Developing, implementing, and disseminating an adaptive clinical reasoning curriculum for healthcare students and educators

612454-EPP-1-2019-1-DE-EPPKA2-KA

D5.3 Evaluation and analysis of learner activities of the pilot implementations of student curriculum

Deliverable number	D5.3
Delivery date	March 2022
Status	v1.0 draft | final
License	BY-NC-ND
Authors	JU
Reviewed by	All partners

Co-funded by the
Erasmus+ Programme
of the European Union

1. Summary

After we had tested the train-the-trainer courses of the DID-ACT curriculum, it was time to evaluate the quality of learning units for students. We have conducted a series of pilot studies that validated five different learning units in eight evaluation events across all partner institutions including also associate partners. We have recorded student activities in the virtual patient collection connected with the DID-ACT curriculum available for deliberate practice. In addition, we evaluated the usability of the project's learning management system in several test scenarios.

Overall, students agreed to a large extent that the piloted DID-ACT learning units improved their clinical reasoning skills (average 5.75 in 7-point Likert scale). As a special strength of the curriculum students frequently named the benefit of virtual patients cases integrated with the learning units. Another highlight were small-group group discussions, often conducted in multinational teams which broadened their views on clinical reasoning. However, a challenge in the tested version of the curriculum implementation was navigation in the learning management system (Moodle). As a consequence, we have further analyzed these data and, furthermore, conducted a series of usability tests. These analyses and tests led to a process to address the issues wherever it is possible. We have also received several requests for modifications of the developed learning material that we will address in the "refinement of course based on pilot implementation" stage of the project.

2. Introduction

The goal of this deliverable is to present the results from the DID-ACT pilot evaluations of the student curriculum developed in the work package 4 (WP4). Out of the collection of implemented DID-ACT learning units we have selected five learning units and the virtual patient collection for deliberate practice for pilot evaluations.

The selected topics were:

- What is clinical reasoning - an introduction (LU1);
- Person-centered approach and the role of the patient (LU6);
- Health professionals roles in clinical reasoning: novice level (LU7);
- Generating differential diagnoses and deciding about final diagnoses (LU10)
- Health professionals roles in clinical reasoning: intermediate level (LU24);
- Virtual patient collection for deliberate practice in gathering and interpreting information, generating differential diagnoses and developing a treatment plan.

3. Quality criteria

The quality criteria agreed upon among the partners prior to commencing the deliverable were:

- Use of tested instruments for data collection.

- Use of electronic survey tools.
- Possibility for adaptations of the evaluation tools to the needs of partner institutions.
- Option for paper-based data collection.
- Evaluation data from all academic partner institutions.
- Collect a total of at least 250 surveys from participants of the student pilot courses.
- Descriptive statistics grouped by learning unit; if there is enough data, subgroup analyses by profession, partner institution.
- Content analysis of free-text comments completed in pairs and reviewed by associated partners.
- Learning analytics based on at least 3 indicators (e.g. number of visitors, type of content, use in time) presented numerically (descriptive statistics) and visually.

4. Methods

4.1. Satisfaction measurements

Based on our positive experience with ETELM-LP-S and ETELM-IP questionnaires [Cook15] gained in the DID-ACT Train-the-Trainer (TTT) pilots, we decided to continue using these tools for evaluation of satisfaction in the student curriculum pilots. The tools and their implementation in LimeSurvey were already reported in deliverable 5.2 [D5.2]. We employed the same parameterizable links to the questionnaires:

- ETELM-LP-S (for participants in the student curriculum pilots) https://survey.instruct.eu/index.php/588891?LU=40&newtest=Y&lang=en
- ETELM-IP (for facilitators in student curriculum pilots) https://survey.instruct.eu/index.php/471319?LU=40&newtest=Y&lang=en

We did not introduce any new items in the questionnaires for the student curriculum. The question about improved teaching skills in clinical reasoning was automatically hidden based on the number of the learning unit set in the “LU” parameter of the URL.

Data analysis of the satisfaction data was performed in the same way as in D5.2. We calculated descriptive statistics for the Likert-scale questions in Microsoft Excel. The qualitative analysis was done by two researchers. Non English-language comments were translated into English by native speakers in the respective partner language. We applied the same coding frame as in D5.2 to divide the participant utterances in 9 themes: Didactical, Content/Course, Content Assessment, Technical, Interaction/Collaboration, Implementation/ Time, Implementation/Facilitators, Overall and Others. Additionally, the comments were divided based on their emotional valence into positive, negative and neutral. The coding was performed by one researcher and double-checked by a second one. The interpretation was open for comments by all project members.

4.2. Motivation measurements

Student motivation for learning was measured in one of the pilot evaluations. We have selected for this purpose a scale developed by Prenzel et al. [Prenzel93]. The scale consists of 16 items in a 4-point scale ranging from 0 (Almost never) to 3 (Very often). The 16 questions are covering intrinsic and extrinsic motivational aspects, self-assessment of competency, and self-determination. We have implemented the tool in the projects' data collection tool LimeSurvey as an extension to the standard ETELM-LP-S satisfaction questionnaire.

4.3. Person-centered approach measurements

For the outcome evaluation of the "Person-centered approach and the role of the patient" learning unit (LU6) we decided to use the Patient Practitioner Orientation Scale (PPOS) scale [Krupat00]. This is a tool consisting of 18-items that measures providers' and patients' opinions on their role in healthcare. The two opposing orientations are:

- the doctor-/(disease-)centered approach - according to which the patient should defer to the physician's judgment and the encounter be focused on the medical problem.
- the patient-centered approach - with the premise the "patient as a person" should be the focus of the treatment. The patient plays an active information seeking role in the management of the disease, and the provider acts as a consultant to present options to choose from.

The items in the PPOS scale are answered by 6-point graded Likert-type questions. The total score is calculated as an average over the number of items in the questionnaire. The scale comprises of two 9-items subscales [Krupat00]:

- "Sharing" - that measures orientation towards power and decision making in the patient-provider relationship. It measures the degree of patients' desire for information regarding the treatment process and being part of decision making.
- "Caring" - that captures attention to emotions and lifestyle. It measures to what extent are the patient's expectations, feelings and life circumstances critical elements in the treatment process.

We have implemented the tool in the projects' data collection tool LimeSurvey in two language versions: English and Polish.

- https://survey.instruct.eu/index.php/528527?lang=en
- https://survey.instruct.eu/index.php/528527?lang=pl

The PPOS tool was used with permission of the author and the translation in Polish was validated in a former study by one of the project members [Pers19]. The Institutional Review Board of Jagiellonian University Medical College permitted the use of the scale in the Laboratory Training of Clinical Skills 2/4 course.

4.4. Learning analytics

4.4.1 DID-ACT learning management system Moodle

We have applied the same set of learning analytics tools for the pilot student curriculum as in the pilots of Train-the-Trainer courses [D5.2]. This involved the collection of atomic learning events in the learning management system Moodle stored in the system logs. Discarded were all activities coming from instructors or members of the DID-ACT project. We have analyzed what type of learning resources/activities the learners interacted with, what the learners' general activity profile was (bounced, sporadic and frequent user) and how their activities distributed in time.

4.4.2 Virtual patients collection

During our pilot implementation phase, Instruct offered the virtual patients that are part of the DID-ACT curriculum as additional learning resources to their registered users.

These virtual patients (VPs) are designed to mainly deepen the following learning units:

- Collecting and prioritize key clinical findings
- Generating differential diagnoses and deciding about final diagnosis
- Developing a treatment / management plan

In addition, students can make errors in these VP environments and get feedback if certain biases (premature closure, availability bias, confirmation bias) occurred.

4.5. Usability evaluation measurements

4.5.1 General procedure

The usability of the learning management system Moodle selected to host the Train-the-Trainer (TTT) and student curriculum learning units was tested in a series of seven test scenarios developed by the DID-ACT consortium. Users who were representative for the target group but naive to Moodle were invited to participate in the tests. The users were expected to complete the test cases following the pre-specified order. If a user failed to complete some tasks that were required for the later test scenarios, before the next task began, the observer completed the failed task together with the user to adequately prepare the test environment.

The following sections list a description of the individual test cases presented to the testers in the usability evaluation. The test scenarios are characterized by a few parameters often encountered in user experience (UX) testing [Schwarz16]:

- User story - are informal descriptions of the system features presented from the user perspective.

- Instructions for the users - exact wording how the task should be introduced to the tester.
- Success criteria - definition of what should happen to qualify the scenario as accomplished successfully.

Recorded were:

- Outcome of the individual tasks
  - Success
  - Partial success (document which points failed, why?)
  - Failure (user gives up or performs a task that does not correspond to the description)
- Time on task (min:sec)
- Free text comment of the user on the task
- Observer notes

4.5.2 Description of test cases

Scenario 1: DID-ACT platform sign-in
User story: As a [student / teacher] I would like to start using the DID-ACT clinical reasoning curriculum in a self-directed manner.

Instructions for the user: Please look on the website https://www.did-act.eu for the DID-ACT curriculum and do whatever is needed to open any course / learning unit stored in the platform to learn from it self-directed.

Success criteria: The user should:

- locate the DID-ACT learning management system (platform) on the Internet (e.g. using Google)
- enroll in the platform either by eduGain access or manual enrollment selecting while doing that the proper role and study mode.
- open any learning unit which is part of the curriculum stored on the platform.

Scenario 2: Findability of a particular learning unit
User story: As a [student / teacher] I would like to find a particular learning unit not necessary knowing the exact name of the module

Instructions for the user: You have heard there is a learning unit you are unsure of the name. It was about

- student: theoretical background of clinical reasoning at intermediate level of difficulty
- teachers: methods to remedy differential diagnosis generation

Find the learning unit on the DID-ACT platform and enroll there
Student version of the task:
“Now go to the LMS https://did-act.instruct.eu You have heard there is a learning unit for which you are unsure of the name. It was about “theoretical background of clinical reasoning at the intermediate level of difficulty”. Please find the learning unit on the DID-ACT platform and enroll there”

Teacher version of the task:
“You have heard there is a learning unit and you are unsure of the name. It was about “methods to remedy differential diagnosis generation”. Please find the learning unit on the DID-ACT platform and enroll there”

Success criteria: The user should:

- login to the DID-ACT platform
- browse through list of available learning units
- locate the correct learning unit at the correct difficulty level

Scenario 3: Content-related findability

User story: As a [student / teacher] I would like to locate some concrete information related to clinical reasoning in the curriculum

Instructions for the user: Please find on the DID-ACT platform content explaining what is:

a) System 1 thinking
b) A clinical reasoning model popular among nurses

Success criteria: The user should:

- Find the relevant information in the learning modules

Sample solution :

- student: a) Dual Process Theory module; b) Using the Outcome Present State Test Model module
- teachers: a+b) What is clinical reasoning and theories

Other potential tasks in this test case

- Find out what clinical reasoning is? (LU specific)
- Find out what OPT means (Glossary)

Scenario 4: Providing feedback

User story: As a [student / teacher] I would like to provide feedback on the quality of a learning unit

Instructions for the user: Assume you have completed the learning unit

a) Student: What is clinical reasoning and how can theories be put into practice
b) Teacher: Information gathering, Generating differential diagnoses, Decision making, and Treatment planning

and would like to evaluate the quality and provide feedback on the quality of the learning unit. Complete the whole feedback process indicating in the free text comments you are entering “test data”.

Student version of the task:

“Assume you have completed the learning unit “What is clinical reasoning and how can theories be put into practice” and would like to evaluate the quality and provide feedback on the quality of the learning unit. Complete the whole feedback process indicating in the free text comments you are entering “test data”.”

Teacher version of the task:
“Assume you have completed the learning unit “Information gathering, Generating differential diagnoses, Decision making, and Treatment planning” and would like to evaluate the quality and provide feedback on the quality of the learning unit. Complete the whole feedback process indicating in the free text comments you are entering “test data”.”

Success criteria: The user should:

- locate the relevant evaluation questionnaire on Moodle and fill it in completely with test data.

Scenario 5: Access to virtual patients

User story: As a student I would like to use interactive learning resources as virtual patients in the DID-ACT curriculum

Instructions for the user: Please start the first card of the virtual patient named Jane Cramer in the learning unit “What is Clinical Reasoning - An introduction”.

Success criteria: The user should:

- Locate and complete the first screen card of the virtual patient.

Scenario 6: Assessment of knowledge

User story: As a student I would like to verify my knowledge

Instructions for the user: Please complete the knowledge test in the learning unit “Biomedical Knowledge and Clinical Reasoning”

Success criteria: The user should:

- Locate the knowledge test and complete all three questions in the “Biomedical Knowledge and Clinical Reasoning” learning unit.

Scenario 7: Finding support

User story: As a [student/teacher] I would like to get help in case I encounter problems in using the DID-ACT platform

Instructions for the user: Imagine you encountered a technical problem in one of the learning units. What do you do?

Success criteria: The user should locate the email address: support@instruct.eu

5. Results

5.1 Satisfaction results

5.1.1 Pilot student implementations

As already reported in the deliverable D4.2, the DID-ACT consortium pilot tested five learning units from the student curriculum in the time period from October 2021 to January 2022 which involved 198 students. Together with 618 students who pilot-tested the integrated virtual patient cases in deliberate practice learning mode, we had 816 students involved in pilot testing of the curriculum (Table 1).

Table 1. Overview about topics, participants, and dates of the conducted student pilots

ID	Topic	Pilot lead	Number of participants	Participant Institutions	Professions	Dates
1	What is clinical reasoning - an introduction	UAU	34	UAU, Karolinska Institute Sweden, University of Zurich and ETH Zurich, Switzerland, UBERN, MFUM, University of Porto, Portugal	Medicine	Nov 22 - 25 2021
6	Person-centered approach and the role of the patient	EDU	10	EDU	Medicine	Nov 22 - 30 2021
		JU	49	JU	Medicine	Oct 18 - Jan 20 2022
7	Health professionals roles in clinical reasoning (Novice)	UAU	34	UAU, Karolinska Institute Sweden, University of Zurich and ETH Zurich, Switzerland, UBERN, MFUM, University of Porto, Portugal	Medicine	Dec 6 - 9 2021
10	Generating differential diagnoses and deciding about final diagnoses	UBERN	6	UBERN	Medicine	Nov 11 - 18 2021
		JU	35	JU	Medicine	Nov 23 2021 - Dec 10 2021
		MFUM	10	MFUM	Medicine	Dec 10 2021 - Jan 12 2022
24	Health professionals roles in clinical reasoning (Intermediate)	ORU	20	ORU, JU, Berner Bildungszentrum Pflege, Switzerland	Nursing, Medicine	Oct 13/14 & Nov 30/Dec 1 2021
VP	Gathering and interpreting information, Generating differential diagnoses, Developing a treatment plan	Instruct	618	International	Medicine	Oct 1 2021 - Jan 10 2022

5.1.2 Participants' perspective (ETELM-LP-S)

5.1.2.1 Overall statistics

In total 125 ETELM-LP-S questionnaire responses were collected in the piloted learning units. The response rate was 63%. The demographics of the participants are presented in table 2. The average age of participants was 21.8±3.2 years. Most of the respondents were female (68%), medical students (90%).

Table 2. Summary of demographic data of responding student courses participants

Variable	Values	n
Gender	Female	85
	Male	40
	Not disclosed, other	0
Learning unit	What is clinical reasoning - an introduction (LU1)	13
	Health professionals roles in clinical reasoning (Novice) (LU7)	28
	Person-centered approach and the role of the patient (LU6)	36
	Generating differential diagnoses and deciding about final diagnoses (LU10)	32
	Health professionals roles in clinical reasoning (Intermediate) (LU24)	16
Institution	EDU	7
	Jagiellonian University	62
	University of Augsburg	19
	University of Bern	15
	University of Maribor	4
	University of Örebro	5
	Other	13
Profession	Human medicine	113
	Nursing	11
	Other/Blank	1

Table 3 presents average ratings of all evaluated learning units in the quantitative questions of the ETELM-LP-S questionnaire. In general, the courses were rated highly with an average in particular aspects in the range from 5 to 6 in a 7 Likert-scale point scale. The item regarding technical issues is in the reversed scale. When inverted, the score is above the 5-point mark in the 7-point scale.

Table 3. Ratings of the ETELM-LP-S questionnaire items in all evaluated learning units

Theme	Question	LU1	LU6	LU7	LU10	LU24	Total
	Responses:	*n=13*	*n=36*	*n=28*	*n=32*	*n=16*	*n=125*
	of enrolled:	34	59	34	51	20	198
	Response rate:	38%	61%	82%	63%	80%	63%
Objectives	Instructions provided a good introduction to the learning unit (e.g., how to get started, where to find various learning units components, how to obtain technical support if needed, etc.).	5.77	5.97	5.89	6.13	5.56	5.92
	Learning unit objectives, expectations, and policies were clearly stated.	5.69	5.81	5.70	6.50	5.31	5.89
	Learning unit objectives were relevant to my needs.	5.85	5.77	5.56	6.28	6.06	5.90
Technology	Navigation of the technology-based components of the learning unit was logical, consistent, and efficient	5.85	5.61	5.57	5.97	5.06	5.65
	The learning unit technologies and media supported the learning objectives.	6.15	5.83	5.96	6.22	5.38	5.94
	I had significant computer / technical problems during this learning unit. (negative answer is better; if agree, please explain at the end of the survey)	1.31	1.86	1.32	2.18	3.40	1.96
Learning activities	The educational activities encouraged engagement with learning unit materials / content.	6.08	5.57	5.81	6.13	5.63	5.83
	The educational activities promoted achievement of the learning unit objectives.	6.00	5.69	5.81	6.32	5.69	5.91
	Educational activities encouraged interaction and collaboration with other participants	5.75	5.57	6.11	6.06	6.31	5.93
	The learning unit effectively blended online and face-to-face elements.	5.92	5.49	5.96	6.13	5.77	5.82
Assessment/ Feedback	Assessments (e.g. tests and self-assessments) were appropriate for the learning unit objectives, content, and activities.	5.91	5.47	5.81	6.29	5.50	5.79
	I had sufficient opportunity to assess and reflect upon my learning progress.	5.58	5.34	5.82	5.80	5.75	5.64
	I received adequate feedback on my learning progress.	4.89	5.35	4.96	5.93	5.31	5.36
	I received adequate support for any questions or concerns I had about my learning.	5.89	5.53	6.04	6.23	5.94	5.91

Impact	This learning unit will improve my clinical reasoning.	6.08	5.40	5.43	6.29	5.81	5.75
	The overall quality of this learning unit was excellent.	5.83	5.14	5.43	5.90	5.31	5.49
	The overall effectiveness of the instructor(s) was excellent.	5.92	5.91	5.93	6.48	5.44	6.00

Legend. LU1: What is clinical reasoning - an introduction; LU6: Person-centered approach and the role of the patient; LU7: Health professionals roles in clinical reasoning (Novice); LU10: Generating differential diagnoses and deciding about final diagnoses; LU24: Health professionals roles in clinical reasoning (Intermediate). Scores are in 7-points Likert-scale ranging from 1: strongly disagree to 7- strongly agree.

The highest grades in student evaluation were given to the learning unit on generating differential diagnoses and deciding about final diagnoses (LU10). There was no learning unit that could be pointed out as clearly less favorably evaluated. Overall it seems that students wished to receive more feedback on the learning process (5.36 out of 7) which was especially noticeable in LU1/7 where the grades were below the 5-points level. Students valued most the instructor's effectiveness (6.00 out of 7) with an outstanding 6.48 score for the LU10.

5.1.2.2 Content analysis of the free-text comments

We have received 194 free text comments by students. Out of those, 71 comments were in languages other than English (mainly German or Polish) and were translated to English (appendix 9.1). Out of those, 104 (54%) had a positive valence, 80 (41%) negative and 10 (5%) neutral. Most frequently commented were content aspects of the learning units and the didactical approach (table 4).

Table 4. Division of student free-text utterance across themes and valence of the comment

	LU1			LU6			LU7			LU10			LU24		
Code	+	#	-	+	#	-	+	#	-	+	#	-	+	#	-
Didactical	3	0	1	5	0	0	15	0	2	4	0	3	6	0	4
Content/Course	2	0	1	9	0	9	0	0	16	14	0	7	1	0	2
Content/Assess	1	0	0	2	0	0	0	0	1	0	0	2	0	0	0
Technical	0	0	1	0	0	2	0	0	6	0	0	6	0	0	3
Inter/Collab	1	0	0	0	0	1	12	0	0	1	0	0	6	0	0
Imp/Time	0	0	1	0	0	0	2	0	1	0	0	0	0	0	2
Imp/Facilitators	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1
Overall	2	0	0	3	0	0	4	0	0	1	0	0	0	0	0
Other	2	0	1	0	3	0	2	5	2	3	1	2	2	1	1
Total valence	11	0	5	19	3	13	35	5	29	24	1	20	15	1	13

Legend. Inter/Collab - Interaction/Collaboration; Imp - Implementation. [+] positive; [#] neutral and [-] negative valence of the comments. U1: What is clinical reasoning - an introduction; LU6: Person-centered approach and the role of the patient; LU7: Health professionals roles in clinical reasoning (Novice); LU10: Generating differential diagnoses and deciding about final diagnoses; LU24: Health professionals roles in clinical reasoning (Intermediate).

What is clinical reasoning - an introduction (LU1)

The learning unit was evaluated in an international workshop coordinated by the University of Augsburg. Students from seven European universities participated in the event. All students were in their early stages of medical education. The response rate to the questionnaire was relatively low (at 40% level) but this could be explained by the fact that some of the students evaluated the workshop based on the second part only - ie. LU7 (Health professionals roles in clinical reasoning - novice). The greatest interest was aroused by the virtual patient case “Mrs. Cramets”. Several students were keen on its presence and pointed it out as a highlight of the learning unit, but there were also two critical opinions - one suggesting complete removal of the case, the other splitting it in stages which would be discussed separately and tested with quizzes. Students also liked the international collaboration in the learning unit.

Positive elements	Negatives and requests for extension
+ Virtual patient case (n=4) + (International) Collaboration (n=2)	- Time constraints (n=1) - More interactive virtual patient (n=2)

Person-centered approach and the role of the patient (LU6)

Two higher education institutions decided to pilot the learning unit on the person-centered approach: Jagiellonian University and EDU. In total 59 students participated in the classes which makes it the learning unit with the most registered students across the pilot studies. We have received 36 filled-in evaluation questionnaires (response rate 61%). The strongest point of the learning unit was definitely virtual patients. The unit contained three cases with similar clinical data, but diverse patient needs. Students liked the cases because they appeared to them authentic and allowed autonomous decisions. The request for improvements was mainly the wish for more virtual patients regarding more diverse topics. As a matter of fact this could be interpreted as a complement to the unit because the students liked the cases so much they mainly wished to see even more examples like that. The students also liked the follow-up questions (which were part of the virtual patients). A perceived strength of the unit was also the selection of the topic because some of the students noticed that patient-centredness is rarely addressed in medical curricula. Two students reported minor technical/usability issues such as low quality of images when zoomed in or confusing navigation in the learning management system.

Positive elements	Negatives and requests for extension
+ Virtual patient cases (n=7) + Follow-up questions (n=4) + Importance of topic (n=3) + Videos (n=1)	- Wish for more virtual patient cases (n=8) - Usability issues (n=2)

Health professionals roles in clinical reasoning - novice (LU7)

This learning unit (LU7) was piloted in connection with the LU1 as part of an international workshop organized by the University of Augsburg. An international group of 34 early-stage medical students from seven European universities participated in the event. In total 28 out of 34 students answered the satisfaction survey which is a very good response rate of 82%. Most positive opinions were voiced about the virtual patient cases integrated with the learning unit (Mrs. Khaled, Mr. Berner). The students liked to learn from examples and the patients' stories were engaging and presented well the perspectives on clinical reasoning of different professions. There were also many positive opinions about the synchronous Zoom meeting with small break-out rooms (even though some of the students commented they would welcome those sessions were more structured and the discussions led by an expert). The students liked that the sessions were conducted in a relaxed way and that many universities were represented.

Most requests for improvements were regarding the interprofessional videos. The students complained the videos were confusing to them and not helpful in answering the subsequent tasks (but there were also exceptions of students who particularly liked those videos). The other reported issue was the usability of Moodle that was for students not easy to navigate. Finally students requested changes regarding formative assessment. Some preferred to answer close-ended questions in test-like quizzes instead of uploading file assignments with answers.

Positive elements	Negative elements and requests for extension
+ Virtual patient cases (n=14) + Group discussion on Zoom (n=9) + Friendly, relaxed, international learning environment	- Videos on different perspectives on clinical reasoning (n=8) - Usability of Moodle learning platform (n=4) - Formative questions with answers to be uploaded (n=3)

Generating differential diagnoses and deciding about final diagnoses (LU10)

This learning unit was evaluated at three universities: in Bern, Maribor and Kraków. The unit received the highest overall quality score in the quantitative Likert-scale questions of the ETELM-LP-S (5.90 out of 7 with an average for all learning units of 5.49). Most of the free text comments came from Kraków. This learning unit was implemented in Kraków relatively early in the curriculum (second year; third semester of the curriculum) and much of the excitement about the learning unit came from the opportunity to interpret unaided results of medical tests in the virtual patient context. Students regarded it as challenging, but at the same time very motivating and rewarding as they saw how theory from biomedical sciences meets clinical practices. The students liked the formally explained strategies on how to generate the differential diagnosis that they previously applied intuitively and the opportunity to work in small groups. They saw the learning design of the class as an interesting alternation to the teaching style applied in preceding classes of the “Introduction to Clinical Sciences” course (i.e. Problem-Based Learning presentations based on paper cases). There were suggestions that the didactical approach presented in the learning unit should be applied more often in the course.

The requests for improvements regarded the need to introduce in the virtual patients more explanations about the medical test results students were supposed to interpret. This could be a local issue of the implementation in Kraków because of the early stages of the curriculum. Such explanations could be regarded by more advanced students as making the unit overly lengthy as was as a matter of fact noticed by some of the students from Bern. Some of the comments regarded too many student presentations or the need to reschedule them which could be a sign of tiredness of this type of student activity in Kraków. There were also reports of some technical issues (missing email, wrong patient image) and remarks regarding usability of the user interface of the learning management system. One student from Bern prefered the learning unit would be in German not English. The students in Kraków worked with presentations and virtual patient cases translated into Polish.

Positive elements	Negatives and requests for extension
+ Motivating teaching methods (n=8) + Virtual patient cases (n=3) + Application of theory to practice approach (n=2) + Diverse teaching methods (n=2) + Discussions/group work (n=2) + Friendly attitude of the teacher (n=1)	- Need for more information about how to interpret medical tests (n=3) - Too many or need of change in student presentations (n=3) - Time issues - better schedule of the classes needed (n=3) - Usability issues (n=3) - Technical glitches (n=2) - Language (n=1)

Health professionals roles in clinical reasoning - Intermediate (LU24)

The pilot implementation of this learning unit was coordinated by the Örebro University (ORU) in cooperation with partners from Switzerland (Berner Bildungszentrum Pflege) and Poland (Jagiellonian University, Kraków). In total 20 students enrolled in the pilot. This was the only pilot learning unit in which non-medical (i.e. nursing, n=11) students participated. We have received 16 out of 20 eligible ETELM-LP-S questionnaires. Most of the positive comments related to the opportunity to discuss in small international groups and to learn about the perspectives of other professions. Students enjoyed collaboration in English and the opportunity to meet students from other universities and countries. A strong point was also an interesting clinical case discussed in the classes. Students wished for more clarity of instructions for the small group sessions. Another theme of comments was time management. The students wished for less time or more content for the first phase and more time for the second day. One negative comment regarded the usability of Moodle and one student reported technical problems in joining the group discussion.

Positive elements	Negatives and requests for extension
+ Discussions with students from other universities (n=9) + Relevant case (n=4) + Interprofessional learning (n=2)	- Clarity of instructions (n=3) - Time issues (n=3) - Usability issues (n=1) - Technical issues (n=1)

5.1.2.3 Course facilitator’s perspective

We have received n=6 ETELM-IP-S questionnaires presenting the perspective of facilitators of the pilot courses (table 5). The small sample makes it difficult to draw firm conclusions. The weakest point seems to be navigation of the learning unit and possibilities for assessment/provide feedback (4.7 out of 7 points). The facilitators liked the planned learning activities for students which were judged as engaging (6.0 out of 7 points). We have not received enough free text comments for a qualitative analysis of the answers.

Table 5. Facilitator ratings of the pilot student learning units

	Learning Unit	**1**	**6**	**7**		**10**		**Avrg**
Question	**Institution**	**UAU**	**EDU**	**UAU**		**JU**		
Instructions provided a good introduction to the learning unit		6	7	3	7	4	6	5.5
Learning unit objectives were relevant to participant needs.		6	6	3	6	6	5	5.3
Navigation of the technology-based components of the learning unit was logical, consistent, and efficient		7	6	2	6	4	3	4.7
The learning unit technologies and media supported the learning objectives.		7	5	2	5	5	5	4.8
The learning unit required that participants possess inappropriately high computer skills. (negative answer is better; if agree, please explain below)		1	1	2	1	2	2	1.5
The educational activities encouraged participants' engagement with learning unit materials / content.		7	7	4	7	5	6	6.0
The educational activities promoted participants' achievement of the learning unit objectives.		7	6	4	7	5	6	5.8
I was able to contribute a personal presence / personal touch during the learning unit’s development and/or delivery.		6	6	2	6	6	6	5.3
Educational activities encouraged participants' interaction and collaboration.		7	7	2	7	6	6	5.8
The learning unit effectively blended online and face-to-face elements.		6	6	2	6	6	6	5.3
Face-to-face activities contributed meaningfully toward achieving the learning unit objectives.		6	6	2	7	6	6	5.5
Assessments (e.g. tests and self-assessments) were appropriate for the learning unit objectives, content, and activities.		7	6	4	6	4	4	5.2
Learner assessments and provision of feedback proceeded smoothly (i.e., no unforeseen problems).		5	5	4	5	4	5	4.7
I was able to provide adequate support to students for questions or concerns about their learning.		n/a	7	6	6	4	5	5.6

I plan to use learner feedback to improve the learning unit.	4	7	6	7	5	6	5.8
The learning unit will be easy to maintain and deliver again.	7	6	6	6	5	5	5.8
It will be easy to re-use of all or part of the learning unit materials in other, future courses.	6	6	4	6	5	4	5.2
The learning unit was a good use of time and resources.	6	7	4	7	5	5	5.7
The overall quality of this learning unit was excellent.	6	6	3	6	4	5	5.0

Legend. LU1: What is clinical reasoning - an introduction; LU6: Person-centered approach and the role of the patient; LU7: Health professionals roles in clinical reasoning (Novice); LU10: Generating differential diagnoses and deciding about final diagnoses; LU24: Health professionals roles in clinical reasoning (Intermediate)

5.3 Motivation results

In table 6 we summarize the results of the questionnaire measuring motivation of participants of LU1 and LU7 completed at the end of the pilot course. The students felt taken seriously, experienced curiosity and had room to make decisions in the pilot learning unit implementations. Based on the responses it seems that assessment/feedback in the learning unit could be improved (“I noticed what I can do resp. what I cannot do yet.”; 1.67 out of 3 points) which was also noticeable based on the ETELM-LP-S questionnaire.

Table 6. Motivation of students in LU1/5 based on the tool by Prenzel [Prenzel93]

Question (*During the learning session …*)	**n**	**Mean**	**Range**
I experienced myself as curious or inquisitive.	19	2.26	1 - 3
I enjoyed working.	20	2.20	2 - 3
I was so fascinated by the subject matter that I forgot everything around me.	20	1.25	0 - 2
I found the learning really exciting.	20	1.65	1 - 3
I felt like I could hardly break away from the subject matter.	20	1.35	0 - 3
I had the impression that I was only learning for the seminar certificate.	18	0.61	0 - 2
I found the learning to be exhausting.	20	0.50	0 - 2
I felt like I had to force myself to work.	20	0.55	0 - 2
I noticed what I can do resp. what I cannot do yet.	19	1.68	0 - 3
I felt active.	20	2.10	1 - 3
Issues arose from the subject matter that I would like to look into more thoroughly.	19	1.58	0 - 3
I had the impression that I could control my own learning success.	20	2.05	0 - 3
I felt taken seriously during the learning session.	20	2.85	2 - 3
I felt strongly controlled	20	0.70	0 - 2
I felt like I was doing something that I wanted to do myself.	20	2.05	1- 3
I felt like I had room to make decisions.	19	2.26	1 -3

4-point scale ranging from 0 (Almost never) to 3 (Very often), n - responses

5.4. Person-centered approach

Measurement of the person-centered approach using the PPOS scale [Krupat00] was taken before and after the LU6 pilot at Jagiellonian University as part of the Laboratory Training of the Clinical Skills 2/4 course. The questionnaire was filled in before the class by n=37 students, and n=31 students after the class. The results are presented in table 6 as total and split into the “Sharing” and “Caring” subscales.

Table 6. PPOS scale results in the LU6 pilot pre- and post-test

	n	**Total**	**Sharing**	**Caring**
Pre	37	4.19	4.06	4.32
Post	33	4.13	3.97	4.29

The PPOS is a 6-point scale. A high score indicates an orientation toward patient-centeredness.

Statistical tests showed no statistically significant differences in the person-centered orientation before and after the piloted learning unit ($p>0.05$).

5.5 Learning analytics

5.5.1 Data collected in Moodle

We have collected 5668 atomic learning events of 219 learners from system logs of Moodle (table 6). The learning unit with the most learners on Moodle was LU1 (n=57) which is interesting because this was not the course with most reported participants from partner institutions (table 1). The number of visiting students exceeded by 14 the number of “officially” enrolled students. It means it attracted the attention of external students who participated the course self-directly. The learning unit with most learning events generated by students was LU7 which had also the highest event/student ratio (39 events/student).

5.5.2 Types of participants

Table 6 presents the division of students into bounced (5%), sporadic (53%) and frequent (42%) user categories based on the same criteria as in D5.2.

Table 6. Types of participants in student on-line learning units

	Events	Number of visitors			
LU	Total	Total	Bounced	Sporadic	Frequent
1	1190	57	7	29	21
6	827	54	2	50	2
7	1699	44	3	10	31
10	1388	44	0	16	28

24	564	20	0	11	9

Visitors: bounced: events < 5; sporadic: 5 ≤ events < 25; frequent: events ≥ 25. LU1: What is clinical reasoning - an introduction; LU6: Person-centered approach and the role of the patient; LU7: Health professionals roles in clinical reasoning (Novice); LU10: Generating differential diagnoses and deciding about final diagnoses; LU24: Health professionals roles in clinical reasoning (Intermediate)

As presented in figure 1, the learning units with the most frequent visiting users were LU7 (70%) and LU10 (64%). Most sporadic users were in LU6 (93%) which could be easily explained by the fact that most of the activities in this learning unit happened in the virtual patient system CASUS (table 7) that is not recorded in Moodle statistics.

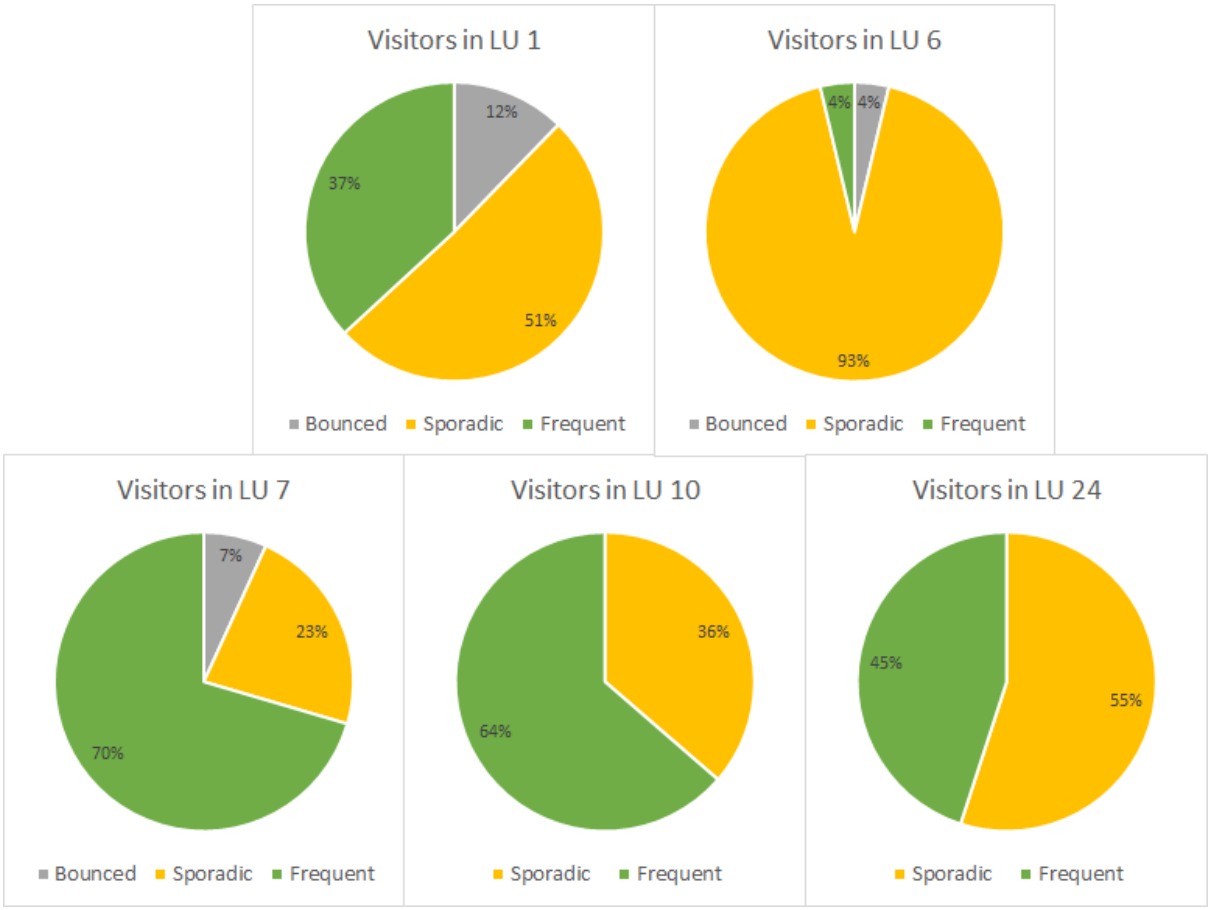


Fig. 1. Comparison of type of visitors across piloted student curriculum learning units

5.5.3 Elements in use

The type of activities performed by students in the learning units are presented in table 7. Students in LU1 and LU24 frequently used discussion fora. The most common type of activity in LU7 and LU10 were assignments. All learning units except LU24 contained virtual patients tasks which were most frequently utilized in LU6. This was also the learning unit where most links to external videos and web pages were employed.

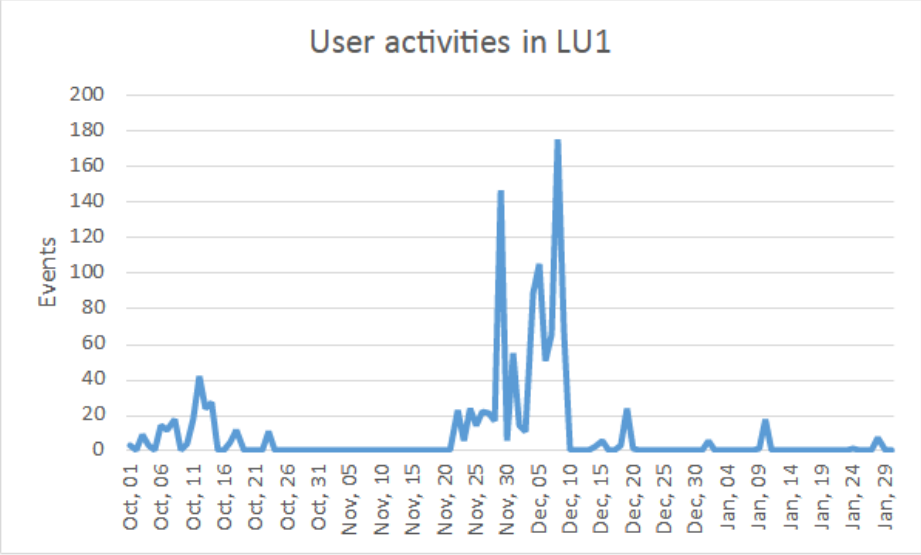
Table 7. Types of elements in use on the DID-ACT Moodle platform

LU	Total Events	Resources					Activities						
		System	Tour	File	Page	URL	Assign ment	File subm.	Forum	O. text subm.	Quiz	User report	VP
1	1190	46%	2%	1%	0%	6%	0%	0%	23%	0%	11%	1%	12%
7	1699	34%	8%	1%	6%	3%	33%	5%	1%	0%	4%	0%	5%
6	827	59%	8%	0%	1%	9%	0%	0%	0%	0%	0%	0%	22%
10	1388	34%	10%	0%	0%	3%	28%	5%	0%	5%	0%	0%	14%
24	564	50%	3%	0%	15%	6%	0%	0%	25%	0%	0%	1%	0%

subm. - submission; o. text - on-line text. LU1: What is clinical reasoning - an introduction; LU6: Person-centered approach and the role of the patient; LU7: Health professionals roles in clinical reasoning (Novice); LU10: Generating differential diagnoses and deciding about final diagnoses; LU24: Health professionals roles in clinical reasoning (Intermediate)

5.5.4 User activities distributed in time

The graphs in fig. 2 & 3 present how student activities in the learning management system Moodle were distributed in time. The peaks in activities are well correlated with the dates of synchronous learning events declared by the partner institutions in table 1. Those learning units which planned activities between the phases (e.g. LU1/LU7) present more evenly distributed activity profiles (Nov. 25 - Dec. 10). It seems also that LU7 succeeded most in gaining attendance of visitors after the evaluation time was over (activities after Dec. 20).


User activities in LU1
Events
200
180
160
140
120
100
80
60
40
20
0
Oct, 01
Oct, 06
Oct, 11
Oct, 16
Oct, 21
Oct, 26
Oct, 31
Nov, 05
Nov, 10
Nov, 15
Nov, 20
Nov, 25
Nov, 30
Dec, 05
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Dec, 25
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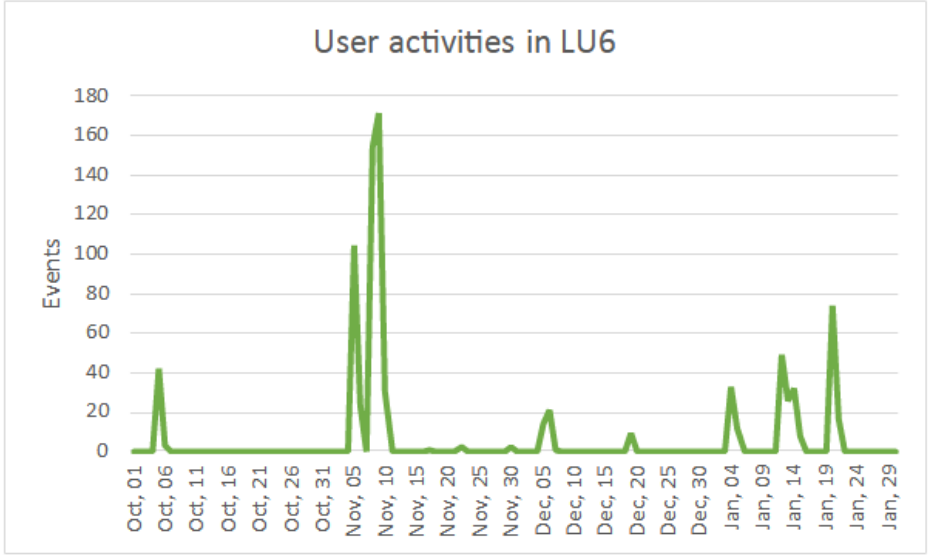
Jan, 04
Jan, 09
Jan, 14
Jan, 19
Jan, 24
Jan, 29


User activities in LU6
Events
180
160
140
120
100
80
60
40
20
0
Oct, 01
Oct, 06
Oct, 11
Oct, 16
Oct, 21
Oct, 26
Oct, 31
Nov, 05
Nov, 10
Nov, 15
Nov, 20
Nov, 25
Nov, 30
Dec, 05
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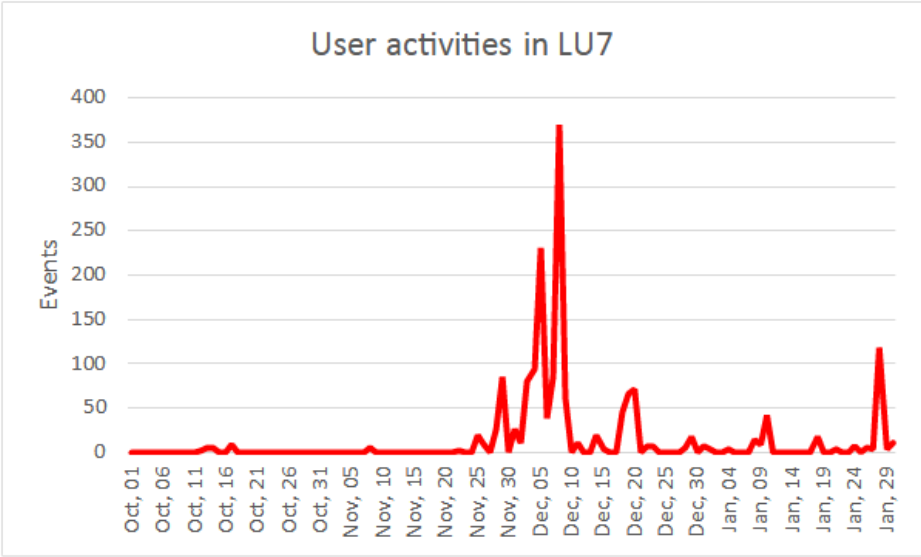
Jan, 04
Jan, 09
Jan, 14
Jan, 19
Jan, 24
Jan, 29


User activities in LU7
Events
400
350
300
250
200
150
100
50
0
Oct, 01
Oct, 06
Oct, 11
Oct, 16
Oct, 21
Oct, 26
Oct, 31
Nov, 05
Nov, 10
Nov, 15
Nov, 20
Nov, 25
Nov, 30
Dec, 05
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Jan, 04
Jan, 09
Jan, 14
Jan, 19
Jan, 24
Jan, 29

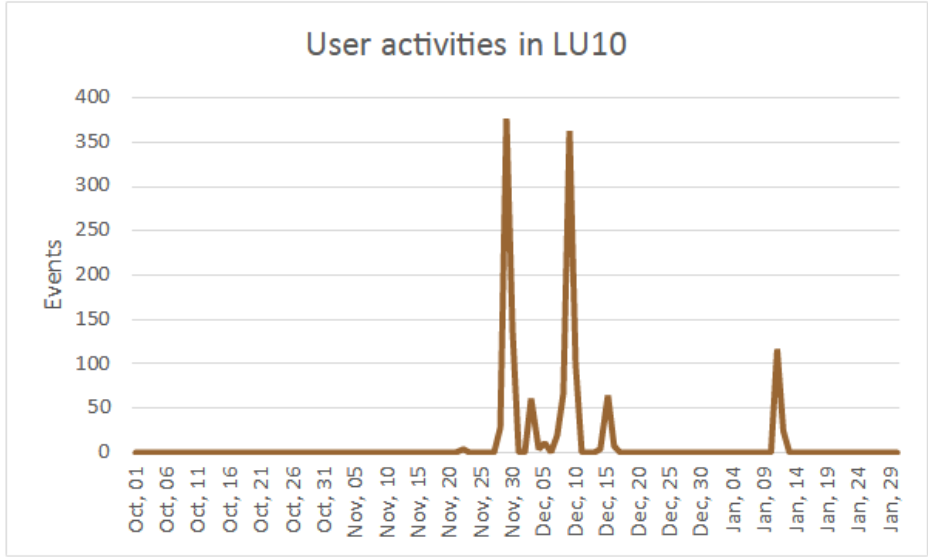
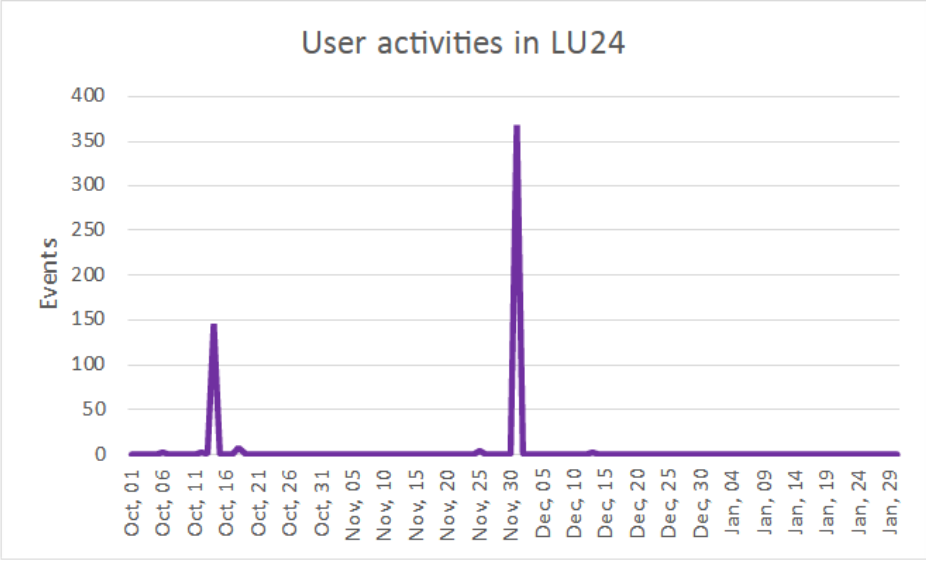

User activities in LU10
Events
400
350
300
250
200
150
100
50
0
Oct, 01
Oct, 06
Oct, 11
Oct, 16
Oct, 21
Oct, 26
Oct, 31
Nov, 05
Nov, 10
Nov, 15
Nov, 20
Nov, 25
Nov, 30
Dec, 05
Dec, 10
Dec, 15
Dec, 20
Dec, 25
Dec, 30
Jan, 04
Jan, 09
Jan, 14
Jan, 19
Jan, 24
Jan, 29

Fig. 2 Time distribution activities of student curriculum participants in DID-ACT's learning management system Moodle. (part 1/2)



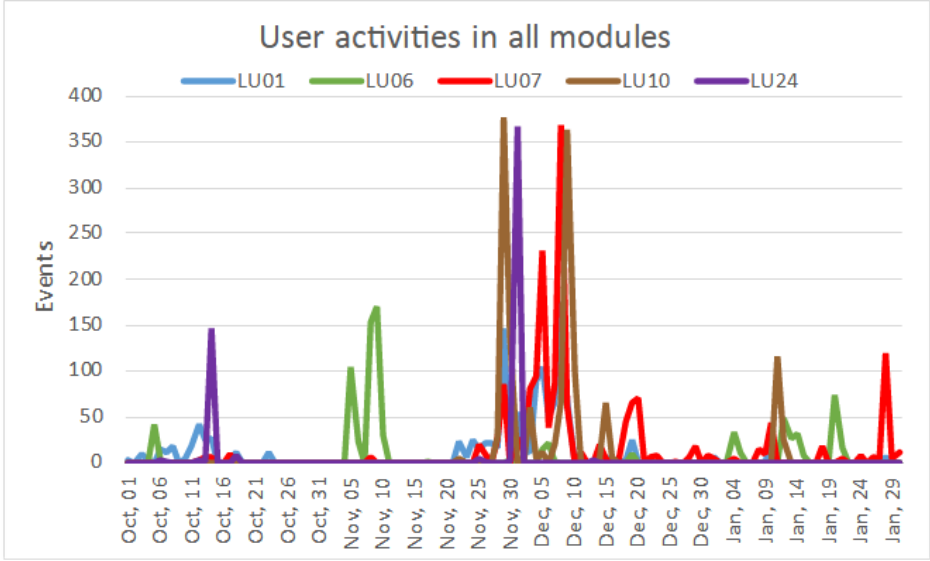


Fig. 3. Time distribution activities of student curriculum participants in DID-ACT's learning management system Moodle. (part 2/2)

5.5.5 Virtual patient activities

During the time from Oct 1st 2021 until Jan 10th 2022 a total of 618 users accessed the courses for clinical reasoning training and completed at least one VP. Overall, we recorded 1516 completed VP sessions with an average time on task of 31 minutes.

From the total of 1516 sessions in 498 (32.9%) sessions, learners made an error when deciding about the final diagnosis. In 70 of the 498 errors, the system suspected a premature closure, in 27 a confirmation bias, and in 8 an availability bias. In 321 sessions learners gave up after they made an error and requested the correct final diagnosis from the system. The average confidence with the decision about the final diagnosis was 63.4 on a scale from 0 to 100.

Students used a clinical reasoning learning tool integrated with the virtual patients that required them to create a concept map of the reasoning process [Hege17]. The concept maps have elements of four types corresponding to different types of concepts relevant in resolving virtual patient cases. These types of elements are: findings/problems, differential diagnoses, test and treatment options. On average learners entered 6.7 findings (0-43), 4.7 differential diagnoses (1-20), 4.3 tests (0-18), and 1.8 treatment options (0-10). The elements in the maps can be linked by connections showing how the concepts relate in the clinical reasoning process. On average 4.2 connections were made by learners with a wide range from 0 to a maximum of 49 connections (Figure 12).

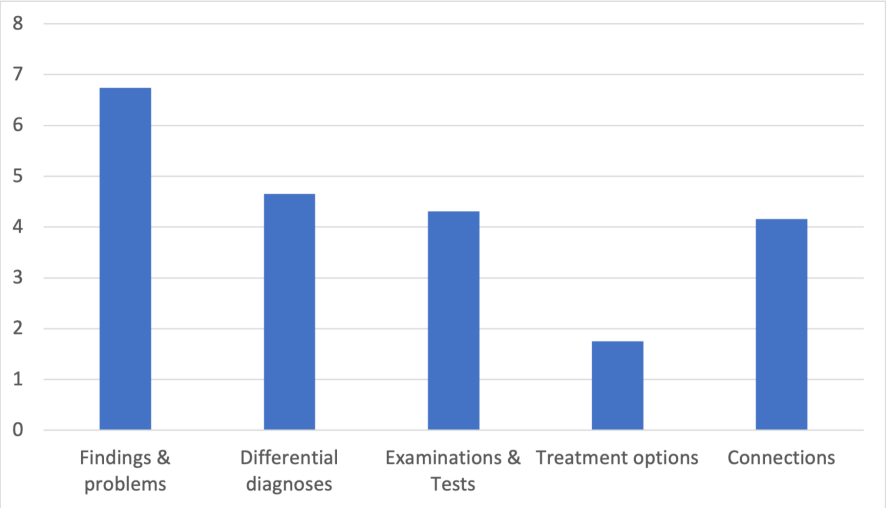


Fig. 4: Average number of items in clinical reasoning concept maps entered by learners.

5.6. Usability evaluation results

5.6.1 Participants

In March 2022 we organized six individual usability tests with participants from Germany, Poland and Sweden, which are summarized in the following. All seven tasks were presented to the participants, including briefing, explanation and debriefing; each test took around one hour. Notes were taken and the sessions were recorded when possible.

5.6.2 Outcome of sessions

The usability sessions resulted with the following outcome:

- Session 1: 5/7 Tasks finished successfully, 49 minutes time on tasks
- Session 2: 6/7 tasks finished successfully, 25 minutes time on tasks
- Session 3: 6/7 tasks finished successfully, 34 minutes time on tasks
- Session 4: 6/7 tasks finished successfully, 35 minutes time on tasks
- Session 5: 6/7 tasks finished successfully, 34 minutes time on tasks
- Session 6: 6/7 tasks finished successfully, 35 minutes time on tasks

Most difficult task was the findability of course by “terms”:

- CRT Nurse model
- System 1 thinking

In the first session global search was not yet active, this was improved after this session, but with the actual settings global search was still not helpful, the glossary was also not active in the first session but even after activation, not all next users used/found the glossary. At that point it did not make sense to have more usability testing on that task, and we are aware that we have to improve the global search and findability first and then might do additional usability testing after that. This should be possible even when the related deliverable of WP5 is finished during the WP7 integration guideline deliverable.

Also already after the first session the homepage and dashboard were edited with a brief course structure.

Course booking was successfully performed by all participants, even though some had issues with the guest course button, the question is whether users without the given tasks of a usability session would give up at a certain point of the course booking procedure. So this might have to be improved as well. Our tester had no problems in locating the course evaluation forms.

The web page has to be transferred from a project to a more “product” driven page, which was already detected before when analyzing the needs for the integration guidelines.

5.6.3 Conclusions from usability evaluation

Usability testing uncovered critical issues which can be improved within DID-ACT D3.3/D4.3. deliverables and with the integration guidelines. Some more trials on a potentially better course booking can be done, even though we have to work with the mechanisms of Moodle LMS. Feedback overall was positive, of course it makes a difference when people worked with Moodle before, but even first time users were able to work on the given tasks without major issues.

6. Discussion

The goal of the D5.3 deliverable was to report the evaluation results of pilots of the DID-ACT curriculum. We succeeded in attracting the attention of over 800 students out of which close to 200 participated in eight formal pilot events organized by partner institutions. We have applied a range of evaluation methods (surveys, learning analytics, usability tests) and targeted different outcomes (satisfaction, motivation and attitudes).

The general picture that is rendered by the results is positive. The great majority of students report they feel they improved their clinical reasoning skills thanks to engaging in the piloted learning units. The reported challenges pertained to the usability aspects of the learning management system, suggestions for more content and more clear instructions is not critical. We can conclude from the quantitative results of the questionnaires that clinical reasoning knowledge skills, assessment and feedback has space for improvement. Despite the limitations the students were able to take advantage of the learning content produced by the DID-ACT consortium. These findings are corroborated by the different named sources of information.

The initially planned number of student questionnaires was not reached (125 instead of the planned 250 forms). But the response rate of 63% surveys is satisfying considering the often observed survey fatigue among students at our institutions. We also had more students interacting with the additional DID-ACT project resources (e.g. virtual patients) than expected. Not all learning units of the student curriculum could be piloted due to the large number of developed learning units. We were able to evaluate units at all partner institutions for different levels of students. Many of the themes in the feedback were generic and repeated across learning units. However, it could be, however, that some of the not evaluated learning units, had unique challenges we are noy aware of. We will discuss this during the refinement stages of the project.

It is of course disappointing we were unable to show a statistically significant increase in patient-centeredness of students after the LU6 learning unit evaluation at Jagiellonian University. The average values around the 4.15 out of 6 mark obtained before and after the learning activity show a score which would, according to the interpretation of Krupat et al [Krupat00], be classified as a doctor-centered orientation (with patient-centered orientation starting with PPOS score > 5.00). This leaves room for improvement. A plausible explanation is that the learning unit was too short to show an impact on such a profound characteristic as

patient-orientation which is deeply rooted and promoted by the general medical curriculum outside the course in which we implemented the learning unit and attitudes are notoriously difficult to change. The learning unit received mainly positive free-text comments and the dominant wish for improvement was to implement more virtual patients in the unit. In light of this we can conclude that this learning unit is a valuable addition to other curricular activities in relation to patient-centeredness.

Learning analytics data showed that the students engaged in different forms of activities available for them in the learning management system Moodle and the virtual patient platform CASUS. Each learning unit had its special strengths but it was easily recognizable that implementing virtual patients and case-based learning was always well received and actively employed. The peaks of activities mainly around the synchronous pilot sessions are not surprising. Students are overloaded with different tasks during their studies and it is challenging for them to explore content self-directed if it is not connected with an assignment which is part of their curriculum. We will go more in depth in the curricular integration strategies as part of the planned activities of work package 7 (D7.3 integration guidelines).

Limited usability of the learning management system Moodle was a constant theme in the students' comments. We acknowledge the issue and in response to that organized formal usability evaluation to observe the moments in which the users struggle the most. The conclusions caused some instant adaptations and will further inform future developments to improve the user experiences during the remaining project activities.

Finally, we have noted several suggestions for improvements reported by students in individual learning units. The challenge is that some of them are conflicting or seem to be related to features of a particular pilot implementation context. If addressed uncritically, refinements could worsen the learning units for other target groups. The plan is to analyze carefully all the suggestions reported in this deliverable and implement refinements as part of D4.3 to retain the recognized strength of the learning units and strategically modify the courses to maximize the utility of the curriculum useful for our target audience.

7. Conclusions

This deliverable reported outcomes of a series of evaluation events during pilot implementations of selected learning units of the DID-ACT curriculum student courses. Students were in general satisfied with the content of the learning units but requested several minor extensions and improvements in navigation of the learning management system. This will serve as the starting point for the planned refinements of the student curriculum.

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9. Appendix

9.1 Free text opinions of participants in the student curriculum pilot courses (ETELM-LP-S questionnaire)

Editorial note: Quotes in [square brackets] are translated from the native language of the responder to English.

How could the quality of the learning unit be improved? What would you change, remove, or add? Please describe and explain.

LU1

- Remove this online case study on moodle. Just have live/zoom sessions and in those sessions talk about real-life scenarios.
- [In my opinion, the discussions in the small groups were too limited in time, so it was difficult for the smaller group to discuss all the material completely in the short time and also to record it in writing. Also, the division of the groups was not quite even (I assume this was not intentional, but due to the absence of some participants).
- [everything perfect]

- It has already a good quality. Maybe you could change the separation of the case description of Mrs. Cramers case and the quiz afterwards and include the quiz between the different stages of Mrs. Cramers case. So the learning would be more interactive.
- A better overview of the online self-study

LU1/7

- The learning unit overall was very well designed. What I would change are the videos included in the learning unit after the first Zoom-Meeting, where the differences concerning clinical reasoning throughout the different professions were supposed to be described. I found these videos to be more confusing than informing. They were out of context for my understanding. It was quite hard to draw any conclusion concerning the definition of clinical reasoning for physical therapy for example. Maybe you could include more straight forward videos for the task.
- Quiz on Moodle instead of downloading a Word document and having to upload it again
- I would add more clinical examples and more case studies, as it helped me to connect the subject to an actual case. (visalization)
- The theory part was a bit dry, it would have been better to do it live instead of watching videos.
- If we had been able to speak in our native language, we would certainly not have been so shy and could have had a more relaxed discussion. The results might have been a little better.
- [Overall, the learning was very pleasant and I did not find it exhausting. In my eyes, the online units need to be improved, especially the preparatory task regarding the different health care professions: here, unfortunately, the videos were not very helpful to work on the subsequent tasks.]
- [I would revise the videos on Clinical Reasoning with different professional groups]
- Use a different platform than moodle and make it easier to see. I missed some videos because I did not find them. It would be better to have zoom sessions where some healthcare professionals would give concrete/real-life examples of clinical reasoning.
- Sometimes the tasks were a bit unclear (at least to me), e.g. when we were asked for differences in the Clinical reasoning process of different professions. In this particular example, I had a hard time deciding what was a difference and what was a concept, which is transferable to any profession (e.g. slow/fast thinking)
- I would maybe change the videos, which were showing the roles of the different professionals in the process. Some of them were really hard to understand and in my opinion didn't really fit to the questions which were asked.
- [The layout of the website (the many hyperlinks, the opening and closing of elements and that seemingly everything looks "the same" or the hierarchy was not clearly visible) caused some inhibitions in the beginning - but then went well during the work through, except that I have tried again and again really extensively to browse through everything, so that I could be sure to have completed everything necessary. Conclusion: Clearly make the website clearer.]

- I would make it more clear what the objectives of the module are and how to complete them.
- I liked the course the way it was. Maybe there could be an introduction with some information about clinical reasoning in the first zoom meeting. Because in the first breakout-room of the first meeting the other participants and me weren't sure if we had the right idea about clinical reasoning but had to define it. So we felt a little bit lost. But perhaps this was planned for the first breakout-session, that the participants should define clinical reasoning without previous knowledge.
- [Videos on clinical reasoning in medicine, nursing, physical therapy, etc. did not fit the task so well in some cases.]
- I didn't quite like the videos of the different perspectives in clinical reasoning, it would be easier to just have an overview what is important for which profession or different texts. It was quite hard to extract similar informations for the different professions out of each video.
- The videos that should teach us more about the clinical reason process in different fields where a bit hard to follow sometimes. Some of them where a bit confusing. Maybe it's possible to find better ones or do a presentation on your own.
- I would add more of a structure to the discussions when presenting the results of the individual smaller groups so that it can be more effective. The online Moodle course was a bit confusing to me so that could be improved to make the access easier.
- I missed the first session, so I jumped into the second session without properly understanding the learning objectives. The tool used to support learning wasn't great and quite confusing. I've used may e-learning tools in my earlier career and this one isn't up to standard. Navigation is clumsy, parts is translated in a very poor way and it is unclear what is expected of me as student.
- I missed a quiz or something similar after the learning unit of the case of Mrs. Khaled. So I am not completely sure if I found the information, that is seen important by the instructors.
- It depends on what exactly what was supposed to be achieved. If the point was to only make students conscious of the principle of 'clinical reasoning' it was very well achieved. It seems to me just about every aspect of the theory of it was covered in great detail. I don't know if it would lend us any practical help when we actually begin working in clinics, though, if that was the idea I would add more practical tools. Example: Knowledge of common logical-fallacies commited by medical staff, practical advice as to how to deal with work-life balance so as not to be exhausted when treating patients, how to better communicate and transfer important information interdisciplinary, etc.
- use a platform thats clearer than moodle. Give more educational information.

LU6

- [The possibility to zoom in schemes and info cards without a loss in quality; diversify clinical cases]
- [I wouldn't change anything.]
- [Add more clinical cases but with different diseases.]
- [Cases should be more diversified.]

- [I think that the videos shown during our classes were interesting and useful. I like using such teaching aids.]
- [Final tests after finishing a case, more diversified cases, perhaps some videos]
- [Implement bigger diversity of clinical cases.]
- [More diversified cases.]
- More diverse examples (retarded patient)
- I cant think of things to improve. I found the session quite useful.
- [I would add additional clinical cases for interested students to solve, because they are a good method to verify your skills.]
- [Implement more clinical elements, cases, etc.]
- [I think that the classes are very useful, although before classes about, for example, dialogues about gathering urine samples, one could familiarize the students with guidelines on how to perform such procedures]

LU10

- i didn't receive the e mail first
- [The first learning unit was somewhat lengthy. Basically, much was taught that I implement intuitively in practice without thinking and therefore it would have been clearer to work directly with examples or cases. I would have benefited more from the theory and generally from the PPT if it had been in German. The case study could have been used to go into more detail about which element in the text makes DD a possibility (e.g., in anuria, think of kidney involvement such as pyelonephritis).]
- [I think that the online module should be spiced up by giving more in-depth explanation about tests performed on the patient, because students at the current state of their education lack the necessary knowledge to do without external sources (most commonly - the Internet), and the data found is not always true.]
- [The final presentations performed by students about diagnoses, which summed up the characteristic symptoms]
- [I would add making presentations on the 3rd class about this case, because it would allow to widen the knowledge useful for us, regarding pretty common cases, like myocardial infarction.]
- [The classes were very interesting, using this new form provided a good variation after the previous case. I think that the most sensible thing would be to alternatingly teach classes in various forms, because each one has some advantages]
- [Improve the visual aspect, less text, courses should be more visible, sometimes it was hard to find the right course]
- [More visual clarity, and when solving the case good (sic!)]
- [I would delete or enhance the introduction part, in which we formed the hypotheses, because we had been looking for very sophisticated diseases, which was useless when the point was to learn the basics first. The rest - very good.]
- [Better patient's tests description is a must. More feedback for the student]
- [More single/multiple choices question in order to review one's thought process better]
- [I would add info about what awaits us in the next step, for example "suggest tests" and then we know that on the next cards we'll see the test results.]

- [The user interface isn't very intuitive. I would widen the scenario, more test questions.]
- [I would reduce the amount of presentations. Instead of model in which everyone has to make one on given class, which forces participants to come up with unnecessary and repetitive presentation topics, I'd propose that the amount of presentations would equal the amount of class participants (taking into account that you'd have to grade everyone), and for example on one class 4 people would make a presentation, and 5 on the other.]
- [From the student's perspective, I think that in case of former cases (the first and the second), one would be able to complete them in two classes.]

LU24

- Everything was OK.
- take less long time like 10 min for the nursing group to come up with something and then 10 min discussion in the multiprofessional group
- Add more components in favour of learning such as radiology, histology (PAD), different diagnostics (ecg, spirometry etc) would be fun
- A bit more clear instructions to follow, we sometimes had concern on what to do next. Something like "step by step" plan maybe could help with organization of teamwork.
- One supervisor should be present during the discussions in the breakout rooms on the second day. I felt totally lost preforming the exercises and didn't really know what we should have been doing. Maybe if the questions were stated in a form to fill in, it would help with organization.
- I would provide more clear instructions to participant on what are expected to do in each exercise. Maybe graphical instructions send before the course would be helpful.
- I think that this page moodle is a little bit complicated for PL students because we dont use it daily in our studies so we will have a little problems with this. But everything was perfect expect this ;)
- Mabey spent more time on the cases, and shorten the first day
- I will make the unit more complex and also expand this project to more meetings, so we can learn more and get to know each other. Also add some interproffesional classes in real life.
- The instructions, especially the questions, are easier to record. for example in the forum on didact or under the example
- I wouldn't change anything.

Overall, what elements of this learning unit most contributed to your learning, excitement and engagement as a learner? Please describe and explain.

LU1

- Group work on zoom.
- I found that the virtual patient Jane Cramer exercise was very effective, as it promoted the participant to actually participate in the course. By answering the

questions about the patient, one was able to even better understand the meaning behind the exercise. All in all, I thought that it was really interesting to participate in it.
- the case study of mrs. Cramer surely helped the most to get the knowledge together and apply it to a realistic everyday situation.
- I liked that i could identify myself with the health professional in Mrs. Cramers case.
- The online self-assessment with Jane Cramer

LU1/7

- I can definitely say, that the Zoom-meetings were the largest contributor. They were fun and informing and had a very laid-back work environment.
- i like the case studies with the virtual patients and quizzes on moodle
- Certainly the case studies. For me it is important to visualize the things that I learn and to use the techniques and train them actively.
- I had the greatest learning success with the case studies and with the tasks that we answered in the groups.
- The interactive elements between the online sessions and the discussions afterwards contributed most to my learning success. Applying what was learned was useful. In addition, the rest periods between the learning units were useful. I was able to think about the subject and the knowledge was manifested.
- [The live assignments in the break-out rooms were what got me the most, as there were very open discussions and many different perspectives were considered.]
- [The case studies that you could work on yourself were fun to do]
- It was great that the sessions weren't too long as too much information can be overwhelming. I liked zoom sessions.
- Group discussions
- The cases. Because you have to think about all the stuff you have learned.
- I found the zoom meetings very good because it was a chance to interact with students from different universities and see their experiences and perspectives. Unfortunately my time schedule didn't allow me to participate on both meetings.
- [The Zoom meetings (collaboration with the other students + the leader's feedback and explanations) left the most impressions on me and actually provided most of the conceptual clarification. In addition, the exchange was partly very lively and it was fun. There was both understanding shown and above all given and encouraged.]
- The different cases, and first-person perspective. Completing the exercise together in a group.
- The interactive case of Mrs. Cramer was very interesting to do, because I could actively participate in the process of clinical reasoning. Also I liked the discussion with the other participants from other universities.
- [Online case-based learning e.g. Mr Berner]
- I really liked the case studies. I got engaged in the story, wanted to know which step would be next, how it would end and how the different actors in the story would interact with each other.
- the cases the had to work on on the casus website were very interesting and engaged actively reflecting on the case and the aspects regarding clinical reasoning. I found myself interested in figuring out what affects the clinical reasoning and how

different characters can contribute to make the clinical reasoning a patient-oriented process.
- The discussion in the group especially helped me see other point of views and get a broader idea of how clinical reasoning works in different cultures. That was very interesting and will most likely help me in the future.
- The session where students from many backgrounds and countries collaborated was good an interesting.
- I like it that the case is built in a way, that the reader is the doctor who finds himself confronted with the case and can interpretate the results of the examination.
- Learning: I didn't feel as though I was learning many new things, but the videos of the different people explaining clinical reasoning as specific to their professions were interesting to see. Excitement and engagement: Working in small groups with fellow medical students was fun and engaging.
- Case study

LU6

- [looking for answers to follow-up questions - it forced you to pay attention while reading the info cards]
- [The possibility to solve clinical cases unassisted and to take the role of a physician.]
- [The ABCD questions and open-ended questions in order to think the case through.]
- [Tests examining your knowledge.]
- [I felt more engaged while watching videos than when answering tutor's questions.]
- [Nice trivia about the patients.]
- [Follow-up questions - allowed you to check whether your line of reasoning is correct]
- [Similarity of cases]
- I think it is helpful to remind medical students that each patient is different and it is important to treat patients in an individual way. I can imagine with time some doctors might tend to get a little tough towards patient.
- the approach to patient centered care is an imporant factor in patient treatment. the implementation of this topic in medicine studies is really important and great that we do that. friends of mine who study medicine at other universities don´t focus on these 'off-medicine-topics' which I find really bad.
- Explaining and defining PCC in a way I can personally relate to. Especially the exercises. I personally think that a person will learn and implement things faster and more efficient when he/she/they is able to relate to it.
- [Clinical cases were a very good method of verifying how would I behave in specific situations, because they showed each patient's individuality.]
- [Examples built upon real clinical events.]

LU10

- [It was good to see what is applied in everyday life without thinking, once as theory in front of you. I found it helpful to apply the theory using a case study. I also found the division into 2 learning units positive.]
- [Throwing into the deep end in the context of describing symptoms and imaging methods forces you to delve into the subject. Furthermore, solving such clinical

cases doesn't take too much time, and it just makes one want to browse through the sources to find information and decipher incomprehensible stuff.]

- [Thanks to the group work, my involvement definitely increased. The online module in the CASUS app is pretty interesting, too - but it would be more interesting if enriched with additional data both about the patient and the disease entity.]
- [Interpretation of lab test results, physical examination, x-ray. Searching for connections among different symptoms]
- [Info that I didn't know, which turned out to be popular and significant for given case.]
- [Attempt to describe the X-ray and ECG]
- [Subsequent steps of the case,]
- [New case, discussed]
- [In my opinion the motivation was to find out the disease. And the interesting patient's history also contributed to the desire to learn what happened later and deepen the knowledge.]
- [New patients' diagnostic tests contributed the most, which up to this point I wasn't able to interpret]
- [Actual test results, both laboratory and imaging. I alone had to find out the reason of the patient's symptoms, and thanks to that I learned a lot, not only on a certain case's basis..]
- [Subsequently revealing symptoms/lab values which narrowed the spectrum of differential diagnoses was very interesting. We were able to use our preclinical knowledge and confront it with a clinical case, and still we were led through case stages. Independent searching for meaning of some symptoms/test results also contributed to improvement of knowledge.]
- [The general algorithm and "sorting out" how to handle a given disease]
- [The clinical case that we solved in between the classes was the thing that contributed to my learning the most, because it widened and promoted widening of knowledge in an interesting way.]
- [Interaction with other students, joint discussions and thoughts exchange]
- [Analysis of the new cases and making diagnoses, which will be a cornerstone of our future job, is what brings the most excitement and attention.]

LU24

- Full description of the topic, and interesting history of the patients. I had an opportunity to tell what I was thinking about the case.
- for me it was like pbl (problem-based learning) so it was really helpful
- The interprofessional aspects to patient care from arriving to discharge from the hospital. Also that the case of this learning unit was highly relevant, we all could be in charge of taking care of this patient in the future as physicians and nurses. It also provided feeling of being in charge which I reckon is one of the major advantages to us becoming better professional health care providers in the future.
- Working in small groups was great, and I really appreciate that firstly we had a chance to discuss in group of students of same programme, and then share thoughts in mixed groups. It expand horizons.

- The group discussions were engaging. Getting to know the perspective of the other students from different professions.
- I haven't been able to fully benefit from the course due to technical and communication problems. Almost half of the time assigned to group exercises was wasted to organisation problems.
- I think that the most contributed my learning was case.
- Discussion of the clinical case
- Opportunity to collaborate with other student and to talk in English a lot.
- the discussions in the individual groups were very instructive
- I think sharing information with nursing students was really valuable for me.

Further comments

LU1

- I found it to be a very good study session. I found it interesting to work internationally and think that this should be done a lot more often. I am glad I was there and would be there again and again.
- Thank you for the chance to participate in this course. I wish you all the best for your future :)

LU1/7

- 3,5 VPS isn't really enough for the amount of time spent on the zoom and moodle sessions, it added up to be more hours
- none
- I think it would be great if there was an expert in eatch of the different learning groups.
- [Thank you for offering insight and feedback! "Clinical Reasoning" is now a fixed term in my professional understanding!]
- I really liked the overall experience of the whole curriculum. I think I understand the method clinical reasoning much better now and I am eager to use it myself as soon as I am finished with the medical school
- I really enjoyed the zoom group sessions where we had to discuss certain subjects and could write down our ideas to present them later. As clinical reasoning is a team process I found that the group discussion session were in alignment with our goal to learn more about clinical reasoning. Furthermore I enjoyed exchanging ideas with other young people which improved my motivation and learning progress.
- Thank you for the opportunity and good luck with your thesis! :)
- I think SBA [Single-Best-Answer] questions would have been a better way to enforce the learning
- I think I gave feedback on these matters already in a preceding survey. Finally: Thank you very much for the opportunity to partake in this course and creating it in the first place!
- Thankyou for the learning possibility.

- I didn't feel like any of the information I was presented with was new, or something I didn't know yet. Maybe that's just because I went into the course with false expectations, or because our university already provides a really excellent course on this topic in the first semester. /I was expecting the course to present me with more concrete tools/ ways to structure my thoughts/ etc. in order to be better at clinical reasoning and avoid the mistakes that are so often made during clinical practice. Maybe be presented with common logical-fallacies or thought-traps medical staff often fall into and commit? I don't know if such things exist, but that was what I was expecting. / Instead the course seemed to focus more on making us conscious of the fact that a thing such as 'clinical reasoning' even exists and the fact that the amount of people/factors that interact with patients and have an effect on their wellfare is large. / Perhaps this is just my university, but this is something that was very strongly hammered into our heads from day two, and the rest of the things we learnt could be inferred quite quickly just from the name 'clinical reasoning'. / So perhaps it was just my wrong expectations, but I don't think I was able to take anything away from the course that I didn't already know or guess, which I was a bit disappointed about. / In any case, it was fun to watch the videos of different professions explain the concept of clinical reasoning specific to themselves, and it was fun to interact with and meet other medical students, so thank you for your time.

LU6

- [No comments, perhaps maybe a more clear software design would be of use]
- [No comments.]
- [None]
- thanks!

LU10

- [Technical problems appeared when solving a case in the Casus app. The X-ray image was incorrect and the angiogram lacked description.]
- [none]
- [Cool way of going through case, spices up the classes. This way could take turns with the earlier one.]
- [It's good]
- [Awesome vibe during the class was a very good part of it, also the tutor had a friendly attitude and was very helpful.]
- [Amazing classes!! :D]

LU24

- No more comments.
- It was so much fun getting to know the students from the other universities/countries and collaborating. Everyone was very engaged and contributed, excellent learning opportunity on clinical reasoning!

- I felt like too little was done during the first day and we were rushing everything during the second. Maybe if some time during the first day would be dedicated to preparing us for the activities on the second, it would be less chaotic.

9.2 Free text opinions of facilitators in the student curriculum pilot courses (ETELM-IP questionnaire)

How could the quality of the learning unit be improved? What would you change, remove, or add? Please describe and explain.

LU1

- In some groups, a little more time (maybe 5 - 10 minutes) would have been good for plenary discussion of the results of the small group brainstormings. I think this is especially the case if this LU should be conducted in presence and not virtually.

LU7

- The worksheet is perhaps a bit too rigid in terms of which task comes when, and more professions, i.e. EMS, should be represented. // Concerning the discussion of questions like "What are the similarities and differences in the clinical reasoning process?", some sort of multiprofessional consensus on potential answers, such as focus of reasoning/patient contact/diagnosis development, might be useful for the facilitator to provide more decisive input. This could be facilitated by a review of example solutions developed during the pilots. // In an online learning setting via zoom, the originally planned course outline is a little hard to conduct. For example, we left out the 10 minutes of individual learning and the speed dating due to feasibility concerns and instead just discussed the differences in the groups' worksheets in the plenary, facilitated by a shared screen with each solution opened in an individual window.

Overall, what elements of this learning unit most contributed to your learning, excitement and engagement as a learner? Please describe and explain.

LU1

- The brainstormings in small groups motivated most students to discuss the topics and they could profit from different levels of experience within the group. Also, the video on CR, which is provided on moodle, gives a very good summary of the topics discussed.

LU7

- In general, the small group activities were very well received and students had fun discussing the corresponding content in a playful way.

Further comments

LU1

- I had the impression that having a few participants with at least some sort of clinical experience in the course made the brainstormings in the small groups and the plenary discussion more lively.