Article

Distance Education for Supporting "Day One Competences" in Meat Inspection: An E-Learning Platform for the Compulsory Practical Training of Veterinarians

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Abstract: Obtaining a Veterinary Surgeon degree relies on the acquisition of "Day One Competences" (DOCs), among which professional skills related to meat inspection are acquired during visits to abattoirs. In 2020, lockdown measures due to COVID-19 pandemic limited on-site practical training. The present study describes the creation of an e-learning course on bovine and swine slaughtering as an alternative tool for compulsory DOCs achievement within the course "Inspection and control of food of animal origin" during the fourth year of the Veterinary Medicine degree program (Department of Veterinary Sciences of the University of Pisa). Academics and external professionals took part on the planning and development of the learning material. Video pills, consisting of shooting of the slaughtering coupled with trainers' descriptive explanations, were produced. The perceived effectiveness of course contents, trainers' communication skills and technical quality were assessed with a questionnaire. The developed e-learning platform consisted of four main sections (Introduction, Swine slaughtering, Bovine slaughtering and Additional topics), integrated by multiple-choice questions for the student's self-assessment. According to students' assessment, the platform, of high technical quality, effectively condensed contents on meat inspection. Despite the unique and irreplaceable role of practical training in the achievement of the professional skills included in the veterinary curriculum, the e-learning course may concur in providing DOCs and is in line with the adoption of a modern teaching model where e-learning resources engage students in deeper learning approaches.

Keywords: veterinary education; food inspection; slaughtering; official control; e-learning course

1. Introduction

The Treaty establishing the European Community [1] (Art. 47), and the Treaty of the Functioning of the European Union [2] (Art. 49), allow the free circulation of workers within the European Union (EU). Such treaties also regulate the right of establishment that arises when a professionally qualified person intends to pursue a profession in a Member State different from the one where the qualification was obtained. In this light, the Directive 2005/36/EC [3] harmonized the educational systems for the mutual recognition of a limited number of professionals, among which veterinarian is included.

In 1988, the European Association of Establishments for Veterinary Education (EAEVE) was founded to promote veterinary education and reinforce cooperation between establishments. The association was also appointed to manage the European System of Evaluation of Veterinary Training (ESEVT) by the Commission of the European Community (https://www.eaeve.org/esevt/history-of-the-esevt.html accessed on 8 October 2021). Finally, after the enactment of the aforesaid Directive [3], EAEVE acquired the role of

official accreditation authority in charge of assessing and developing the quality and harmonization of veterinary medical establishments and teaching activities.

Veterinarian is a professional degree subdued, at the European level, to a harmonized education and training program aimed at the acquisition of specific knowledge and competences in animal health and welfare, in public health, and in the safety, hygiene and traceability of food of animal origin intended for human consumption [3]. Thus, the curriculum to access the veterinary profession includes the acquisition of procedural and operational skills that are exclusively acquired through practical activities and training periods in the various areas of interest detailed above. To meet the requirements of the overall basic EU veterinary competences, specific "Day One Competences" (DOCs), detailed in the ESEVT Standard Operating Procedures (SOPs), were identified by the European Committee on Veterinary Education (ECOVE) and approved by the European Coordination Committee on Veterinary Training (ECCVT). The DOCs represent the minimum standard knowledge required for newly graduated veterinarians (https://www.eaeve.org/esevt/sop.html accessed on 8 October 2021). DOCs regarding the hygiene and technology of the production, manufacture and commercialization of foodstuffs of animal origin intended for human consumption and their related laws are also defined. Three specific SOPs (1.33, 1.34, 1.35) are addressed to the acquisition of skills on *ante-* and *post-mortem* inspection of food-producing animals. A specific attention is given to the preservation of animal welfare, and to the evaluation of animal health and meat suitability for human consumption [4]. Thus, practical experience in a slaughterhouse is crucial.

The Department of Veterinary Sciences of the University of Pisa adheres to the abovementioned EAEVE's SOPs. Learning activities relevant to DOCs on meat production are delivered within the course "Inspection and control of food of animal origin" during the fourth year of the Veterinary Medicine degree program. The course provides theoretical knowledge addressing the EU legislation on food safety and hygiene and official controls, propaedeutic to the practical activities conducted during basic practical training (BPT) and professional practical training (PPT). Due to the absence of an internal slaughterhouse, BPT relies on visits to external abattoirs (bovine, swine, and poultry). During visits, students observe the workflow required for a hygienic conversion of livestock into meat [5]. Students also assist to *ante-* and *post-mortem* inspection performed by Official Veterinarians (OVs) according to the current legislation [6–8]. In addition, Pisa University established an agreement with Local Health Authorities (LHAs) for the PPT. Therefore, undergraduate students spend additional time in premises operating in all the production chains (meat, fish, milk, egg production) where they are supervised, as one-to-one tutoring, by OVs. Active participation in practical activities relevant to the acquisition of the required DOCs is facilitated by the small number of students enrolled in the Veterinary Medicine Degree Course at Pisa University (only 55–65 students per year have been admitted in the last several years).

The spring semester of 2020 was significantly disrupted by the spread of COVID-19 and by the strict confinement measures to control the global pandemic [9]. Closures also affected universities, which had to build up a virtual teaching environment, where the internet was the main facilitator [10]. Subsequently, distance learning became the only applicable teaching resource to maintain the social distancing and assumed the form of an emergency remote education [11].

The Department of Veterinary Sciences of the University of Pisa also adapted its delivery to effectively cover the EAEVE DOCs in a remote delivery format. The integration of traditional teaching methods with Information and Communication Technologies (ICT), Multimedia and Digital training by the creation of e-learning courses [12–14], responds to the objectives of the veterinary education. Departmental structures such as surgical and necropsy rooms were therefore equipped with electronic devices for providing BPT. This approach was also used for laboratory practical activities within the course of "Inspection and control of food of animal origin". Moreover, given the impossibility to conduct internship periods at LHAs, an alternative distance training path was activated to substitute

PPT. It was mainly based on problem-solving of case studies dealing with risk management during food production. However, the main issue was the difficulty in providing, in a virtual format, a training experience similar to that acquired through external visits to slaughterhouses on-site. Therefore, in this study, the development of an e-learning course to replace face-to-face compulsory practices in meat inspection for DOCs acquisitions and veterinary program professional skills related to bovine and swine slaughtering is presented, together with the results of its evaluation by students.

2. Materials and Methods

2.1. E-Learning Course Development

The e-learning course was intended for the BPT of students attending the "Inspection and control of food of animal origin" course and for the online PPT of previous years' students. The e-learning course was entitled "Bovine and swine slaughtering: hygiene, animal welfare and management of by-products of animal origin" and was structured in four sections: Introduction, Swine slaughtering, Bovine slaughtering and Additional topics.

Academics and external professionals (trainers) took part in the planning and development of the course. Academics were the teachers responsible of the course of "Inspection and control of food of animal origin" (University trainer 1, 2, 3) while the external professional belongs to the LHA Toscana Centro. The latter was involved to enrich the training course by including the practical perspective of OVs within the slaughterhouse. The e-learning platform creation, including filming and editing, were produced in collaboration with a communication and marketing agency specialized in the creation of web products and in the development of user experience for teaching (https://declar.it/ accessed on 12 November 2021).

Firstly, the collaboration of the slaughterhouse's owner (Italpork srl.) and the filming consent were obtained. Then, a flowchart of all stages of bovine and swine slaughtering procedures was prepared to define the shooting plan. In particular, four main sections were defined including: a general introduction on the OV duties, responsibilities and control activities at the slaughterhouse, bovine slaughtering line, swine slaughtering line, additional topics related to the handling and management of the food by-products resulting from the slaughtering procedures. In addition, all the European and national laws referring to the hygiene of the slaughtering process, animal welfare and food by-products management were collected. The video technicians followed the shooting plan along the two production lines by filming both full film and close-up shootings. In parallel, the trainers produced specific descriptive videos to be combined with those of the production lines. At the end of each video, multiple-choice questions for the student's self-assessment were produced. The final videos and related questions, together with legislative references, were made available to students through a dedicated e-learning platform (https://veterinaria.declar.dev/ accessed on 12 November 2021). Personal credentials and passwords were provided to the students, while trainers were provided with administrator profiles for monitoring the progresses.

2.2. Assessment of the E-Learning Course Effectiveness

Two different questionnaires consisting of 5 point likert-scale (from 1 = poor to 5 = excellent) questions, organized in three sections and two open-ended comments, were distributed to two different student groups to assess the e-learning course's effectiveness. In particular, the first questionnaire (Q1) (see details reported in Table 1) was addressed to the students who followed the e-learning course as a substitute for the BPT (group one).

Table 1. Details on the questionnaires administered to students for the assessment of the e-learning course effectiveness.

Questionnaire Sections	Q1—Administered to Students Involved in Basic Practical Training (BPT) (Group One)	Q2—Administered to Students Involved in Professional Practical Training (PPT) (Group Two)
A—Usefulness and efficacy of the contents	A1—Relevance of the covered topics covered with respect to the topics those of the study program A2—Effectiveness/usefulness of the course for the preparation of the exam A3—Effectiveness/usefulness of self-assessment test for verifying the information provided in the course A4—Acquisition of DOCs related to animal welfare: A4.1—during the slaughter phases A4.2—*ante-mortem* visit A4.3—*post-mortem* visit A4.4—management of by-products	A1—Relevance of the covered topics with respect to the objectives of the PPT A2—Effectiveness/usefulness of the path as an alternative tool to the foreseen practical activity A3—As Q1 A4—Revision of DOCs related to animal welfare: A4.1—during the slaughter phases A4.2—*ante-mortem* visit A4.3—*post-mortem* visit A4.4—management of by-products
B—trainers evaluation	B1—Clarity of course trainers in the introduction and description of the specific topics (individual evaluation on each trainer): B1.1—university trainer 1 B1.2—university trainer 2 B1.3—external trainer B1.4—university trainer 3	B1—As Q1
C—e-learning platform evaluation	C1—e-platform quality: C1.1—video C1.2—audio C1.3—supplementary documents	C1—As Q1

The second questionnaire (Q2) (see details reported in Table 1), slightly modified, was addressed to the students who followed the e-learning course as a part of their PPT (group two; N = 57). The two open comments (OC), identical on both questionnaires, were formulated to collect the overall course perceived strengths (OC1) and weaknesses with related improvement suggestions (OC2). A total of 63 students, consisting of N = 23 students involved in BPT, corresponding to 48% of the group one, and N = 40 (70%) students who completed the online PPT (group two), took part in the survey.

The survey was conducted through Google forms software by emailing the students the access link. A short presentation letter specifying the aims of the survey and the anonymity of the responses was also sent. Finally, also spontaneous feedbacks received by students were taken into consideration.

3. Results and Discussion

3.1. E-Learning Course Development

In higher education, didactical content is increasingly provided through web-based platforms managed by each institution (e.g., Moodle, Schoology, Edmodo). These include assessment and student tracking features, and can be accessed both on and off-campus, 24 h a day [15,16]. Among these, Moodle is the most used by Italian Universities [17] and it is also adopted by the University of Pisa. Therefore, the e-learning course set up in this study was initially developed for the Moodle interface of the Veterinary Sciences Department (https://elearning.vet.unipi.it/ accessed on 12 November 2021). However, the existing platform did not support the size of the multimedia files used, and the creation of a new platform (https://veterinaria.declar.dev/ accessed on 12 November 2021) was required.

The structure of the developed e-learning course (four main sections and related subsections) is detailed in Figure 1.

Figure 1. Final structure of the e-learning course homepage. The length of each video is shown in brackets.

Students could attend all the OV activities, from the supervision of the animal welfare at the arrival to slaughterhouse, to the post-mortem inspection. In particular, the SOPs related to ante-mortem inspection, post-mortem inspection, and veterinary official control were addressed. The course was intended for learners that already followed the theoretical classes on the topic, and thus held basic knowledge of slaughtering procedures. Each section contained several specific videos composed of the shooting made along the production line and of the trainers' contributions. Videos were complemented with legislative references and multiple-choice questions. Each video offered the possibility to observe, in detail, the establishment facilities and directly follow all aspects related to the hygiene and management of the slaughtering process. A pivotal aspect in the video editing, in which Declar group assumed a preeminent role, was the short video's length (from one minute and 30 s to about eight minutes). This format was chosen to maintain students' attention and maximize the videos' communicative effectiveness. In fact, a sudden drop of the learner or video user attention is described after nine to ten minutes [18,19]). For this reason, the e-learning course was based on a micro-learning approach, on the model described by Redondo and colleagues [19], in which DOCs were provided by short videos with specific topics, coupled with in-depth documents. This enables the students to experience an autonomous training without the need to seek further information.

The digitization of training experiences as a valid alternative to on-site visits was recently highlighted by ECCVT in a survey on the impact of Digital Training instruments and Multimedia learning in veterinary training. Furthermore, e-learning activities were presented as potentially time and cost-saving tools for students to reach establishments located in rural contexts. Contrariwise, two significant weaknesses identified were the difficulty to improve soft skills via distance learning, and the insufficient acquisition of DOCs [20]. In fact, the shift to online practical training may affect the acquisition of

technical skills [21,22]. Currently, virtual experiences presenting activities conducted within a slaughterhouse are lacking, and generally presented as virtual slaughterhouse simulators [23].

Another strength of the e-learning course is the promotion of an active learning process. In this respect, the veterinary curriculum has undergone a profound renewal over the years. A shift from a passive teacher-centered and inductive learning curriculum to students' proactive roles in the learning process [24] has been promoted. Accordingly, EAEVE's latest reform of teaching procedural standards [20] recommended this switch through introducing learning tools to improve students' ability in a problem-solving, rather than in an encyclopedic, approach [25,26]. In traditional classroom settings, teachers and students directly interact, so students' assessments can be more easily monitored. However, in online learning, different approaches are necessary for the evaluation of the achieved skills and of the ability to transfer pre-established competences [27]. Assessment strategies include a variety of clearly explained assignments providing meaningful and timely feedback to students regarding the quality of their work. More specifically, in online self-learning activities, such as e-learning platform models, the resolution of case studies and self-assessment tests represent effective strategies to lead the students to evaluate their learning abilities at their own pace and to quickly verify if specific learning outcomes are being met [28]. Thus, self-assessment questionnaires were included in the study and unlimited access was guaranteed to each course section and to each self-learning questionnaire. In parallel, the trainers were able to monitor the progress of each student in real-time by accessing the participants register as administrators. The administrator register offered cumulative and individual data on the students access frequency and the average scores achieved on the various sections.

By accessing the administrator register, and in particular, the register summary chart, including all the students participating to the e-course, only the sections in which the video had been completely viewed and the self-assessment test had been performed at least once will appear flagged (completed) in the students' e-learning course career. In addition, by scanning the individual registers, the administrator has the possibility to specifically check and monitor the number of accesses and the time spent by each student within the section for each study section. This latest parameter might represent a reliable indirect index to evaluate the single sections' efficacy and highlight issues in the communicative efficiency of the contents.

3.2. Assessing of the E-Learning Course Effectiveness

Several researches conducted on the effectiveness of online against traditional learning gave conflicting results. Some highlighted no substantial difference [29,30], others noted a significantly positive impact [31–33]) and others underlined the need to evaluate the limits of the online mode when compared to face-to-face teaching by assessing the training quality, effectiveness and compliance with policy and ethical/deontological regulations about the use of digital technologies [20]. Therefore, the use of these tools for the acquisition of DOCs must always be verified to guarantee the substantial equality with the replaced activities and the effective achievement of the expected objectives [34]. This evaluation assumes decisive importance following the reshaping of the programs and practical activities suddenly imposed by the COVID-19 emergency [22]). Therefore, we decided to assess the e-learning course's effectiveness by conducting a survey as described in Section 2.2. As mentioned, the e-learning platform, initially developed for Veterinary Medicine degree students attending the course of Inspection and control of food of animal origin and involved in BPT, was also extended to the students involved in the online PPT.

The two student groups were questioned with two substantially different objectives regarding the assessment of the e-learning platform contents (A) (Table 1). Therefore, the results obtained by the two student groups were elaborated separately (see Section 3.2.1).
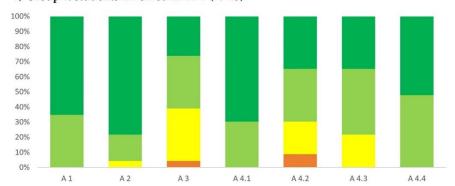
On the contrary, the same questions, grouped on the evaluation of the communicative effectiveness of the trainers (questionnaire section B) and the technical and informative

quality of the e-learning course (questionnaire section C), were administered to both groups, and the results were analyzed and discussed together (see Section 3.2.2).
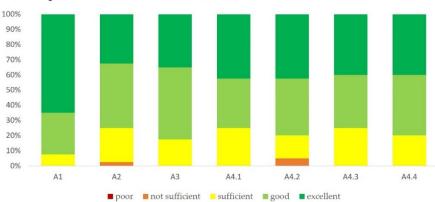
3.2.1. Section A: Usefulness and Efficacy of the Contents

Students considered the contents of the e-learning course as relevant for the acquisition of DOCs and specific skills. In details, students belonging to group one considered that by studying and completing the course they had successfully acquired the DOCs relating to animal welfare (good in 30.4% and excellent scores in 69.6% of the questionnaires) and management of by-products (good in 47.8% and excellent for 52.2% of the students) and a sufficient (21.7%), good (43.5%) to excellent (34.8%) efficacy in the acquisition of DOCs relating to *post-mortem* carcasses inspection (Figure 2).

Figure 2. (A) Students' evaluation of the usefulness and efficacy of the e-learning contents on a 5-points scale. (A1) Relevance of the topics to the study program; (A2) Effectiveness/usefulness of the course for the preparation of the exam; (A3) Effectiveness/usefulness of self-assessment test for verifying the information provided in the e-learning course; (A4) Acquisition of DOCs relating to animal welfare during the slaughter phases. A detailed description of the content of each question is presented in Table 1.

On the contrary, the e-learning subsection on *ante-mortem* inspection in both bovine and swine slaughtering sections were found less effective, with a non-sufficient score highlighted in 8.7% of the questionnaires. In fact, *ante-mortem* visit includes several activities consisting of the verification of the food chain information, the identification of the animals and, finally, a physical examination of the animals, all under the direct responsibility of the official veterinarian. A plausible explanation of the unsatisfactory results might be attributed to the difficulty in guaranteeing the complete overview of all the *ante-mortem*

veterinary activities in short explanatory videos. Therefore, the subsections will be revised for improving the contents and the way of presenting the activities, also considering further modifications of the veterinary activities provided by the new Regulations on official controls currently in force [6–8]. In fact, according to the most recent legislation *ante-mortem* inspection could also be performed out of the slaughterhouse at the holding of provenance, in all the species and under certain criteria. Furthermore, the introduction of official auxiliary in support of the official veterinarian for the routine tasks within *ante-mortem* inspection might determine a revision of the related DOC objectives.

The students attending online PPT evaluated all the contents of the e-learning course more homogeneously, assigning scores from sufficient (15 to 25%) to excellent (40 to 42.5%) for all the sections addressed (Figure 2). However, it should be noted that this group of students had already acquired DOCs following face-to-face visits in slaughtering plants during the previous academic year before the advent of the COVID-19 emergency.

Specific comments collected from the open-ended question, the results of which are discussed in the following paragraphs (Section 3.2.3), were directed to the *post-mortem* subsections in both bovine and swine slaughtering sections. A video integration was requested, focused on practical cases on the management of lesions found on the carcasses by the official veterinarian. In this regard, the greater propensity of students to follow an interactive video rather than a self-learning based on a documentary study is therefore confirmed [19]. The creation of video pills, with in-depth case studies, however, goes beyond the micro-learning purpose. In fact, these parts, already included in the course, are presented in the form of presentations and supplementary documents. With a view to improving the contents, the integration of supplementary materials could be envisaged through the preparation of in-depth focuses containing case studies accompanied by specific photographic contributions. This emphasizes the need to provide an interdisciplinary approach between the various courses related to and preparatory to inspection (pathology, parasitology, toxicology).

3.2.2. Sections B and C: Trainers and E-Learning Platform Evaluation

Overall, the expertise and communicative effectiveness of the trainers, as well as the technical quality of the e-learning path, were evaluated positively by the students (Figure 3).
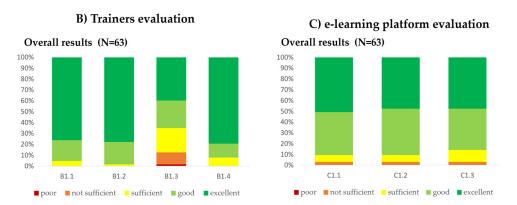

Figure 3. Evaluation of the communicative effectiveness of the trainers (**B**) and the technical and informative quality of the e-learning course (**C**). B1.1, B1.2, B1.4 University teachers responsible for the Food Inspection course, the B1.3 external trainer, belonging to food safety section within the Local Health Authority; C1.1 quality of the videos, C1.2 quality of the audio, C1.3 quality and usefulness of the supplementary documents provided. Details of each question are also reported in Table 1.

As for the trainers, the difference in score highlighted in the evaluation of the official veterinarian when compared to the course teachers was evidently attributed to two factors. First, the greater familiarity of the students with the communicative approach of the course teachers when compared to the external professional and, second, the use by the teachers

of a more didactic approach in the descriptive part of the videos. It should be emphasized that in the teacher assessment, as underlined by Pavlina and colleagues [35], students combine three perceived characteristics: teacher expertise, teaching competence and personal qualities. Thus, without prejudice to the expertise recognized to the professional, also in accordance with the spontaneous feedbacks (see Section 3.2.3), the attribution of less positive scores to the official veterinarian was plausibly due to the unfamiliarity with the communication register used by the professional. The inclusion, in the various courses of study, of specific interventions held by external professionals, would surely favors students' contact with the professional environment and working realities outside of the academic context.

3.2.3. OC1 and OC2: The E-Learning Strengths and Weaknesses with Related Improvement Suggestions

Major strengths highlighted were: (i) the possibility to stop and review topics at each one's learning pace which allowed one to appreciate details and focus on single aspects of the production line with respect to the on-site visit; (ii) the usefulness of the platform in summarizing contents related to animal welfare, meat inspection and by-products control and in reviewing them before the course exam; (iii) the usefulness of the platform to fix and retrace the concepts studied during the course, therefore perceived as a didactic aid during the preparation of the exam. Numerous students underlined that the course is particularly effective as a review tool by virtue of the shortness of the videos and the alternation of production line shootings with descriptive frames. This allowed the students to fix technical topics and skills in a dynamic process that integrates with frontal teaching and individual study, as already pointed out by Redondo and colleagues [19].

Moreover, the intervention of the LHA official veterinarian as one of the course trainers, despite the observed lesser communicative effectiveness from a purely didactic point of view, increased the focus on the practical aspects, including professional ethics. Interestingly, students also pointed out that videos, instead of the real experience, granted a less shocking approach to the slaughtering process, which was usually quite emotionally touching for most of them. This comment is partially in contrast with the studies of Seguino and colleagues [23] and Hulsbergen and colleagues [36], from which a substantial reduction of emotional stress had not emerged.

Suggestions for improving the e-learning course were related to few specific aspects on the *ante-mortem* subsection, already discussed above, and to a clearer indication of the correct answer in the self-study tests at the end of each subsection. In fact, failure to highlight the correct answer does not allow the student to fully verify the knowledge acquired. In order to improve this aspect, the authors intend to integrate the self-assessment test with a short discussion to be visualized before proceeding to the next question in association with the correct answer, including specific references to the legislation or procedures of interest described in the subsection.

Specific comments have been received regarding the atlas of anatomopathological lesions. Although considered extremely useful, it was suggested to integrate it with detailed references to the etiopathogenesis of the lesions and to specific insights into the management procedures of non-conformities found during the *post-mortem* inspection, underlying the need of deepening and interdisciplinary integration of professionalism and skills.

Overall, the comments also revealed a careful reading and the desire to deepen the level of skills in a process of stratification of learning stimulated by the micro-learning path developed as described by Redondo and colleagues [19].

Finally, a few issues were referred to difficulties in viewing the videos (slow charging), depending on the hardware, software and internet connection speed used. This last consideration highlights the need for investing in usable tools for distance education.

4. Conclusions

Considering the conditions imposed by the pandemic, the experience represented a valuable opportunity to enlarge the didactical offer for students. In fact, it provided an additional adaptable and flexible tool complying to EAEVE DOCs requirements in meat safety and animal welfare during slaughtering procedures. The outcomes of the analysis on the e-learning platform perfectly fit into a scenario, already foreseen by numerous authors, of the adoption of a modern veterinary curriculum, a hybrid training approach in which in-person learning or training activities can be modulated, supported and integrated by e-learning resources to engage students and encourage them to adopt deeper learning approaches [25,26,37].

When looking at the overall student perception on the e-learning course, relevant strengths were highlighted, especially related to: (i) the course accessibility and the possibility to stop and review topics at each one's learning pace, (ii) the course efficacy in summarizing contents related to meat inspection, offering a valid aid in final exam preparation, (iii) an increased focus on the professional role of the official veterinarian, (iv) a less shocking first approach to the slaughtering process with respect to an on-site visit. The weaknesses related to some of the contents and the communicative effectiveness of certain topics will constitute elements of reflection for a further strengthening and editing of the platform.

Particular attention will be paid to the review of the self-assessment tests with the inclusion of brief explanatory comments and links to the supplementary teaching material accompanying the individual subsections. To conclude, in the authors' opinion, following the return to face-to-face activities, the platform might still represent a valuable tool for the preliminary preparation of the students to BPT acquired during on-site slaughterhouse visits which, in any case, represent irreplaceable practices in veterinary training.

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