

DOI: 10.5455/msm.2023.35.312-318

Received: Nov 20 2023; Accepted: Dec 15, 2023

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ORIGINAL PAPER

Mater Sociomed. 2023; 35(4): 312-318

Education on Vaccination Competence: an Intensive Course for Skillful Health Science Students

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ABSTRACT

Background: Vaccination is one of the most successful and cost-effective interventions for public health. Studies have shown that health professionals who have good knowledge and positive attitudes towards vaccination are more likely to provide effective vaccination protection to people, including themselves. Therefore, health science students must acquire evidence-based knowledge during their education to meet the challenges of healthcare. **Objective:** The aim of this study was to investigate the knowledge, attitudes and feedback of health science students who participated in the Educating Vaccination Competence (EDUVAC) Intensive Course. **Methods:** A five-day Intensive Course was implemented for health science students, which included a pre-assignment. The EDUVAC Intensive Course used different teaching methods (lectures, workshops, interactive games, discussions), group work, study visits, and cultural programs to encourage students' motivation. For the purpose of the study, students filled out an online questionnaire after giving informed consent. **Results:** Sample consisted of 31 health science students from five European Higher Institutions. They had very good knowledge on most knowledge questions. In the post measurement it was significantly greater and equal to 81%, $p < 0.001$. Almost all students (93.5%) totally agreed that "It is important for adults to receive all recommended vaccines according to national guidelines". The statement "I have

had an active attitude and participation in the Intensive Course" received 80.6% total agreement. Over 90.3% rated the Intensive Course as "excellent" or "above average". **Conclusions:** After completing the EDUVAC Intensive Course, students felt confident in their vaccination knowledge and skills, which benefited their professional development.

Keywords: intensive course, knowledge, attitudes, satisfaction, vaccination competence, health science students

1. BACKGROUND

Every year, vaccination against infectious diseases prevents over 4-5 million deaths. It is one of the most successful and cost-effective interventions for public health (1). Health professionals play an important role in the success of immunization strategies by providing accurate and accessible information about vaccines, addressing people's concerns and misconceptions, and promoting the benefits of vaccination (2, 3).

Studies have shown that health professionals who have good knowledge and positive attitudes towards vaccination are more likely to provide effective vaccination protection to people, including themselves (4, 5). Health professionals need to work hard to encourage people to participate in vaccination programs, building and maintaining a positive relationship, and providing updated scientific infor-

mation to support vaccination practice (2). Additionally, health professionals' knowledge and ability to encourage people to participate in vaccination programs have a significant effect on vaccination coverage rates in their communities (6, 7).

The importance of vaccination competence among health professionals has become even more apparent during the COVID-19 pandemic, as countries around the world continue to vaccinate against the new coronavirus. As of January 2023, more than 13 billion doses of COVID-19 vaccine had been administered worldwide, according to the World Health Organization (8).

Therefore, health science students must acquire evidence-based knowledge during their education to meet the challenges of healthcare. To ensure the safe administration of vaccinations, health science students need to obtain the necessary knowledge and skills, which may require a variety of learning methods in addition to clinical practice (9). For that reason, developing the vaccine competence of future health professionals is crucial (10). It is important to create safe learning environments which make possible for students to feel free from the fear of being judged when the performance or the knowledge is not yet assimilated (11).

A number of vaccination education methods for future health professionals have been implemented and documented globally. A previous study conducted in Finland on vaccination proficiency showed that public health nurse students scored a lower percentage (76%) of correct responses on the knowledge test compared to public health nurses (83%, $p < .0001$), indicating a need for better vaccination education. (12).

An interprofessional education program for family nurse practitioner students and pharmacy students that utilized a blended approach to learning, including online learning and face-to-face activities, demonstrated the importance of face-to-face interaction in education (13). Another university conducted an interprofessional education for first year students across all schools of health sciences on the topic of children's vaccinations. This interprofessional education seemed to promote not only collaborative practice skills but also assimilate team approach for vaccination corroboration, education and follow-up which can affect vaccination outcomes. Interprofessional education can also develop awareness of how to improve population health (14). Furthermore, peer-assisted learning on learning the principles of vaccinations showed positive results and benefits for nursing students in a quasi-experimental study (15).

Different kinds of intensive and short courses for vaccination have been implemented around the world. A five-day summer school on vaccinology was developed for future health care workers by international team of experts. The team developed an international intensive course that received high praise from both students and teachers. The students particularly appreciated the communication and practical skills training, as well as the interactive teaching methods (7). Several organizations, including the World Health Organization and Centers for Disease Control and Prevention (CDC), offer training

programs and short courses related to vaccination for healthcare professionals and doctors. According to Dochez et al. (18), there are a total of thirty-three vaccination programs offered worldwide in 2021. Out of these, seventeen are short courses, eleven are post-graduate courses, and five are master-level courses.

Educating vaccination competence (EDUVAC, 2019-2021) was an Erasmus+ funded project in order to enhance the quality and relevance of education in vaccination; to develop and implement a web-based course (3 ECTS) and an Intensive course (2 ECTS) for vaccination for international use. Five European universities participated in the project: University of West Attica (UNIWA) from Greece, coordinator of the project, Metropolia University of Applied Sciences (UAS) from Finland, University of Trnava from Slovakia, University of Vic (UVic) from Spain and University of Modena and Reggio Emilia (UNIMORE) from Italy.

2. OBJECTIVE

The aim of the current study is to investigate the knowledge, attitudes and feedback of health science students who participated in EDUVAC Intensive Course of vaccination competence.

3. MATERIAL AND METHODS

The Intensive Course was designed for students in health visiting, public health nursing, nursing and midwifery, and it took place in Finland in May 2019. The course consisted of a pre-assignment and a five-day intensive program. Its aim was to enhance the quality and relevance of learning about vaccinations, as well as to strengthen the knowledge, skills, and attitudes of students in vaccinating different population groups and counseling people of different age groups and their families.

Before attending the Intensive Course, all participating students were required to complete the EDUVAC web-based course Vaccination Competence, which was hosted on the Moodle platform of Metropolia UAS. The course covered the following topics: Vaccination basics, Vaccination procedure; Counselling people; Vaccinating refugees, migrants and asylum seekers; Vaccinating travellers and people on the move; and People who hesitate to take vaccines and anti-vaccination groups.

During the Intensive Course, students worked in multicultural groups to prepare their assignments, while teachers worked together as transcultural pairs. The course incorporated a range of teaching methods, including lectures, workshops, interactive games, and discussions, as well as team-building activities, study visits, and a cultural program to encourage student motivation.

Data were collected in Spring 2019. For the purposes of the study, an online questionnaire was developed by the research team based on relevant literature. Students filled in the questionnaire before and after the Intensive Course. The questionnaire consisted of questions about vaccination knowledge, attitudes, and feedback on the Intensive Course. Knowledge statements were evaluated with answers of "wrong" or "correct". Questions

about attitudes were evaluated using a Likert-response scale ranging from “totally disagree” to “totally agree”, while feedback was evaluated using a Likert-response scale ranging from “not achieved” to “fully achieved”, “above average” to “poor”, or in some questions, with a “yes/no” response.

Ethical issues

Informed consent was obtained by all participant students who were informed about the study purpose, voluntariness and anonymity, before filling in the online questionnaire. The approval was obtained in March 2019 by Metropolia UAS because it hosted the EDUVAC web-based course in Moodle, and by other universities if required.

Statistical analysis

Quantitative variables were expressed as mean values (SD), while qualitative variables were expressed as absolute and relative frequencies. For the comparison of proportions chi-square and Fisher’s exact tests were used. Student’s t-tests were computed for the comparison of mean values. Student’s t-tests and analysis of variance (ANOVA) were computed for the comparison of mean values. All reported p values are two-tailed. Statistical significance was set at $p < 0.05$ and analyses were conducted using SPSS statistical software (version 26.0).

4. RESULTS

Sample consisted of 31 participants for each measurement and their characteristics in the pre and post measurement were similar. The majority of the participants were females (96.8%), aged between 18 and 25 years old. More than half (51.6%) of the students were studying nursing, 25.8% were studying community health and 19.4% were studying public health nursing. Most of the participants (77.4%) had studied as a pre-assignment before the Intensive Course the educational material of the EDUVAC web-based course in the Moodle platform of Metropolia UAS.

A grade number of students (74.2%) included theoretical education about vaccinating in their current studies while 41.7% had performed vaccines to people of different ages in supervised clinical practice during their studies. Most of the students (74,2%) stated that practical training in vaccinating people of different ages, practicing different vaccination techniques such as intradermal, subcutaneous, intramuscular techniques (74,2%) and theoretical knowledge (58.1%) have provided more to their vaccination education than exams (19.4%) or written learning assignment (9.7%).

Participants’ knowledge on vaccination is presented in Table 1, in both measurements. In the majority of the questions, the percentage

		Pre N (%)	Post N (%)	P
According to the vaccination recommendations:				
Seasonal Influenza vaccination is given every year	Wrong	4 (12.9)	3 (9.7)	>0.999++
	Correct	27 (87.1)	28 (90.3)	
Tetanus is spread from person to person	Wrong	27 (87.1)	29 (93.5)	0.671++
	Correct	4 (12.9)	2 (6.5)	
Rotavirus vaccine is given against diarrhea of babies	Wrong	10 (32.3)	2 (6.5)	0.010+
	Correct	21 (67.7)	29 (93.5)	
Two doses of MMR vaccine are needed for proper protection of MMR diseases	Wrong	8 (25.8)	4 (12.9)	0.199+
	Correct	23 (74.2)	27 (87.1)	
Common contraindications for vaccinating are:				
Infection with fever	Wrong	1 (3.2)	2 (6.5)	>0.999++
	Correct	30 (96.8)	29 (93.5)	
Under recovery from infection	Wrong	8 (25.8)	15 (48.4)	0.066+
	Correct	23 (74.2)	16 (51.6)	
Disability	Wrong	29 (93.5)	27 (87.1)	0.671++
	Correct	2 (6.5)	4 (12.9)	
Serious immunodeficiency	Wrong	10 (32.3)	6 (19.4)	0.246+
	Correct	21 (67.7)	25 (80.6)	
Breastfeeding	Wrong	21 (67.7)	25 (80.6)	0.246+
	Correct	10 (32.3)	6 (19.4)	
Previous life-threatening or serious reaction after same vaccine	Wrong	7 (22.6)	2 (6.5)	0.147++
	Correct	24 (77.4)	29 (93.5)	
Strong hypersensitivity to any constituent of vaccine	Wrong	9 (29)	5 (16.1)	0.224+
	Correct	22 (71)	26 (83.9)	
Taking antibiotics	Wrong	21 (67.7)	16 (51.6)	0.196+
	Correct	10 (32.3)	15 (48.4)	
The following recommendations are followed with regard to the injection area of vaccinations:				
Infants’ (<1-years-olds) intramuscular vaccinations are administered to upper front part of the thigh	Wrong	2 (6.5)	0 (0)	0.492++
	Correct	29 (93.5)	31 (100)	
BCG vaccination is administered to right upper arm	Wrong	16 (51.6)	12 (38.7)	0.307+
	Correct	15 (48.4)	19 (61.3)	
Toddlers’ (1-6 years) intramuscular vaccinations are administered to shoulder muscle of the upper arm or upper front part of the thigh muscle	Wrong	6 (19.4)	3 (9.7)	0.473++
	Correct	25 (80.6)	28 (90.3)	
School age children (≥7 years) and adults’ (≥18 years) subcutaneous vaccination are administered to upper arm	Wrong	5 (16.1)	2 (6.5)	0.425++
	Correct	26 (83.9)	29 (93.5)	
School age children (≥7 years) and adults’ (≥18 years) intramuscular vaccinations are administered to shoulder muscle of the upper arm	Wrong	5 (16.1)	2 (6.5)	0.425++
	Correct	26 (83.9)	29 (93.5)	
Aseptic practices include:				
Disinfecting the skin always before injecting the vaccine	Wrong	6 (19.4)	16 (51.6)	0.008+
	Correct	25 (80.6)	15 (48.4)	
Disinfecting hands before the vaccination	Wrong	0 (0)	0 (0)	-
	Correct	31 (100)	31 (100)	

Disinfecting hands after the vaccination	Wrong	2 (6.5)	4 (12.9)	0.671++
	Correct	29 (93.5)	27 (87.1)	
Managing an anaphylactic reaction includes:				
A vaccinated person should be monitored at least for 15 minutes after the vaccination in case of an anaphylactic reaction	Wrong	3 (9.7)	0 (0)	0.238++
	Correct	28 (90.3)	31 (100)	
Adrenalin is injected deep in the muscle	Wrong	4 (12.9)	2 (6.5)	0.671++
	Correct	27 (87.1)	29 (93.5)	
The strength of intramuscular adrenalin is 1:10 000	Wrong	14 (45.2)	13 (41.9)	0.798+
	Correct	17 (54.8)	18 (58.1)	
A client's age determines the dose of adrenalin	Wrong	13 (41.9)	11 (35.5)	0.602+
	Correct	18 (58.1)	20 (64.5)	
The body weigh determines the dose of adrenalin	Wrong	8 (25.8)	4 (12.9)	0.199+
	Correct	23 (74.2)	27 (87.1)	
Adrenalin dosage can be given to an individual 3-4 times every 5 minutes	Wrong	19 (61.3)	13 (41.9)	0.127+
	Correct	12 (38.7)	18 (58.1)	
A vaccinated person having an anaphylactic reaction must be referred to a hospital	Wrong	2 (6.5)	2 (6.5)	>0.999++
	Correct	29 (93.5)	29 (93.5)	
Travelers' vaccination:				
Yellow fever vaccination is mandatory for travelers travelling to India	Wrong	14 (45.2)	11 (35.5)	0.437+
	Correct	17 (54.8)	20 (64.5)	
A single dose of yellow fever vaccine provides lifelong protection	Wrong	8 (25.8)	6 (19.4)	0.544+
	Correct	23 (74.2)	25 (80.6)	
Pre-exposure rabies vaccination consists of three doses given on days: 0, 7 and 21 or 28.	Wrong	7 (22.6)	3 (9.7)	0.167+
	Correct	24 (77.4)	28 (90.3)	

Table 1. Participants' knowledge on vaccinationNote. +Pearson's chi-square test; ++Fisher's exact test

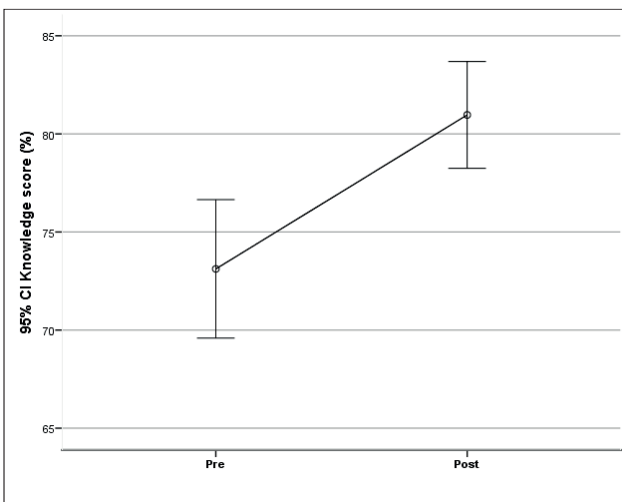


Figure 1. Participants' knowledge score

of correct answers were similar in both measurements, $p > .05$. However, the percentages of answering correctly the questions “Rotavirus vaccine is given against diarrhea of babies” and “Disinfecting the skin always before injecting the vaccine” were significantly greater in the post measurement.

Participants' knowledge score could range from 0% to 100%, with greater score indicate greater knowledge. In the pre- measurement mean knowledge score was 73.1% (SD=9.6%) and in the post measurement it was significantly greater and equal to 81% (SD=7.4%), $p < 0.001$ (Figure 1).

Participants' attitudes towards vaccination are presented in Table 2, in both measurements. Vaccination was found to be difficult by 58.1% of the sample in the pre-measurement and difficult by 41.9% in the post measurement. In both measurements the majority of the sample totally agreed with the statement “It is important for adults to receive all recommended vaccines according to national guidelines” (74.2% in the pre-measurement and 83.9% in the post one). Also, 32.3% of the participants agreed in the pre-measurement with the statement “Vaccines are more important for children than adults” and 29% agreed in the post measurements. Moreover, 71% of the participants agreed in the pre-measurement with the statement “I think there should be a national electronic vaccine registry that keeps track of all the vaccines that I administered to individuals” and 77.4% in the post measurement. All participants agreed/ totally agreed with the statement “It is important to inform adults about the benefits and risks of vaccinations” in both measurements. Participants' attitudes towards vaccination were similar in both measurements ($p > .05$).

Students' feedback after their participation in the Intensive Course is presented in table 3.

The 80.6% of the participants totally agreed with the statement “I have had an active attitude and participation in the Intensive Course” while, their “overall satisfaction with the Intensive Course as a whole was” excellent or above average (90.3%). Furthermore, 87,1% answered yes to the question “Do you feel more confident about your vaccination competencies (knowledge and skills) after completing this Intensive Course”. The 90.3% of the students answered yes to the question “Do you think/feel the Intensive Course has benefitted your professional development?” and 93.5% said that they “would encourage other students to participate in the Intensive Course”.

5. DISCUSSION

In this study, we examined the knowledge, attitudes, and feedback of students who attended the EDUVAC Intensive Course. The results after the course showed a positive effect on students' knowledge and attitudes regarding vaccination competence. Additionally, students expressed satisfaction with their experience of the intensive course on vaccination.

The literature supports that e-learning is perceived to be effective in increasing students' knowledge, and it can be used alone or in combination with face-to-face teaching methods (19). According to de Jong et al. (20), blended learning, which combines online learning with

	Pre N (%)	Post N (%)	P
How do you find vaccinating?			
Difficult	18 (58.1)	13 (41.9)	0.204+
Easy	13 (41.9)	18 (58.1)	
Vaccinating is an important health promotion method ¹ , mean (SD)	8.7 (1.9)	8.3 (2.7)	0.479‡
My vaccination knowledge is up-to-date ¹ , mean (SD)	5.5 (2.4)	6.1 (2.4)	0.317‡
It is important for adults to receive all recommended vaccines according to national guidelines			
Totally disagree	0 (0)	0 (0)	0.335++
Disagree	0 (0)	0 (0)	
Neither agree nor disagree	0 (0)	1 (3.2)	
Agree	8 (25.8)	4 (12.9)	
Totally agree	23 (74.2)	26 (83.9)	
Vaccines are more important for children than adults			
Totally disagree	4 (12.9)	4 (12.9)	0.326++
Disagree	6 (19.4)	4 (12.9)	
Neither agree nor disagree	9 (29)	6 (19.4)	
Agree	10 (32.3)	9 (29)	
Totally agree	2 (6.5)	8 (25.8)	
Vaccines that are recommended for adults should be available free of charge			
Totally disagree	0 (0)	0 (0)	0.811++
Disagree	0 (0)	0 (0)	
Neither agree nor disagree	4 (12.9)	3 (10)	
Agree	8 (25.8)	10 (33.3)	
Totally agree	19 (61.3)	17 (56.7)	
I think there should be a national electronic vaccine registry that keeps track of all the vaccines that I administered to individuals			
Totally disagree	0 (0)	0 (0)	0.214++
Disagree	0 (0)	0 (0)	
Neither agree nor disagree	5 (16.1)	1 (3.2)	
Agree	4 (12.9)	6 (19.4)	
Totally agree	22 (71)	24 (77.4)	
It is important to inform adults about the benefits and risks of vaccinations			
Totally disagree	0 (0)	0 (0)	>0.999++
Disagree	0 (0)	0 (0)	
Neither agree nor disagree	0 (0)	0 (0)	
Agree	3 (9.7)	2 (6.5)	
Totally agree	28 (90.3)	29 (93.5)	
It is important to use persons encounters as an opportunity to ask about their vaccine status			
Totally disagree	0 (0)	0 (0)	0.396++
Disagree	0 (0)	0 (0)	
Neither agree nor disagree	5 (17.2)	2 (6.5)	
Agree	9 (31)	9 (29)	
Totally agree	15 (51.7)	20 (64.5)	

Table 2. Participants' attitudes towards vaccination 1 in a scale from 1 (totally disagree) to 5 (totally agree) +Pearson's chi-square test; ++Fisher's exact test; ‡Student's t-test

face-to-face teaching, is a useful learning method for future health professionals and this was reinforced in the EDUVAC Intensive Course. Previous studies have stated that traditional teaching methods are not always efficient (3, 21). The EDUVAC Intensive Course was designed using non-traditional learning methods to motivate students to be active. Critical thinking and collaborative learning were promoted to make learning more effective. As stated by Brisolara et al. (14), collaboration in small multicultural groups and teamwork are elements that

encourage students' practical skills.

The results showed that students had very good knowledge on most of the vaccination-related questions after completing the EDUVAC Intensive Course. In a recent study by Bushell et al. (22), a vaccination training program was developed for pharmacists at the bachelor's and master's levels using pedagogical approaches to promote understanding and skill competency. The project consisted of asynchronous learning and an intensive four-day workshop for vaccination training. The authors

concluded that the vaccination training program increased students' knowledge with no significant difference between bachelor's and master's students. In a study by Wiley et al. (2019), (21) first-year medical students who followed a one-week education program using the team-based learning method for HPV performed better in knowledge about HPV and HPV-related cancers and reported higher satisfaction with their education than graduating students and those from the same year.

The study shows that more attention needs to be paid in education to aseptic practice, travelers' vaccination, managing an anaphylactic reaction and some contraindications. The most challenging question seems to be "Disinfecting the skin always before injecting the vaccine". More than half of the students (51.6 %) knew the correct answer. According to the newest research by Dulong et al. (23), skin disinfection is not needed before the vaccination if the skin is visibly clean. The main thing is to ensure that the skin is dry before vaccination, if disinfection of the skin is implemented.

Half of the students had poor knowledge about the statement "Taking antibiotics" as a common contraindication for vaccination. However, according to the CDC (24) and the Government of the UK (25), the use of antibiotics is not a contraindication to defer vaccination.

Students' positive attitudes towards vaccination were increased after they attended the Intensive Course, which is critical if we consider that these students are the future health professionals (26).

The students perceived their overall satisfaction with the EDUVAC Intensive Course as excellent or above excellent. During the Intensive Course week, students had the opportunity to interact, study, and communicate in small groups with students from different countries. Their satisfaction aligns with a meta-analysis study that highlighted how learning methods and activities in small groups are more effective than traditional lectures for health science students (27).

It is worth noting that the students felt very confident about their vaccination competence (knowledge and skills) after the EDUVAC Intensive Course, which is consistent with another study's findings (3). Additionally, the students felt that the Intensive Course had benefited their professional development and would encourage other students to participate in it.

Limitations of the study

This study has some limitations regarding the questionnaire and sample. The data were collected by a questionnaire which was developed for this study and used for the first time. However, a multidisciplinary research team developed it and the items were based on the literature review.

The number of the participants in the Intensive Course is small and this might have an influence in the results so that they cannot be generalized.

	N	%	
I feel more confident now in the use of the English language, in a professional context of vaccination	Not achieved	2	6,5
	Fully achieved	18	58,1
	Largely achieved	3	9,7
	Very limited achieved	8	25,8
I have had an active attitude and participation in the intensive course	Agree	5	16,1
	Disagree	1	3,2
	Totally agree	25	80,6
Overall satisfaction with the Intensive Course as a whole was	Above Average	12	38,7
	Below Average	2	6,5
	Excellent	16	51,6
	Poor	1	3,2
Do you feel more confident about your vaccination competencies (knowledge and skills) after completing this Intensive Course?	No	4	12,9
	Yes	27	87,1
Do you think/feel the Intensive Course has benefited your professional development?	No	3	9,7
	Yes	28	90,3
Would you encourage other students to participate in the Intensive Course?	No	2	6,5
	Yes	29	93,5

Table 3. Participants' feedback after the Intensive Course

6. CONCLUSION

The EDUVAC Intensive Course is a five-day program designed to improve vaccination competence through various learning activities. According to research, the course was successful in achieving its intended learning outcomes. Students who completed the course demonstrated enhanced knowledge and more positive attitudes towards vaccination. Therefore, it is recommended that innovative and engaging educational methods, such as intensive courses, be incorporated into the health sciences curricula of higher education institutions.

The syllabus of the Intensive Course is available for open access at the following link: <http://www.eduvac.eu/intensive-course/>

Further research is needed to evaluate vaccination competences across different educational approaches (face-to-face, online, or blended courses) among a larger student population.

- **Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.
- **Authors' contribution:** Conceptualization and design: all authors, data acquisition: all authors, analysis and data interpretation: all authors, writing -original draft preparation: Dimitra Perifanou, Eleni Konstantinou, Anne Nikula, Sari Nyman, review and editing: all authors, funding acquisition: Evanthia Sakellari, Anne Nicula, Kristina Grendova, Paola Galbani Estragues, Cinzia Gradellini, supervision: Evanthia Sakellari.
- **All authors have read and agreed to the published version of the manuscript. authors were involved in preparation this article. Final proofreading was made by the first author.**
- **Conflict of interest:** The authors declare that they have no conflict of interest.

- **Funding:** This study was carried out as part of the Erasmus+ EDU-VAC project that received funding from the European Commission (2018-1-EL01-KA203-047691).

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