kovine v PSE.

Tališče: 419 °C  
Vrelišče: 906 °C

Elektronska konfiguracija: [Ar]3d<sup>10</sup>4s<sup>2</sup>

#### UPORABA

V medicini, pri galvanskem členu.

Cink je nujno potreben element, ki je pomemben je za normalno rast in razvoj organizma, nevrološke funkcije, reproduktivna funkcije, za celjenje ran in normalno delovanje imunskega sistema.



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2. E-PBL	Experimental Project-Based Learning (KemikUm's New Year's event)	Small project	Constructive type project

## 12. Vprašanje

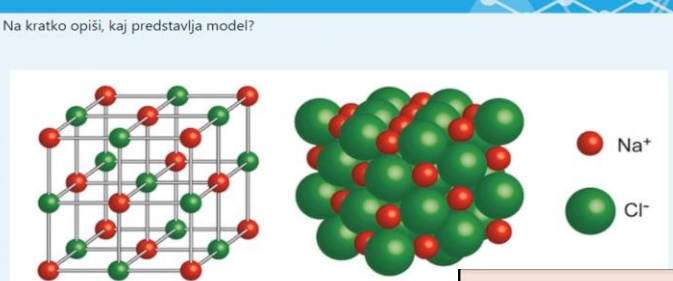
Pravilni odgovor:  
Ionski kristal iz Na<sup>+</sup> in Cl<sup>-</sup>.

Delno pravilni odgovori:

- NaCl,
- Na<sup>+</sup> in Cl<sup>-</sup>,
- natrijeve in kloridne ione in
- ionski kristal.


Pravilno je odgovorilo: **11% učencev.**  
Napačno je odgovorilo: **49% učencev.**

Na kratko opiši, kaj predstavlja model?



Yıldırım in Demirkol, 2018 – primer trganje papirja; raziskava s pločevinko.

Pločevinko Coca-cole povezi avto. Pločevinka se splošči.



Delci se sploščajo, delci se zmanjšajo in sploščajo. Študenti razrednega pouka 58% uspešni, študenti kemije pa 84 % uspešni.

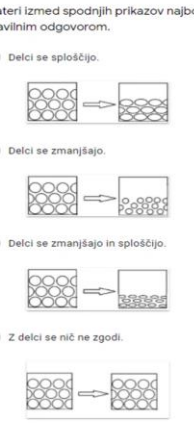
Kateri izmed spodnjih prikazov najbolj pravilnim odgovorom.

Delci se sploščajo.


Delci se zmanjšajo.

Delci se zmanjšajo in sploščajo.


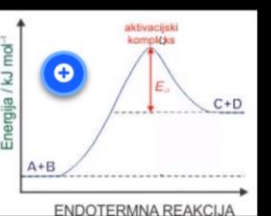
Z delci se nič ne zgodi.



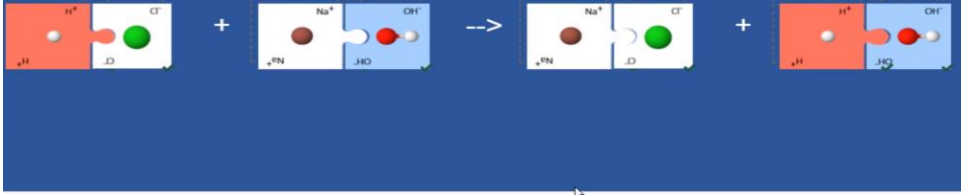
OS 3 b



Študenti

vodikove kisline in natrijevega hidroksida:

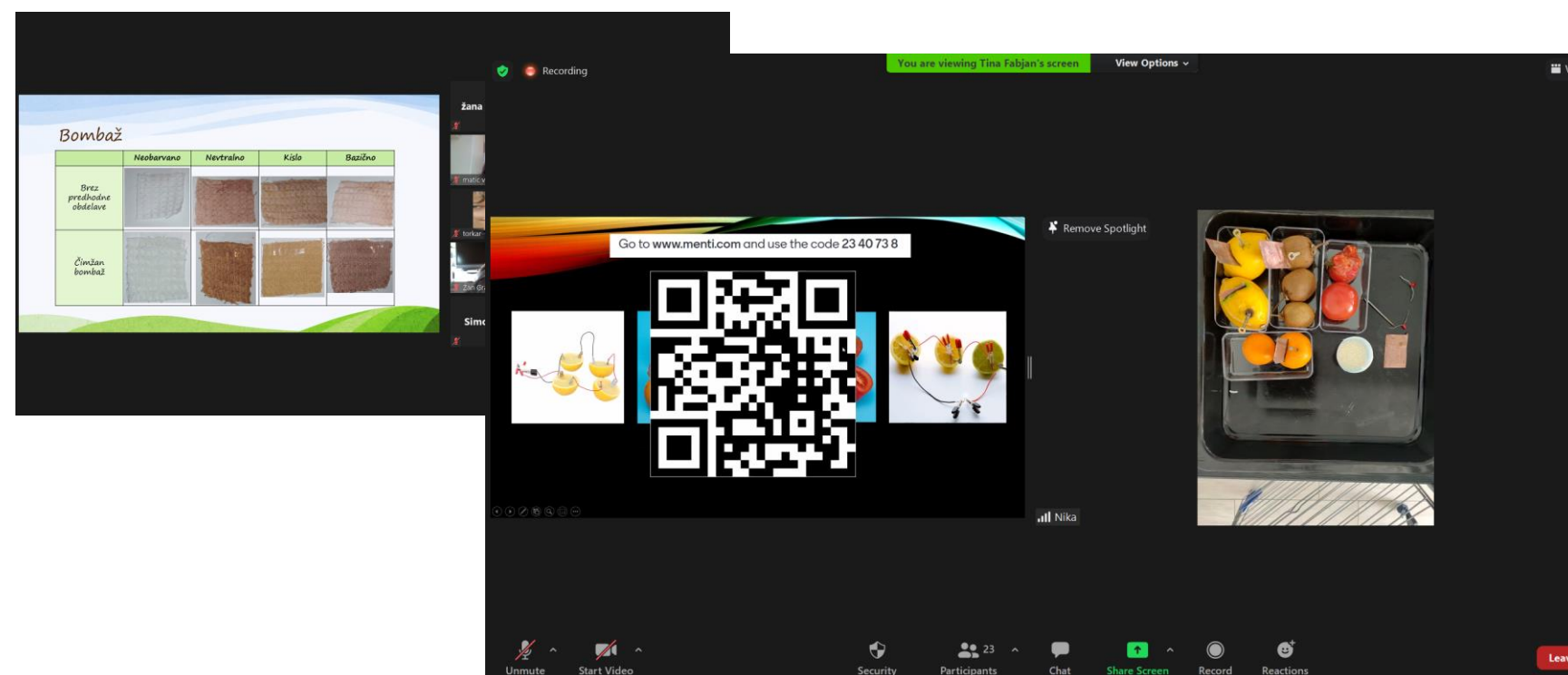


8 / 8

# Presenting the results of PBL

		Type of PBL according to duration and scope	Type of PBL according to purpose and content
1. PBL	Project-Based Learning (with the support of an e-textbook)	Small project	Learning type project / constructive type project
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TEME DELAVNIC	IZVEDBA
 KemikUm raziskuje odpravo na Enceladus	četrtek, 17. 12. 2020
 KemikUm raziskuje pridobivanje barvil iz tujerodnih invazivnih rastlin	torek, 15. 12. 2020
 KemikUm raziskuje razkužila	ponedeljek, 21. 12. 2020
 KemikUm raziskuje alternativne vire energije	ponedeljek, 4. 1. 2020
 KemikUm raziskuje pomen hladilnih tekočin v avtomobilski industriji	torek, 5. 1. 2020



The screenshot shows a Zoom meeting interface. On the left, a presentation slide titled "Bombaž" displays a table with four columns: "Neobravano", "Neutrarno", "Kislo", and "Bazično". The rows show "Brez predhodne obdelave" and "Čvrstan bombaž" with corresponding fabric samples. In the center, a Menti quiz interface is visible with a QR code and the text "Go to www.menti.com and use the code 23 40 73 8". On the right, a video shows a science experiment with fruit (lemons, oranges) and wires connected to a small light bulb. The Zoom control bar at the bottom includes options like "Unmute", "Start Video", "Security", "Participants", "Chat", "Share Screen", "Record", "Reactions", and "Leave".





# Presenting the results of PBL

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**Božična sveča**

Svečo lahko izdelamo iz kučpenega voska, ga segrejemo in vlijemo v kozarce za čajarje.

Svečo lahko pripravimo sami iz odpadnega olja, s pomočjo sosa Oljgate.

**Priloga:**

- Odmerno količino voska glede na naš kozarec.
- Segrejemo vosak v loncu.
- Prilagodimo stari in ga privežemo na sredino palčke in položimo palčko brez odpadnega kosarca.
- V vosak dodamo eterično olje 10-30 kapljic (odvisno od velikosti kozarca).
- Vosak previdno vlijemo v kozarce.
- Pošakarno, da se vosak strdi.
- Odmerno stari s palčko.
- Užijemo v svoji sveči ☺.

**Božični vonj:**

- 1 cimet
- 1 nageljnova zbirka
- 3 pomaranča
- 1 cimet
- 1 kardamom
- 2 pomaranča

**Božična čajanka:**

**Pomaranča - limonen**  
Limonen daje pomaranči značilno aromo.

**Cimet - cinamon**  
Glavna sestavina, ki daje cimetu aromo je cinamon.

**Med - saharoza**  
Saharozna daje medu sladk okus.

**Klinski - eugenol**  
Eugenol je glavna sestavina klinčkov.

**Ingver - gingerol**  
Gingerol daje ingverju ostrin okus.

**lanol - anetol**  
Anetol je glavna sestavina zvezdastega janeža.

**Peprina meta (Mentha piperita)**  
- vsebnost et. olja: 0,1 - 1,0%

**Malina (Malva Officialis)**  
- vsebnost et. olja: 0,1 - 0,2%

**Vrtnica (Rosa damasc)**  
- vsebnost et. olja: 0,02 - 0,03%

**Sivka (Lavandula Angustifolia)**  
- vsebnost et. olja: 0,5 - 1,5%

**Božmarin (Rosmarinus officinalis)**  
- vsebnost et. olja: do 0,5%

**Domača eterična olja.**

**Kemijški BOŽIČNI OKRASKI**

Tjaša, Nika in Tina

**Kromatografske snežinke**

**Chemical Christmas decorations:**

**Božični snežinski kristali**

**Chromatography results:**

**Obični izdelava.**



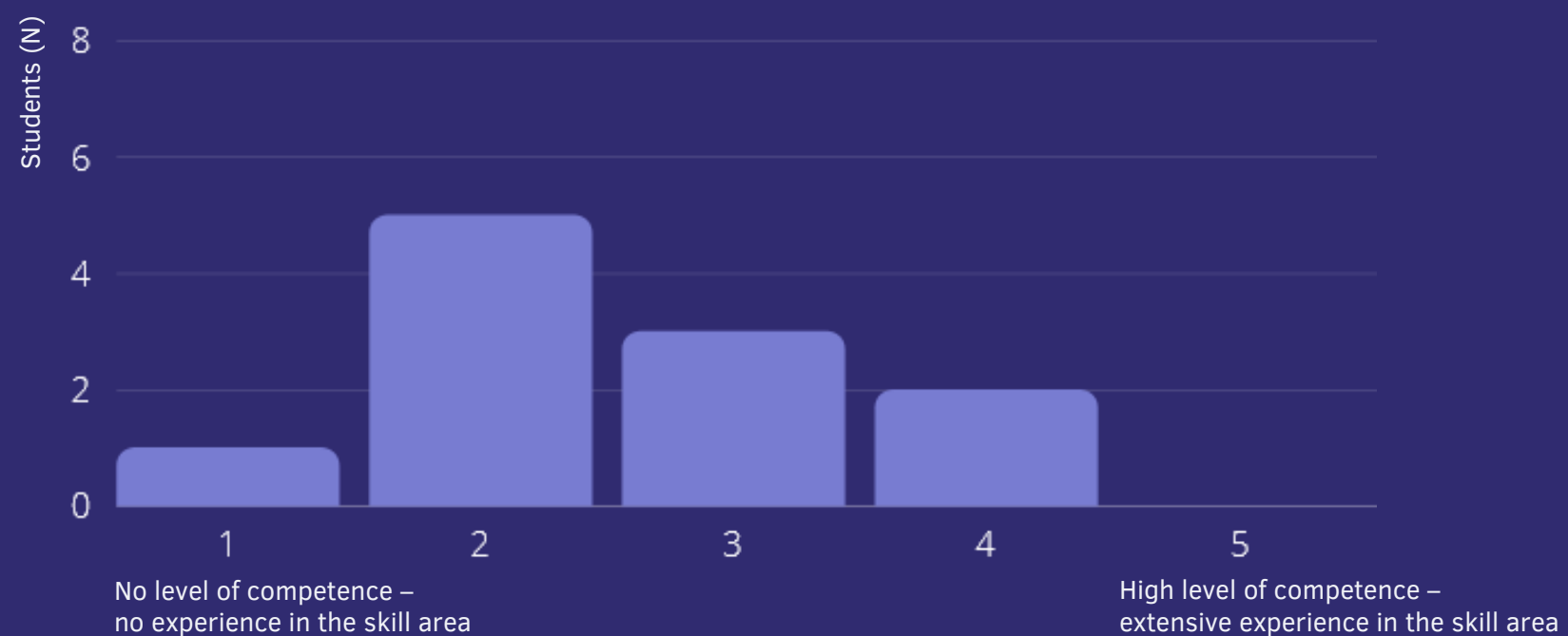


# Students' opinion on the acquired competences



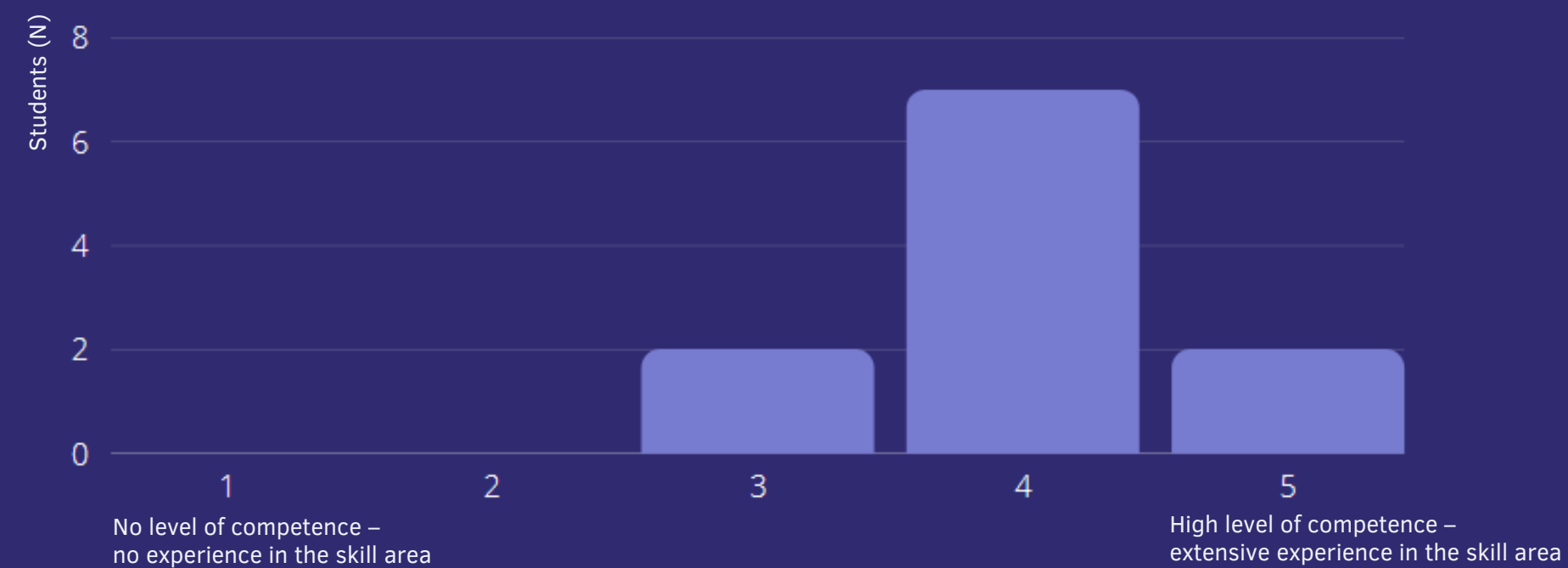
## BEFORE THE IMPLEMENTATION OF THE SUBJECT

Table 1: Students' assessment of their ability (as a chemistry teacher) to implement project-based learning approach in chemistry lessons on a scale of 1 to 5.



## AFTER THE IMPLEMENTATION OF THE SUBJECT

Table 2: Student assessment of their ability (as a chemistry teacher) to implement project-based learning approach in chemistry lessons on a scale of 1 to 5.



# Students' opinion on the acquired competences



Students' thoughts on using different ICT options to support the implementation of project-based learning, e.g. (1) collaborative environment in the general channel in MS Teams - for group meetings, (2) collaborative environment in the channels of individual project groups in MS Teams, (3) online classrooms of the course, (4) videoconferencing environment Zoom, etc.

»In my opinion, the course went smoothly through MS Teams, the groups in the channel are very useful as we can use them outside the lectures. The online classroom is adequate and transparent. Zoom is OK, but I like MS Teams better.«

»Working in the collaborative environment MS Teams was great for me because we were able to solve tasks quickly while "keeping in touch" with each other so that we could quickly solve problems as they arose. I have a positive opinion of the collaborative environment. The structure and organization of the online classroom is very good.«

# Students' opinion on the use of PBL approach



Students' opinion of why they would use the PBL approach in chemistry lessons.

»Because I think it's great for differentiation. It's appropriate for all students - they can determine their own role in the project and we as teachers can address the different interests of the students.«

»It provides a different way to assess students' knowledge, improve students' attitude towards chemistry, it makes learning chemistry more interesting and fun, it allows students to become scientists.«

»I would use PBL to allow students to learn in a different way, bring them closer and encourage them to participate more in subject activities. PBL also allows, a great way to assess students a little differently than usual.«



# Students' opinion on the use of the portfolio in assessment



Students' opinion / experience on using the project portfolio to evaluate PBL.

»Portfolio evaluation is good, because you get the evaluation on the spot. Getting a grade is therefore gradual, it is distributed so it is less stressful.«

»I think it's a great way to evaluate what we have learnt in a different way than usual - through a written test.«

»Using a portfolio seems to me to be a good way to assess because students can show their knowledge in a different way.«



# • • • Reflection on the transfer of experience in future implementations of the subject

In all four PBL cases it is useful to keep the ICT support used for the implementation of the subject: online classroom (Moodle) - access to general information about the course, schedule of course implementation, materials for PBL, assignment (Turnitin) and assessment.

In all four PBL cases it is useful to keep the ICT support used for the implementation of the subject: collaborative environment (MS Teams ) - the possibility of videoconference meetings with all students, the possibility of videoconference meetings of project groups, student collaboration in specific channels of project groups.

In developing teaching and learning tools to overcome student misconceptions in chemistry (2. PBL) it makes sense to communicate about the possibility of using individual online classrooms Moodle in the future - the experience students gain during their studies is directly transferable for use in the school setting.



- • • **Reflection on the transfer of experience in future implementations of the subject**

**It is important to continue the collaboration with schools ( 2. PBL and 1. E - PBL) - exchange of experiences between active and prospective chemistry teachers, insight into the school practice through a research approach.**

**Limitation of the distance learning, which also relates to the project-based learning is that it is not possible to carry out experimental work in a laboratory (1. E - PBL and 2. E - PBL). Due to this limitation, this year the experimental workshops of the 1. E - PBL were conducted online with the participation of students from primary schools. The students developed experimental workshops using substances that we can find at home, which is an interesting opportunity for reflection in the future.**

# References

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