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## Improving preparation for pharmacy entry-to-practice OSCE using a participatory action research

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### ABSTRACT

**Introduction:** In Switzerland, becoming a licensed pharmacist requires succeeding a federal entry-to-practice exam that includes an Objective Structured Clinical Examination (OSCE). Candidates from the University of Geneva (UNIGE) exhibited a higher failure rate in this part of the examination in comparison to candidates from other Swiss institutions. The institution made a specific set of pedagogical changes to a 3-week pharmacy services course that is run during their Master's second year to prepare them for their entry-to-practice OSCE. One key change was a switch from a summative in-classroom OSCE to an on-line formative OSCE.

**Methods:** New teaching activities were introduced between 2019–2020 and 2021–2022 academic years to help students strengthen their patient-facing skills and prepare for the federal OSCE. These online activities consisted in formative OSCEs supplemented with group and individual debriefings and in 18 h clinical case simulations reproducing OSCE requirements and assessed with standardized evaluation grids. Failure rates before and after the introduction of these activities were compared, and their perceived usefulness by UNIGE candidates was collected through a questionnaire survey.

**Results:** The UNIGE failure rate decreased from 6.8% in 2018/2019 to 3.3% in 2022 following the implementation of the new teaching activities. The difference in failure rates between UNIGE and the other institutions became less pronounced in 2022 compared to 2018/2019. The redesigned Master's course was highlighted as useful for preparation, with all new activities perceived as beneficial. Questionnaire responses brought attention to challenges faced by UNIGE candidates, including stress management, insufficient information or practical training, and experiences related to quarantine. These insights informed further development of teaching methods.

**Abbreviations:** CTLS, Center for Teaching and Learning Support; FPE, Federal Pharmacy Exam; OSCE, Objective structured clinical examination; UNIGE, University of Geneva.

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*Discussion:* Although the results do not establish a direct link between participation in new teaching activities and increased performance, they suggest resolving the initial issue. Our findings relate to pedagogical concepts such as constructive alignment, formative assessment and examination anxiety, and generally support the benefits of online format.

*Conclusion:* This study used a participatory action research based on mixed methods to address a challenge in pharmacy education. Online teaching activities including formative OSCEs, case simulations and debriefings were implemented. Improved performance in entry-to-practice OSCE was subsequently observed. The results highlight the potential of formative, active, and constructively aligned online activities, such as role-playing and case simulation, to enhance patient-facing skills and improve outcomes in summative assessments of these skills.

## Introduction

Around the world, health profession curricula, including pharmacy programs, implement teaching activities to support students' preparedness for summative or entry-to-practice objective structured clinical examinations (OSCEs).<sup>1-4</sup> Case-based learning and role playing are recognized strategies in competency-based education in pharmacy.<sup>5</sup> The utility of formative OSCEs to prepare for summative OSCEs has been explored<sup>2,6-11</sup> but evidence on their impact remains conflicting.<sup>11</sup> Despite perceived usefulness by learners<sup>2,6,10</sup> and increased performance in some cases,<sup>2,6,7,10</sup> formative OSCEs don't always improve performance or failure rates at summative examinations.<sup>6,8,9</sup> Formative and summative OSCEs can be held virtually.<sup>12-16</sup> Studies have shown the potential of virtual formative OSCEs to prepare for summative OSCEs<sup>14,15</sup> but literature remains limited regarding their impact on performance in summative OSCEs<sup>14</sup>.

In Switzerland, obtaining a pharmacist license requires completing a three-year Bachelor's degree followed by a two-year Master's program, which includes a 20 to 25-week internship in a community pharmacy and a 20-week research practice leading to a Master's thesis. Pharmacy Master's programs are offered by universities in Basel, Bern (since 2022), Geneva, and Zürich. The University of Geneva (UNIGE) is the sole institution providing a Master's in Pharmacy in French. Most students complete their Master's at the same university as their Bachelor's.

After academic studies, graduates typically take the Federal Pharmacy Exam (FPE), a prerequisite for community pharmacy practice. The FPE comprises a multiple-choice questionnaire, a practical exam on compounding pharmacy, and an OSCE. OSCEs, common in medical and pharmacy education,<sup>17</sup> assess patient-facing skills of future Swiss community pharmacists over two days with 10 clinical vignettes<sup>18</sup> (in-person format was maintained during COVID-19-related restrictions).

The Federal Office of Public Health oversees the FPE, collaborating with universities to organize the exam to be held annually in September.<sup>18</sup> OSCE topics are collectively chosen, and each institution contributes an equal number of clinical vignettes with associated evaluation grids (rubrics). These materials undergo multiple rounds of review and correction, before being tested in the spring at each site. Ten vignettes are then selected and translated into French and German.

To preserve vignette confidentiality, candidates in universities with a large number of candidates (such as Basel and UNIGE) are quarantined before and after the OSCE. Between each vignette, candidates wait in isolation, accompanied by invigilators, and are not allowed to communicate with others. To pass a vignette, candidates must achieve at least 60% of the average of the top scores (determined by pooling the best results from each institution for each vignette, ranging from 3 to 6 top scores per institution per vignette, based on the number of candidates from each institution). To pass the OSCE overall, candidates must pass at least 7 vignettes.

At UNIGE, FPE OSCE preparation predominantly occurs in the three-week "pharmacy services" course during the second year of the Master's program (in June, three months before the FPE). In 2018 and 2019, UNIGE candidates had a higher OSCE failure rate compared to candidates from other institutions, leading to an inquiry of how to improve the preparedness level of UNIGE candidates.

Rooted in reflective practice theory, action research is an inquiry process conducted by educators in their setting aimed at addressing educational issues and improving student learning.<sup>19,20</sup> The participatory approach combining insider and outsider perspectives and mixed methods are both acknowledged for enhancing action research.<sup>21</sup> This combination of strategies led to the implementation of a participatory action research during the 2019–2020 academic year at UNIGE. A collaboration was established among faculty members teaching specific courses in the 2nd-year Master's "pharmacy services" course and 1st-year theoretical courses on pharmacy services and alumni who had undergone the OSCE between 2019 and 2022. The UNIGE Center for Teaching and Learning Support (CTLs) provided an external perspective.<sup>21</sup>

The paper's purposes are to present new online teaching activities focusing on strengthening patient-facing skills and preparing students for OSCE examination and to determine whether these activities, conducted and assessed according to OSCE requirements, have helped to reduce the failure rates of UNIGE candidates.

## Methods

### Study design

The research followed the mixed methods methodological framework for action research developed by Ivankova<sup>21</sup>, which is based on six consecutive phases as illustrated in Fig. 1. The mixed method approach was applied during the evaluation phase, aligning with

common practices in action research studies in higher education.<sup>21</sup> The collection of quantitative and qualitative data occurred concurrently and sets of data were analyzed separately. The results from quantitative and qualitative strands were combined and interpreted together to draw overall conclusions.<sup>21</sup> The CTLS was involved in all phases, except for planning and acting, which were carried out by faculty members in their capacity as academic community pharmacists with an insider perspective.

### Diagnosing phase

In the diagnosing phase (1), it was identified that in September 2018 and 2019, the 132 UNIGE candidates were less successful than the 245 candidates from other universities on the OSCE part of the federal exam. The teaching team aimed to appreciate the importance of this difference, investigate its cause, and address the situation. Hypotheses included potential challenges for UNIGE students with cases from other institutions, individual prior learning difficulties, and cultural differences shaping the interpretation of specific questions according to socio-cultural profiles.

### Reconnaissance phase

During the reconnaissance phase (2), descriptive statistics were conducted using Excel (2010) on the exam results of the 2018 and 2019. This aimed to establish UNIGE candidates' success rates and compare them to those of candidates from other institutions. A chi-square test and a Cramer's V test were performed using SPSS to assess the correlation between the failure rate and the institution where the diploma was obtained. Cramer's V test, tailored for nominal data, is a chi-square-based measure with values ranging from 0 to 1. A score of 0 suggests no association, while 1 implies a perfect association. In the absence of a threshold for interpreting the effect size

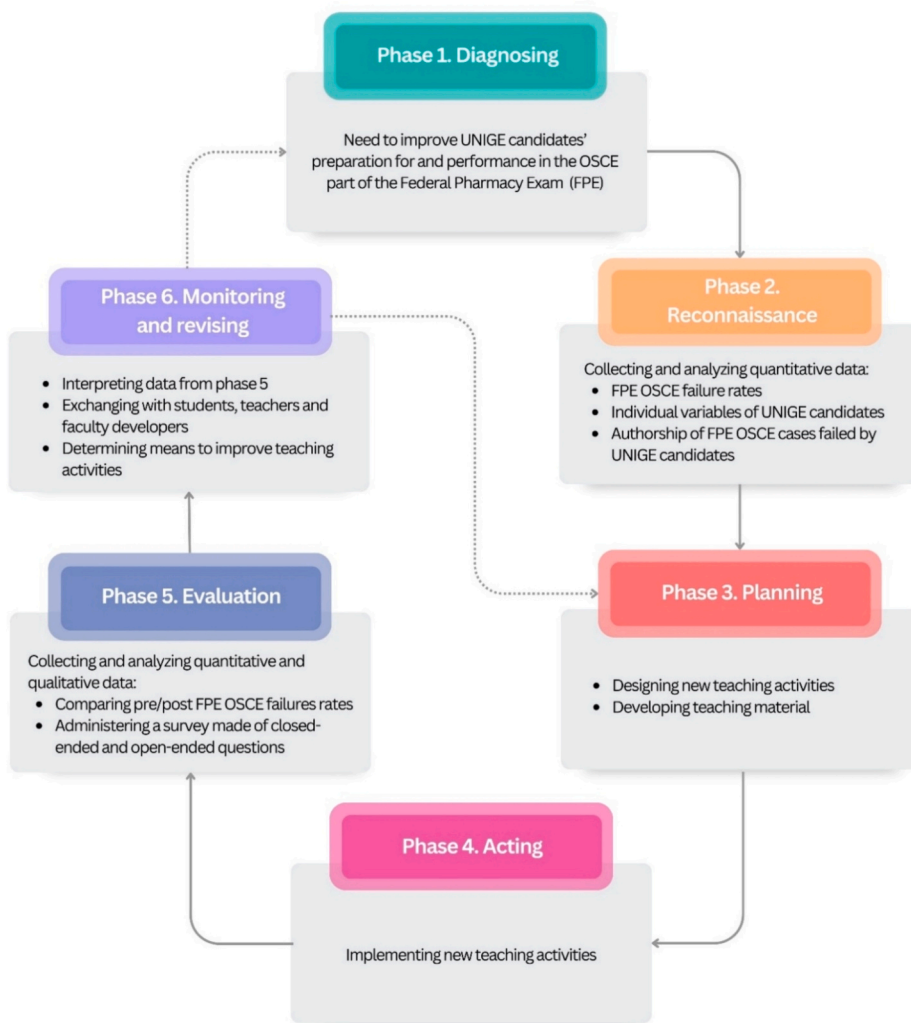


Fig. 1. Design based on framework developed by Ivankova (2015)<sup>21</sup> (p.61).

established in previous similar research,<sup>2-4,6-10,13-15</sup> the magnitude of the effect size based on Cramer's V coefficient was interpreted as follows: 0.00 to <0.10 as negligible; 0.10 to <0.30 as small or minimal; 0.30 to <0.50 as medium; and 0.50 to 1.00 as large.<sup>22</sup> Descriptive statistical analyses were also performed on UNIGE candidates' length of study (indicator of possible prior learning difficulties) and country of previous graduation to determine the possible influence of individual variables (comparisons were made between Switzerland and individual countries, and between Switzerland and European and non-European countries). The authorship of failed vignettes for UNIGE candidates was manually identified and analyzed.

#### *Planning and acting phases*

The planning (3) and acting (4) phases took place during the 2019–2020, 2020–2021, and 2021–2022 academic years. These phases involved designing and implementing new teaching activities, with a shift to an online format induced by the COVID-19 situation in June 2020 and maintained afterwards.

#### *Evaluating action phase*

The evaluating action phase (5) involved concurrent quantitative and qualitative data collection and analysis. One quantitative strand aimed to determine if the new teaching activities improved OSCE performance by analyzing the variation in the UNIGE failure rate before new teaching activities were introduced (2018 and 2019) and after (2022), using descriptive statistics. Candidates who only partially received the new instruction (2020) and candidates who received Master's 1st-year theoretical courses in a different format (2021 - fully online due to COVID-19) were not included in the analysis because they can neither be considered as part of the results before the full set of changes, nor as part of the results after the full set of changes. A chi-square test and a Cramer's V test were conducted to assess the correlation between the failure rate and participation in the new teaching activities altogether. The failure rates between universities were compared using the same method. As no specific remediation is offered after a failed first attempt, results from second and third attempts were included for all institutions, as was the case in the reconnaissance phase.

Another quantitative and qualitative strand aimed at collecting and analyzing UNIGE candidates' viewpoints, to identify components of the curriculum impacting OSCE preparation and factors making this assessment difficult for them. A web-based survey was designed by the teaching team and the CTLS. It was administered with LimeSurvey to 117 UNIGE candidates who experienced the OSCE in 2022, with 45 respondents (38.5%). The questionnaire (available in Appendix A) featured both open-ended and closed-ended questions, with the latter including statements to be rated on a four-point scale ("agree", "somewhat agree", "somewhat disagree", "disagree"). Quantitative data were analyzed using descriptive statistics using Excel, while inductive thematic analysis was performed on qualitative data. To ensure coding quality, two CTLS faculty developers with outsider perspective independently created two sets of codes. These sets were then compared and combined into a unified code set. Both researchers then recoded all data, improving inter-coder agreement.<sup>21</sup> Codes were organized into emerging categories, and category frequency distribution across all questions was determined with Excel.

The most common strategy for integrating quantitative and qualitative methods in concurrent study designs involves comparing or synthesizing results from each strand, along with their interpretations, to generate meta-inferences.<sup>21</sup> In this study, responses to both open-ended and closed-ended questions from the questionnaire were compared to identify convergence or divergence in perceived usefulness of the new teaching activities. Synthesizing responses from both quantitative items and open-ended questions aimed to enhance understanding of perceived usefulness. These findings were synthesized alongside data on failure rates to gain a more comprehensive insight into the intervention's effectiveness.

#### *Monitoring and revising action phase*

The monitoring and revising action phase (6) involved the teaching team interpreting meta-inferences from the collected data, sharing results, and collaborating with current students and the CTLS to adjust teaching activities, thus returning to the planning phase. The results also yielded new diagnostic elements, aligning with the iterative nature of the methodological framework.

#### *Ethical considerations*

The research adhered to ethical principles outlined in the Code of Ethics and Professional Conduct for the Geneva Institutions of Higher Education.<sup>23</sup> Anonymity was preserved during data collection and result dissemination. Two reminders were sent to increase survey participation, but no incentive was offered. Participants' involvement in questionnaires signified informed consent, and ethical security measures were implemented to ensure confidentiality. No separate informed consent was required from students, as teaching activities were part of the researchers' regular professional practice.<sup>21</sup>

## **Results**

### *Findings of phase 1*

UNIGE candidates represented 70 out of 188 FPE candidates in September 2018 and 62 out of 189 in September 2019. The failure rates of the 132 UNIGE candidates who had performed OSCE in 2018 and 2019 were examined and compared to those of the 245

candidates from the two other Swiss institutions (Basel and Zürich): 3/70 (4.3%) vs 3/118 (2.5%) in 2018 and 6/62 (9.7%) vs 1/127 (0.8%) in 2019 (i.e.: 9/132 for UNIGE candidates vs 4/245 for other candidates combining 2018 and 2019). A near 10% failure rate was observed in Geneva, whereas there were no failures or only single failures on the other universities.

### Findings of phase 2

The statistical tests conducted on the overall failure rate for both 2018 and 2019 (9/132 for UNIGE candidates vs 4/245 for other candidates) highlighted an inter-site difference characterised by a *p*-value of 0.01 and a Cramer's *V* of 0.136 (small effect size). No influence was identified in relation to case writing by other institutions, prior learning difficulties or country of previous graduation. Data are not shown due to confidentiality considerations; due to the few UNIGE candidates failing the OSCE, disclosing their country of prior graduation might allow their identification. Hypotheses related to extracurricular factors not being confirmed, the selected course of action was to design and implement an intervention within the curriculum to better prepare UNIGE candidates for FEP OSCE. A course previously consisting of 24 h theoretical reviews, clinical case discussions and an on-site summative OSCE, was redesigned.

### Findings of phases 3 and 4

New virtual formative teaching activities with associated feedback were introduced in the 2nd-year 3-weeks "pharmacy services" course, detailed in Table 1. Clinical case simulations featured a volunteer student as the pharmacist and a teacher as the patient. Performance assessment and feedback, guided by a standardized evaluation grid displaying key questions to be asked per management stage (see Appendix B), were conducted by peers and faculty. The in-person summative OSCE was replaced by an online formative version using Zoom. Initially prompted by the COVID-19 pandemic, the online format was maintained for cost-effectiveness and because it benefited student participation. 10-min individual debriefings followed each student's formative OSCE. A 90-min group debriefing included a presentation on the OSCE examination procedure, crucial points to address, reflexes to develop, pitfalls to avoid and preparation strategies.

### Findings of phase 5

In September 2018 and 2019 (i.e., before new teaching activities were implemented), 132 UNIGE candidates took the FPE OSCE and 9 failed (6.8%). In September 2022 (after the new teaching activities had been fully introduced), 123 UNIGE candidates took the FPE OSCE and 4 failed (3.3%). The tests carried out to analyze this variation resulted in a *p*-value of 0.2 and a Cramer's *V* of 0.081 (negligible effect size). The tests conducted on the overall failure rate for 2022 (4/123 for UNIGE candidates vs 0/109 for other candidates) resulted in a *p*-value of 0.06 and a Cramer's *V* of 0.125 (small effect size).

The analysis of survey results concerned 45 individuals who took the OSCE (participation rate 38.5%) in 2022. 72% were women, 68% had obtained their previous diploma in Switzerland, and 92% had passed the OSCE on their first attempt.

As shown in Fig. 2, the components of the Master's considered most useful in preparing for the OSCE are the personal preparation work (96% "agree" or "somewhat agree" responses), the 2nd year "pharmacy services" course (86%) and the 2nd year internship in a pharmacy (80%). First-year theoretical courses garnered 78% "agree" or "somewhat agree" responses, while 1st year practical exercises garnered 62%.

**Table 1**

Evolution of teaching activities in the 3-week "pharmacy services" course in the 2nd year Master's programme.

Teaching activity by academic year	Before implementation of new teaching activities		Implementation of new teaching activities		
	Until 2017–2018	2018–2019	2019–2020	2020–2021	2021–2022
24-h theoretical courses (refresh of Master's 1st year)	Classroom		Online*	Online / Classroom**	
18-h based on clinical cases encountered by students during their internship	Teachers commenting on cases			10-min student-teacher simulation assessed using a standardized evaluation grid	
OSCE	Classroom		Online* / ***		
	Summative 10 vignettes	5 vignettes	Formative 2 vignettes ***		
Targeted 90-min OSCE group debriefing	Classroom		Online* / ***		
	No		Yes****		
Targeted 10-min OSCE individual debriefing	Not applicable		Online* / ***		
	No			Yes	
	Not applicable			Online**	

\* In 2020: in-classroom format impossible due to COVID-19 semi-lockdown.

\*\* Online also possible for students not wishing to attend in person.

\*\*\* Kept online to hold OSCE with a lower budget.

\*\*\*\* In 2020: switch to 2 cases due to sudden reorganisation related to COVID-19 semi-lockdown.

\*\*\*\*\* Previous responsible teacher suddenly died 6 weeks before the course in 2020; simplest modification brought by new responsible teacher = introduction of targeted OSCE group debriefing.

The new features introduced as part of the “pharmacy services” course, overall, all are considered useful in preparing for the OSCE as shown in Fig. 3. Explanations of the OSCE examination procedure and the reflexes to be developed generated 96% of responses agreeing or mostly agreeing. Online case simulation with semi-structured assessment based on standardized grids came second (91%), followed by online formative OSCEs (87%). Group and individual debriefing following these OSCEs respectively garner 82% and 80% of positive responses.

Since the analysis of results for open-ended questions aimed to assess the perceived effectiveness of the new teaching activities, only those related to the changes introduced during phase 4, i.e. those concerning the “pharmacy services” course, are presented below.

Among the 42 open-ended responses (from 42 people) regarding the most useful curriculum components for OSCE preparation, the most recurrent category was the “pharmacy services” course, associated with 35% of the 60 codifiable units of meaning. Within this category, 86% of comments referred to role-playing exercises (simulated cases and formative OSCEs), while 43% referenced feedback (individual debriefing, group debriefing and detailed corrections by the teaching team). Evaluation grids were referenced in 10% of total units, half of which highlighted the lists of typical questions included in the grids. Other recurrent categories included preparation with peers (22%), internship (10%), and individual preparation (10%). Table 2 displays sample responses related to the “pharmacy services” course.

In the 36 open-ended responses (from 36 people) regarding the least useful curriculum components for OSCE preparation, the predominant category was the “pharmacy services” course (26% of the 42 codifiable units of meaning). Among these, 67% referred to formative OSCEs and associated feedback. Some participants expressed concerns about the timing of the course or specific activities, either considering them too early or too late in the curriculum. Large number of students participating in simulations or debriefings was noted as an issue. Other identified categories included 1st-year practical exercises (21%), everything being useful (12%), gaps in curricular content (10%), and 1st-year theoretical courses or content (10%). Table 3 provides sample responses related to the “pharmacy services” course.

The question about what was most difficult about the OSCE yielded 36 comments (from 36 people) that were broken down into 52 units of meaning. Although none referred to the new teaching activities as such, the frequency of some of the categories (illustrated in Table 4) guided phase 6: the fact that stress management was among the most frequent categories (17% of comments), together with the feeling of lacking information or practical training for this exam (12%) and quarantine (8%). Some responses refer to a negative emotional experience with expressions such as *stress* and its variations (15 occurrences), *tension* (1), *disoriented* (1), *devaluing* (1), *frustrating* (1) and *unpleasant* (1). The proportion of people using such terminology stands at 42% (19 out of 45 respondents).

Findings of phase 6

Findings of phase 5, completed with exchanges with CTLs and faculties in charge of preparing students in the Universities of Basel and Zürich (both also organizing formative OSCEs within the curriculum), informed the development of “pharmacy services” course. The following actions were undertaken as a result of this phase: 1) stopping the 24 h theoretical reviews; 2) introducing more 10-min clinical case simulations conducted according to OSCE requirements (36 h instead of 18 h) with a demonstration from teachers in the beginning – an example of a scenario with its tailored grid is included in Appendix C; 3) starting earlier in the 2nd year the clinical case simulations and spreading the hours over the year instead of condensing everything in June (thus starting in September the year before the FPE, with 2 h every 2 to 3 weeks); 4) sharing photos with explanations of the examination site (OSCE stations, corridors leading to them, quarantine rooms), to help candidates project themselves into it; 5) providing 3 videos (*When to start OSCE preparation; How to prepare for the OSCE; How to deal with OSCE stress*) based on testimonials from previous candidates; 6) sharing a personal summary sheet developed by a previous candidate as example; 7) providing the clinical cases drawn from situations encountered during the mandatory internship in a community pharmacy from previous years, so that students can have vignettes to train independently in groups; 8) replacing clinical case simulations run by a single student observed by all the other ones by peer-led clinical case simulations

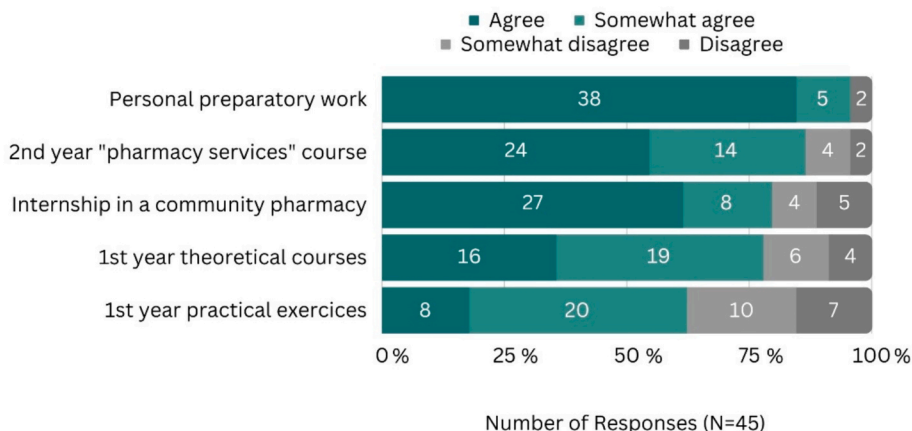


Fig. 2. Elements of the Master's that helped the most preparing for OSCE according to UNIGE candidates.

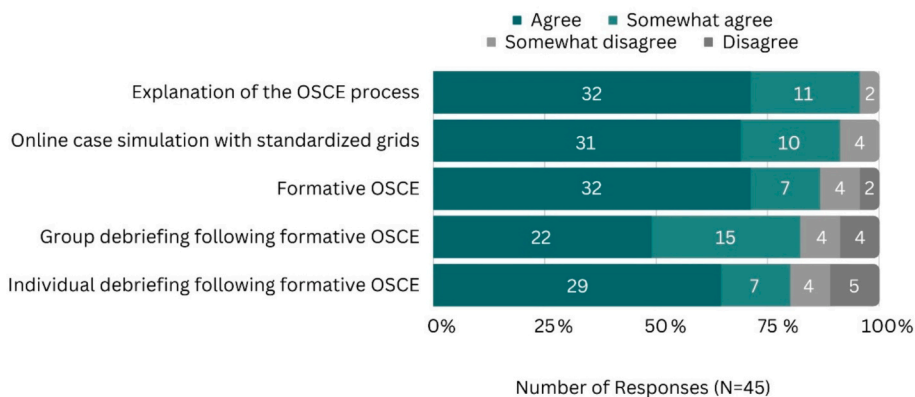


Fig. 3. Candidates' perception of the usefulness of the new teaching activities introduced in the “pharmacy services” course in preparing for OSCE.

Table 2

Sample responses to the open-ended question “What was most useful in preparing me for the OSCE?” referring to the new teaching activities introduced in the “pharmacy services” course.

New teaching activity	Sample responses
Formative OSCE	<p>“Formative OSCE and how they work: just seeing how the exam goes gives us an idea on how to prepare.” [Respondent 42]*</p> <p>“The formative OSCE on Zoom, because we are alone (not in front of the rest of the group), and this is the exercise that best represents the FPE.” [Respondent 27]</p>
Online case simulation with standardized grids	<p>“Online case simulation integrating semi-structured assessment based on standardized grids; allows you to adopt a systematic approach and work on it throughout the summer, in order to carry it through to the FPE in September.” [Respondent 33]</p> <p>“Simulation based on a standardized grid is the best way to understand the exam requirements.” [Respondent 56]</p>
Typical questions to be addressed	<p>“In my opinion, the most useful thing was that I made 2 lists (1 for triage and 1 for validation) of questions using the elements of the standardized grids and adding complements and fluidity. I learnt them by heart and that enabled me to manage each case correctly in a structured way.” [Respondent 03]</p> <p>“For me, it was the internship in a pharmacy, but I was lucky enough to have a pharmacist who had recently graduated, and she gave me a lot of OSCE practice sessions using the grid to develop a systematic set of questions.” [Respondent 05]</p>
Group debriefing following formative OSCE including an explanation of the OSCE process	<p>“Group debriefing of the OSCE, as it shows an example of the approach to follow and also what is essential for a successful OSCE.” [Respondent 45]</p> <p>“OSCE in groups with a debriefing at the end. We could really understand what was expected.” [Respondent 38]</p>

\* When a person opened the survey, an identifier was generated, whether the person completed the questionnaire or not. Consequently, the quantity of identifiers created (and their associated numbering) is higher than the reported number of respondents.

Table 3

Sample responses to the open-ended question “What was least useful in preparing me for the OSCE?” referring to the “pharmacy services” course.

Category	Sample responses
Course/Activity taking place too late in the curriculum	<p>“I found that the ‘pharmacy services’ course held in June wasn’t necessarily the most useful... I would have liked to have had this course at the beginning of the pharmacy internship.” (note: i.e., beginning of the 2nd year) [Respondent 41]</p> <p>“I thought it was a shame that the ‘pharmacy services’ course was held after the pharmacy internship. It would have been better to do it in 1st year.” [Respondent 15]</p>
Course/Activity taking place too early in the curriculum	<p>“The individual debriefing following my OSCE wasn’t conclusive in my opinion because at that point in the preparation I knew very well that there were big gaps almost everywhere.” [Respondent 30]</p> <p>“The OSCE formative exams are held early with respect to the exam date (about 3 months before) ...” [Respondent 01]</p>
Too many students taking part in activity	<p>“Online simulation with the whole class.” [Respondent 33]</p> <p>“The first Zoom session during the ‘pharmacy services’ course in June, where the whole cohort was present. Too many people, the majority just listen to the person passing by. Smaller groups are more useful.” (note: i.e., as in 1st year) [Respondent 27]</p>

**Table 4**

Sample responses to the open-ended question “What was most difficult in the OSCE?” explicitly referring to the new teaching activities introduced in the “pharmacy services” course.

Category	Sample responses
Stress management	“Managing the stress of the OSCE, especially the first cases when you're a bit in the dark.” [Respondent 32] “I was very stressed by the OSCE: it's mainly the waiting that's stressful, catching your breath between each vignette and forgetting about the case that's just taken place, holding on for 10 min with examiners who are there to ‘judge’ your competence.” [Respondent 42]
Feeling of lacking information about or training for OSCE	“Realizing that with the course materials and the knowledge accumulated over five years of study, one feels very ill-prepared for the OSCEs, which require a lot of self-learning with external resources because the answers are not found in the courses/workshops.” [Respondent 51] “Having to figure things out on our own and organize ourselves to train in a suitable manner to pass the exam, as the courses are more useful for practical fieldwork than for the exam. Having to search for information about the exam process since it is often unclear or provided very late, which creates additional stress.” [Respondent 25]
“Quarantine”	“Even if it's well organized, it's very stressful to have to wait for a long time in a room for half a day before the oral.” [Respondent 10] “Morally, because I was in a group that took the OSCE at the end of the afternoon on both days, it's not necessarily pleasant to have 3 h of quarantine before the exam on 2 days, whereas all the others had 1 in the morning and 1 in the afternoon.” [Respondent 05]

in small groups with collective debriefing; 9) providing a 10-min oral briefing just before the OSCE, to remind candidates of the general principles and practical tips and build up their confidence, and 10) informing internship supervisors about OSCEs and making them aware of the importance of enabling students to train for OSCE-type cases during their internship in their pharmacy.

## Discussion

This research presents new teaching activities aimed at increasing UNIGE candidates' performance in FPE OSCE: switch from a summative in-classroom OSCE with 5 to 10 vignettes to a virtual formative OSCE with 2 vignettes, supplemented with group and individual debriefings and completed with 18 h clinical case simulations conducted online according to OSCE requirements and assessed with standardized evaluation grids. These new teaching activities have been introduced over several years, taking into account external circumstances (e.g., COVID-19). Our findings helped to set up following actions as second steps to further strengthen OSCE preparation and start to address the stress management issue.

Our research fits into a line of action research involving the introduction of teaching activities into pharmacy curricula aimed at optimizing students' preparedness for and performance in summative OSCEs.<sup>1–4</sup> It also aligns with studies describing the transition to online-based teaching formats in health professions education in response to the COVID-19 pandemic.<sup>3,12–16</sup> This paper contributes to fill a gap in literature regarding the use of virtual OSCEs in pharmacy curricula<sup>13</sup> and the impact of virtual formative OSCEs sessions on summative OSCE performance.<sup>14</sup>

The effectiveness of the specific teaching activities introduced in the curriculum was assessed by comparing the OSCE failure rate of UNIGE candidates who had received the new instruction with those of previous years. The failure rate decreased after the new instruction was implemented, which represents a positive change for UNIGE candidates. Although this variation is modest, the fact that the difference between UNIGE candidates and candidates from the other institutions decreased between phase 2 and phase 5 tends to suggest that action emerging from the phases 3 and 4 led to a successful resolution of the initial problem. These results are considered to be of practical importance. This observation is consistent with existing literature providing evidence that mixed methods action research represents an effective solution to a practical problem that can have immediate positive effect on a community and its members.<sup>21</sup> Quantitative and qualitative data obtained through a survey revealed to what extent different components of the Master's program were considered useful for preparing for OSCEs and new teaching activities obtained positive results.

The themes emerging from the qualitative responses, and their frequency, align with the responses to the closed-ended questions regarding what is considered most useful for preparation. This convergence, coupled with decreased failure rates, further strengthens the notion that the intervention in the “pharmacy services” course was effective. However, the fact that the course and its activities were rated positively in the closed-ended questions, yet associated with some negative responses in the open-ended feedback, presents an inconsistency. Inconsistencies are particularly important in informing the next cycle of the action research process, as they can reveal elements that may require further exploration.<sup>21</sup>

Both increased performance of UNIGE candidates and perceived usefulness of the new teaching activities can be interpreted in the light of pedagogical concepts such as constructive alignment, formative assessment and feedback as well as test anxiety. The pivot to online-based format can also be considered.

### Constructive alignment

The constructive alignment approach for university teaching, described as aligning teaching and assessment methods with learning outcomes that learners are intended to achieve, has been associated with higher levels of learning and better assessment performance.<sup>24</sup> The observed increased performance of UNIGE candidates in FPE OSCE could support the assumption that aligned teaching activities can have a positive impact on exams performance, as the activities implemented in the “pharmacy services” course (mainly



formative OSCEs and clinical case simulations) were conducted and assessed according to FPE OSCE requirements, themselves aligning with the expected pharmacist skills. The fact that the “pharmacy services” course was widely considered as useful in preparing for FPE OSCE can also support recent findings showing that perceived alignment of teaching-learning activities, assessment tasks and intended learning outcomes can be associated with higher usefulness ratings by students.<sup>25</sup>

### *Formative assessment and feedback*

A key change was the switch from a summative to a formative OSCE. Formative OSCE (sometimes referred to as “teaching OSCE”) can be described as an individual learning tool using the OSCE format, after which the evaluator provides performance feedback that can be used by the learner to prepare for upcoming summative OSCE, without it contributing to the overall grade at the end of the teaching unit.<sup>6,26</sup> At UNIGE, undergraduate pharmacy studies and the first year of the Master's program do not involve OSCEs. It was deemed appropriate for the first encounter with this assessment method to be formative. Consistent with previous research showing that this method can, in some cases, benefit student preparation for and performance in subsequent summative OSCEs,<sup>2,6,7,10</sup> our results suggest that formative OSCEs associated with individual and group debriefing contributed to increase performance in summative OSCE for UNIGE candidates. They were also perceived as useful instructional activities to prepare for final OSCE by most survey respondents, who reported the benefit of gaining in practice whilst receiving detailed feedback aiming for improvement. Same results were obtained for case simulation integrating semi-structured assessment based on standardized grids. Receiving effective feedback, as a dimension of constructive alignment, has been shown to correlate with higher usefulness ratings by students and the use of more deep learning strategies.<sup>25</sup>

### *Test anxiety*

A meta-analytic review demonstrated that test anxiety, also known as exam stress or test stress, was higher on high-stakes examinations and indicated a relationship between higher levels of test anxiety and lower levels of performance.<sup>27</sup> Given that the FPE conditions the candidates' access to the pharmacist profession (thus qualifying as high-stakes exam) and that OSCEs have been associated with high test anxiety levels,<sup>28,29</sup> the potential influence of stress on UNIGE candidates' performance cannot be ruled out. Numerous studies have suggested that the influence of OSCE-related anxiety on performance was not decisive<sup>28-30</sup> even though a negative association was reported by other researchers.<sup>31</sup> In our research, the proportion of respondents reporting OSCE-related stress highlights the need to further investigate this issue. It should be noted that, at the time of the research, no teaching activity was specifically designed to address stress management. Moreover, during the Master's program, students were subjected to very few oral examinations and had no experience of being isolated in a room during an examination (quarantine).

### *Online format*

The pivot to an online-based formative OSCEs and case simulations was initially induced by the COVID-19 pandemic as was the case for many teaching activities in health professions education around the world<sup>3,12-16</sup> and it was maintained due to positive feedback from both faculty and students, as well as for budgetary considerations. Researchers have mentioned the logistical and financial advantages of conducting formative OSCEs virtually.<sup>13-16</sup> At UNIGE, running the summative in-class OSCE in 2018 involved 33 people for two days, with additional resources for surveillance. No resources were then put into giving feedback to students, explaining what was expected, how to prepare for the OSCE, etc. Running a formative on-line OSCE in the same condition as in 2022 with the same number of students as in 2018 would require 10 people for one day, without additional resources for surveillance. In addition, from the teachers' point of view, it requires less uncreative work, it is far more interesting and stimulating as it favours interactions with students that can be improved over time (e.g. completing the feedback). The fact that the transition to the online format coincided with the introduction of other pedagogical innovations in the “pharmacy services” course and was not specifically addressed in the survey does not allow to conclude that this change alone had a positive effect on UNIGE candidates' preparation, on the perceived usefulness of activities and on performance in OSCE. A recent systematic review showed absence of consensus as to whether virtual OSCEs should continue to be used post-pandemic<sup>16</sup> but considering existing literature supporting the benefits of virtual formative OSCEs to prepare for summative OSCEs according to students' perceptions,<sup>14,15</sup> there is a basis to believe that the pivot to an online-based format to conduct the formative OSCEs was relevant in our context.

### *Developments resulting from phase 6*

Clinical case simulations engage learners through the completion of active cognitive tasks (role-play for volunteer students and critical assessment using an evaluation grid for all the others attending the role-play), corresponding to Jacob's definition of active learning.<sup>32</sup> Emphasizing clinical case simulations over theoretical content aligns with the idea of maximizing the benefits of active learning<sup>33</sup> and is consistent with the respondents' perception that theoretical inputs are less useful for preparing for the OSCE.

The idea to better distribute training for OSCEs by introducing it earlier in the curriculum is in line with scientific evidence supporting the idea that intellectual skills learning, and to a lesser extent social skills learning, may benefit from distributed learning, also known as spaced practice.<sup>34</sup>

The introduction of a short briefing immediately before testing aligns with the assumption that it has the potential to reduce anxiety and improve performance.<sup>35</sup> It has been recommended that briefings provide information about the conditions of the simulations, set

the tone and expectations, establish the fiction contract, orient to the equipment and setting, and explain the logistics of the day, thereby creating a psychologically safe environment for participants.<sup>36</sup> Past researchers have shown that a brief intervention asking test-takers to reappraise their anxious arousal as excitement<sup>37</sup> or challenge<sup>38</sup> could have a positive effect on test performance. Instructors could provide UNIGE candidates a 'pep talk' encouraging them to consider the FPE OSCE in a more positive light.

Providing pictures or video recordings showing the setting used for past FPE OSCE editions is coherent with the recommendation that prior to simulation participants should be oriented and familiarized to equipment, scenario settings and other environmental factors.<sup>36</sup> In our context, a picture could be taken of the quarantine room for example, as well as of different types of stations.

Expanding the students-as-partners approach<sup>39</sup> to former students, we created an opportunity for past UNIGE candidates to collaborate with teaching and administrative staff toward a common goal, i.e., improving UNIGE candidates' preparation for and performance in the FPE OSCEs. Phase 6 steps were informed by alumni feedback from the survey. Alumni played a vital role in shaping improvements, particularly in highlighting stress-related concerns that triggered timely actions by the teaching team. Creating video testimonials from successful candidates, positioned as near-peers on the professional path, offered credible advice to students. Semi-structured interviews with four previous candidates explored their preparation methodologies, stress management strategies, and lessons learned from OSCE experiences. Compiled responses formed three thematic videos accessible on the UNIGE institutional multimedia platform (Mediaserver). Sharing a personal preparation checklist from one interviewee aligns with the concept of near-peer counselling.

### Limitations

One limitation may be a selection bias, as survey respondents are likely those motivated to support others. Individuals with negative experiences or disappointment might not have participated.

Researchers can't rule out unmeasured variables influencing the 2022 FPE OSCE scores. Changes over several years, including the impact of COVID-19, could have unidentified influences. Student engagement in new teaching activities was not individually monitored to ensure that they were free to participate or not. Only participation in the formative OSCE was documented: 123 out of 129 participated. The participation rate did not exceed that of the summative OSCE, excluding increased participation as the sole influencing factor.

The obtained results might have been influenced by the quality of the individual's preparation and the learning experience during the internship in a community pharmacy. However, there were no change between 2018/2019 and 2022 regarding these aspects. No information was given to students to guide them in their preparation outside the lessons, nor specific instructions given to the internship preceptors.

The candidates' academic results prior to the federal examination were not analyzed in search of indicators that the 2022 cohort would be better than those of 2018/19. Nevertheless, the failing rate of the other components of the federal exam (multiple-choice questionnaire and practical exam on compounding pharmacy) did not change over that period (data not shown), thereby undermining this hypothesis.

Additionally, results are available for only one-year post-introduction of new teaching activities. The single UNIGE failure in 2023 supports the trend but is not included in this analysis due to potential impact from other program innovations.

While meaningful trends are observable, the limitations include statistical results for the variation in UNIGE candidates' failure rates that do not show a strong correlation or a large effect size, possibly due to a limited sample size.

Due to the need to promptly address candidates' success rate and the short delay before the next FPE session, no specific action was taken to assess survey reliability and validity, aligning with the pragmatic foundation of action research and mixed methods.<sup>21</sup> The lack of a pre-intervention survey hinders comparative analysis with post-intervention data.

Nonetheless, this research presents significant strengths. The well-defined assessment format of OSCEs, regardless of grading methods, facilitates the applicability of our results to diverse contexts. The findings illustrate that a pragmatic approach, focusing on incremental improvements guided by feedback, fosters the evolution of teaching methods. This approach could be applied to address other challenges in pharmacy education.

### Potential directions for future research

A follow-up quantitative strand of the current research could focus on the OSCE failure rates in subsequent years, to see if the performance gains are sustained over time. An additional qualitative strand could be conducted, for example via focus groups, to explore candidates' ideas for potential improvement of new teaching activities.

To overcome the limited transferability of our results due, among other limitations, to the very specific set of educational changes introduced, it could be worthwhile to replicate this project within the other institutions in Switzerland also preparing pharmacy candidates for the FPE OSCE and to draw national research from it. Gathering more data over several years could help establish more distinctly which of these changes contributed to the reduction in the failure rate. Analyzing the use of OSCEs in assessment frameworks at both Master's and undergraduate levels across Swiss institutions could reveal insights into students' familiarity with the format and their stress associated with the FPE. This would also reinforce the systemic scope characteristic of participatory action research.<sup>19</sup>

Consistent with the iterative nature of the framework used,<sup>21</sup> our results lead to new questions that could result in a new research cycle, in line with the notion of stress that the present one highlighted. The available literature regarding the association between test anxiety and OSCE performance remains limited when examining each health profession independently<sup>29</sup> and the prevalence and effects of test anxiety is under-researched among pharmacy students.<sup>31</sup> It would be of interest for further research to investigate the

influence of OSCE-related test anxiety on UNIGE candidates' performance and to implement in the curriculum more teaching activities to address this issue. This research could be conducted using the same methodology, based on Ivankova's framework.<sup>21</sup> It would be interesting to measure the OSCE-related test anxiety level of candidates in every participating university using a validated test anxiety scale, and to make an inter-site comparison. This could show whether the quarantine system (implemented or not depending on the number of candidates), generate more stress, with an impact on success rates. Investigating what other institutions implement in their courses in terms of stress management support would also be relevant.

## Conclusions

This participatory action research aimed at increasing UNIGE candidates' performance in patient-facing skills entry-to-practice examination (FPE) by enhancing their preparedness within a course of the Master's program. After implementing new teaching activities (a virtual formative OSCE associated with group and individual debriefings and online clinical case simulations conducted according to OSCE requirements and assessed using a standardized evaluation grid), performance in FPE OSCE increased. Although the results do not establish clearly that the observed increase in performance is solely due to the new teaching activities, our findings support the general assumption that online active learning activities designed in a constructive alignment logic and combined with effective feedback, can contribute to improve performance in exams measuring patient-facing skills. In particular, setting up formative activities modelled on the federal OSCE's conduct, structure and assessment, combined with feedback, seems worthwhile.

## CRedit authorship contribution statement

Conceptualization, C.H., P.H., A.M. and J.B.; Data curation, C.H. and P.H.; Formal analysis, C.H., P.H. and J.B.; Funding acquisition, J.B.; Investigation, C.H., P.H., P.L. and J.B.; Methodology, C.H., P.H. and J.B.; Project administration, C.H., P.H. and J.B.; Resources, C.H., P.H. and J.B.; Software, C.H., P.H. and J.B.; Supervision, C.H., P.H. and J.B.; Validation, C.H., P.H. and J.B.; Visualization, C.H., P.H. and J.B.; Writing – original draft: C.H., P.H. and J.B.; Writing – review and editing: C.H., P.H., P.L., A.M. and J.B.

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## Institutional review board statement

Ethical review and approval were waived for this study because data collection did not imply any risk to subjects, who voluntarily participated in the study. Researchers are committed to the Code of ethics and professional conduct for the Geneva Institutions of Higher Education. Available online: <https://www.unige.ch/ethique/charter> (accessed on 18 September 2023).

## Informed consent statement

Informed consent was obtained from all subjects involved in the study.

## Disclosure statement

During the preparation of this work the authors used Chat GPT to improve readability and meet word limit requirements and DeepL Pro to translate appendixes from French to English. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

## Declaration of competing interest

No author has any conflict of interest to declare. No funding source had any involvement in conducting the research or in preparing the article.

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## Appendix A. Appendix

**QUESTIONNAIRE ON THE OBJECTIVE STRUCTURED CLINICAL EXAMINATION (OSCE) FOR THE FEDERAL PHARMACY EXAMINATION**

**INSTRUCTIONS**

You have taken the federal pharmacy examination in 2022, which is why you have received this questionnaire.

The purpose of this survey is to gain a better understanding of how you approached the patient-facing part of the examination, which will be shortened to OSCE. Your answers will help us to improve the Pharmacy curriculum.

Thank you in advance.

The Pharmacy Section & The Center for Teaching and Learning Support, University of Geneva

*This questionnaire comprises 9 questions.*

*The questionnaire is anonymous. The recording of your answers does not contain any information that could identify you, unless explicitly requested in one of the questions. The results will be processed by the Center for Teaching and Learning Support. No individual data will be passed on to faculty of the Pharmacy Section.*

**STATISTICAL DATA**

*These questions cannot be used to identify you.*

GENDER:  Male  Female  Other  Prefer Not to Answer

Where did you obtain your high school diploma?

Switzerland  Canada  Luxembourg  I do not wish to answer

Algeria  France  Morocco  Other : \_\_\_\_\_

Belgium  Lebanon  Tunisia

I have passed the patient-facing examination (OSCE) part of the federal pharmacy examination.

Yes  No

I passed the OSCE part of my first attempt.

Yes  No

**MY PREPARATION FOR THE OSCE OF THE FEDERAL PHARMACY EXAMINATION**

This component of the Master's program helped me prepare for the OSCE:

	I agree	I somewhat agree	I somewhat disagree	I disagree
1st year theoretical courses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1st year practical exercises	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Internship in a community pharmacy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2nd year "pharmacy services" course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My personal preparatory work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

During the "pharmacy services" course, what i found most useful was...

	I agree	I somewhat agree	I somewhat disagree	I disagree
Online formative OSCE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Individual debriefing following my formative OSCE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Group debriefing of formative OSCE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Explanation of the OSCE process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online case simulation with standardized evaluation grids	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate what you think has been **most** useful in preparing you for the OSCE part of the Federal Examination, and briefly explain why.\*

Please indicate what, in your opinion, was **least** helpful in preparing you for the OSCE part of the Federal Examination and briefly explain why.\*

Please indicate what was **most difficult** for you in the OSCE part of the Federal Examination and briefly explain why.\*

\*We would be grateful if you could leave us a clear comment that enables us to improve the Master's program.

**Fig. A1.** Questionnaire sent via LimeSurvey to the UNIGE candidates having experienced the OSCE in September 2022 (i.e., after new teaching activities).

**Appendix B. Appendix**

Standard grid for student evaluation of simulated pharmaceutical triage cases			
Assessment of the context	Yes	No	Comments/ details
Is this for you?			
For women of childbearing age: pregnancy?			
For women of childbearing age: breastfeeding?			
In pediatrics: age and weight?			
Location?			
Intensity?			
Nature?			
Since when? Evolution?			
Other symptoms?			
Actions already undertaken? Results obtained?			
Aggravating factors? Improving factors?			
Ever had these symptoms? Recurrence?			
If already experienced: frequency (or when last)?			
Does this worry you?			
<b>Pharmaceutical history</b>	Yes	No	
Other treatments in progress?			
Co-morbidities (including impaired renal and/or liver function)?			
Known allergies?			
Assessment of risk factors			
Looking for red flags (closed questions)?			
<b>Triage decision =&gt; emergency OR consultation OR pharmacy management</b>	Yes	No	
Summarises the complaint and the information gathered			
Decision taken: <input type="checkbox"/> Emergency <input type="checkbox"/> Medical consultation <input type="checkbox"/> Pharmacy management			
Explains/motivates its decision ("I advise you to..., because...")			
If consultation recommended, give a sufficiently precise deadline for contacting the doctor			
If needed, document the decision			
<b>Recommendations for using drug(s) (if managed in the pharmacy)</b>	Yes	No	
Recommended medication(s) (name, dosage):			
Explains this choice and the expected results of the treatment			
Indicates the daily dosage (e.g. single dose, number of doses, maximum dose daily, time of intake in relation to meals)			
If necessary, indicate to take the proposed treatment only if symptoms occur			
Indicates maximum treatment time			
Provides information on possible adverse reaction and how to prevent or mitigate them			
Provides information on possible drug-related interactions and how to prevent or mitigate them			
If necessary, give practical advice on administration (e.g. shake before use), apply in thin layers, etc.)			
<b>Additional advice (if covered by a pharmacy)</b>	Yes	No	
Gives advice on diet/hydration to relieve symptoms or manage the health problem (do's and don'ts)			
Gives advice on non-medicinal management (e.g. cold compresses, etc.) or lifestyle changes (e.g. sleep, sport, etc.) to relieve symptoms or manage the health problem (do's and don'ts)			
<b>Pharmaceutical follow-up (in case of pharmacy management)</b>	Yes	No	
Indicates time to improvement / disappearance of symptoms			
Indicates the circumstances in which a consultation is required (if necessary as a matter of urgency)			
Indicates the circumstances in which further advice from a pharmacy is required			
Proposes an information brochure and/or website tailored to the disease or treatment.			
Indicates to be available to answer any subsequent questions			
<b>Prevention</b>	Yes	No	
Gives advice on non-medicinal management or hygiene (e.g. diet, sleep, sport, etc.) to prevent recurrence or worsening of the health problem (do's and don'ts).			
Gives advice on medication (e.g. vaccination, phytotherapy, etc.) to prevent recurrence or worsening of the health problem			
<b>Social skills, communication</b>			
Consistency of the interview: <input type="checkbox"/> not reached <input type="checkbox"/> partially reached <input type="checkbox"/> reached			
Verbal expression: <input type="checkbox"/> not reached <input type="checkbox"/> partially reached <input type="checkbox"/> reached			
Responding to the patient's needs (empathy): <input type="checkbox"/> not reached <input type="checkbox"/> partially reached <input type="checkbox"/> reached			

Fig. B1. Standard grid for student evaluation of simulated pharmaceutical triage cases.

Standard grid for student evaluation of treatment initiation validation cases			
Assessment of the context	Yes	No	Comments/ details
Is this for you?			
Pharmaceutical file in the pharmacy? if yes, consult it			
New prescription / already taken this/these drug(s): assess if recurring problem			
Check reason for prescription / consultation			
Requests information received from the prescriber			
Checks the date of the prescription, its validity (signature, counterfoil prescription if applicable) and the conditions of use.			
Checks the reimbursement of prescription drugs			
For women of childbearing age: Pregnancy?			
For women of childbearing age: Breast-feeding?			
In paediatrics: age and weight?			
Known allergies?			
Co-morbidities (including impaired renal and/or liver function)?			
Treatment in progress?			
If renewable prescription: <input type="checkbox"/> clearly stated			
<b>Validation decision (indication, dosage, interactions, contraindications)</b>	<b>Yes</b>	<b>No</b>	
Deliver the treatment			
Checks the suitability of the galenic form, if relevant			
Propose another galenic form if necessary			
Propose generic drug(s)			
Remind/explain/confirm indication (particularly if multiple options)			
Dosage (if correct): confirms dosage and mentions			
<input type="checkbox"/> the unit dose			
<input type="checkbox"/> the number of intakes per day			
<input type="checkbox"/> the maximum number of unit doses during 24 hours / the interval to be left between doses			
<input type="checkbox"/> the time of intake in relation to meals (if necessary)			
<input type="checkbox"/> duration of treatment (e.g. max. 7 days, at least 6 months, until further notice)			
Incorrect dosage (if present):			
<input type="checkbox"/> no identification of incorrect dosage			
<input type="checkbox"/> explains how to manage incorrect dosage (e.g. indicates the correct number of doses per day)			
<input type="checkbox"/> contacts the physician to discuss the incorrect dosage (without providing an appropriate solution)			
<input type="checkbox"/> contact the physician to discuss the incorrect dosage and suggest an appropriate solution (change, follow-up, etc.)			
Absolute contraindication (if present):			
<input type="checkbox"/> no absolute contraindication identified			
<input type="checkbox"/> contacts the physician to discuss the absolute contraindication (without providing an appropriate solution)			
<input type="checkbox"/> contact the physician to discuss the absolute contraindication and propose an appropriate solution (change, etc.)			
Relative contraindication/warning (e.g. avoid behaviour during treatment) (if present):			
<input type="checkbox"/> no identification of relative contraindication/warning			
<input type="checkbox"/> identifies the relative contraindication/warning and explains to the patient how to manage it (e.g. avoid behaviour during treatment)			
<input type="checkbox"/> contacts the physician to discuss the relative contraindication/warning (without providing an appropriate solution)			
<input type="checkbox"/> contacts the physician to discuss the relative contraindication/warning and suggest an appropriate solution (change, etc.)			
Drug-related interaction (if none): confirms/explains the absence of interaction			
Drug-related interaction (if present):			
<input type="checkbox"/> no identification of the interaction			
<input type="checkbox"/> if different prescribers are involved, find out whether the physician is aware of the co-medication			
<input type="checkbox"/> explains to the patient how to manage the interaction (e.g. stagger the doses)			
<input type="checkbox"/> contacts the physician to discuss the interaction (without providing an appropriate solution)			
<input type="checkbox"/> contact the physician to discuss the interaction and propose an appropriate solution (change, follow-up, etc.)			
<b>Recommendations for using drug(s)</b>	<b>Yes</b>	<b>No</b>	
If necessary, give advice on administration (e.g. shake before use).			
Suggests a device to assist administration if necessary (e.g. spacer)			
If necessary, give advice on handling (e.g. asthma device)			
If necessary, give advice on storage (e.g. keep refrigerated)			
Mention the beneficial effects to be expected from the treatment (if necessary, specifying the duration)			
Checks understanding of treatment objectives (including long-term objectives) and provides information if necessary			
If necessary, check that the person is able to follow the prescribed treatment plan			
Indicates the most frequent <input type="checkbox"/> serious <input type="checkbox"/> adverse reactions.			
<b>Pharmaceutical monitoring and follow-up</b>	<b>Yes</b>	<b>No</b>	
Check when the next appointment or contact with the physician is scheduled			
Informs of the signs of aggravation to look out for (and advises when to consult a physician if necessary)			
Management of frequent adverse reactions: <input type="checkbox"/> explains how to prevent them (e.g. drink plenty) <input type="checkbox"/> explains how to manage them			
Management of serious adverse reactions <input type="checkbox"/> explains how to identify them (e.g. in the case of severe abdominal pain, etc.) <input type="checkbox"/> explains what to do in the event of symptoms (e.g. stopping the treatment and consultation)			
If necessary, suggests solutions to help the patient follow the treatment plan (e.g. preparing a pill-box)			
Depending on the treatment, explain the self-monitoring measures (e.g. blood sugar, etc.) and/or the importance of regular checks (e.g. INR)			
Mention additional non-medicinal measures (hydration, compresses, etc.) or lifestyle measures (diet, sleep, sport, etc.) to help manage the current situation			
Mentions additional measures to prevent re-offending (e.g. vaccination)			
If renewable prescription: <input type="checkbox"/> specifies the duration or number of pack(s) <input type="checkbox"/> specifies the deadline for coming in to remove the next packs <input type="checkbox"/> offers a copy of prescription			
Propose an information brochure and/or website tailored to the disease and treatment.			
Indicates to be available to answer any subsequent questions			
<b>Social skills, communication</b>			
Consistency of the interview:			
<input type="checkbox"/> not reached <input type="checkbox"/> partially reached <input type="checkbox"/> reached			
Verbal expression:			
<input type="checkbox"/> not reached <input type="checkbox"/> partially reached <input type="checkbox"/> reached			
Responding to the patient's needs (empathy):			
<input type="checkbox"/> not reached <input type="checkbox"/> partially reached <input type="checkbox"/> reached			

Fig. B2. Standard grid for student evaluation of simulated treatment initiation validation cases.

Standard grid for student evaluation of treatment follow-up validation cases			
<b>Assessment of the context</b>	Yes	No	<b>Comments/ details</b>
Is this for you?			
Pharmaceutical file in the pharmacy? if yes, consults it			
Checks if coming only for drug renewal or for another reason			
If new follow-up prescription, compares with previous prescription (identical drugs, identical dosages and dosage regimens)			
If renewal prescription, checks eligibility of renewals; if renewal needed with valide prescription => see decision			
Checks the date of the last appointment with the physician			
Checks the date of the next appointment with the physician			
For a woman of childbearing age: Pregnant? Breast-feeding? (since last visit to the pharmacy)			
Paediatrics: age and weight change (since last visit to the pharmacy)			
If needed, checks whether there has been any "particular event" since the last visit to the pharmacy (e.g. hospitalization)			
If needed, checks whether the next "particular event" planned (e.g. hospitalisation or travel)			
<b>Pharmaceutical history</b>	Yes	No	
Any new health problem / change since the last visit to the pharmacy?			
Change(s) in ongoing treatments (including self-initiated by the patient)?			
If changes in ongoing treatments: checks for possible consequences on drug-related interactions			
If possible, checks that therapeutic objectives are being reached (e.g. blood pressure or LDL) and that therapeutic objectives are understood			
If applicable, checks that self-monitoring is carried out (e.g. blood glucose)			
Explores the presence of frequent or serious adverse reaction(s)			
Explores the presence of new symptom(s) or complication(s) (e.g. hypoglycaemia in case of insulin treatment)			
Checks whether the drug(s) is/are being taken correctly (unit dose, number of doses taken per day) by comparing with the frequency of delivery			
Explores the presence of omissions/adherence problems (including possible discontinuation of treatment)			
Explore the possibility of misuse (overuse, abuse)			
Investigates if there are any difficulties in administering the treatment (e.g. self-injection, aerosol)			
Checks whether there are any storage problems with the treatment (e.g. discarding an eye drop one month after opening)			
<b>Validation of treatment follow-up : decision</b>	Yes	No	
Decision taken: <input type="checkbox"/> delivery of treatment according to the renewable prescription <input type="checkbox"/> agrees to deliver the drug while waiting for a new valide prescription <input type="checkbox"/> recommends a physician's consultation <input type="checkbox"/> gives a precise deadline for contacting the physician <input type="checkbox"/> recommend an emergency consultation			
If delivers drug(s) without a valide prescription gives an adequate amount of drug(s) according to date of future appointment, or likely time for improvement			
Depending on the drug(s) delivered without a valide prescription (e.g. narcotic), documents the decision and, if applicable takes the necessary steps to make the announcement			
If advises to consult, explains/ gives reason for decision ("I advise you to....because...")			
If consultation is recommended, give a sufficiently precise deadline for contacting the physician			
Proposes solutions to manage drug related problems identified: administration (dosage, administration technique); offers demonstration/monitored administration (self-injection, aerosol, etc.) insufficient effectiveness insufficient self-monitoring omissions / insufficient adherence or inappropriate use / abuse new symptom(s) or specific complication(s) adverse reaction(s) drug-related interaction(s) storage			
If relevant, discuss with the physician the detected drg related problem <input type="checkbox"/> , and solutions to consider <input type="checkbox"/>			
Propose one or more generic drug(s)			
Reminds of the dosage of the medicine(s) dispensed			
<b>Pharmaceutical monitoring and follow-up / additional advice</b>	Yes	No	
Reminds the treatment objectives			
Mentions the improvements to be expected from the proposed solutions to the drug related problem(s)			
Provides information on signs of aggravation/decompensation to watch out for			
Gives advice on non-medical management or hygiene (e.g. diet, sleep, sport, etc.) to prevent recurrence or worsening of the health problem (do's and don'ts).			
Gives advice on medication (e.g. vaccination, phytotherapy, etc.) to prevent recurrence or worsening of the health problem			
Proposes an information brochure and/or website tailored to the disease or treatment.			
Indicates to be available to answer any subsequent questions			
<b>Social skills, communication</b>			
Consistency of the interview: <input type="checkbox"/> not reached <input type="checkbox"/> partially reached <input type="checkbox"/> reached			
Verbal expression: <input type="checkbox"/> not reached <input type="checkbox"/> partially reached <input type="checkbox"/> reached			
Responding to the patient's needs (empathy): <input type="checkbox"/> not reached <input type="checkbox"/> partially reached <input type="checkbox"/> reached			

Fig. B3. Standard grid for student evaluation of simulated treatment follow-up validation cases.

Appendix C. Appendix

**Document for the student playing the pharmacist**  
Pharmaceutical triage case

**Description**

**First name, Last name:** Camille Legrain  
**Sex:** Female  
**Age:** 34  
**BMI:** 22 kg/m<sup>2</sup>  
**Known / Unknown:** Unknown to the pharmacy

It's 9 a.m. on a very hot day. This patient arrives at the pharmacy and asks you for something for her diarrhoea and vomiting.

**Definition of objectives to be achieved by students**

- Please process the patient's request and provide pharmaceutical advice in accordance with the rules of good advice practice.
- After the time allotted for solving the case, you will answer a few theoretical questions put by the expert.

**Basic resources available**

- Compendium of Swiss Medication - offline version
- "Drug interactions, cytochromes P450 and P-glycoprotein (Pgp)", Department of Clinical Pharmacology and Toxicology, HUG

**Fig. C1.** Document for the student playing the pharmacist. This introductory information is given to the student playing the pharmacist to begin a case simulation. This is the only information this person receives just before the simulation.



**Document for the student assessing the simulation**  
**Pharmaceutical triage case**

**General information about the case**

- A 34-year-old patient coming to this pharmacy for the first time and suffering from diarrhoea and vomiting.
- Symptoms began the evening before. Description of symptoms:
  - Diarrhoea: Liquid stools (no blood or mucus), the patient has already been to the toilet four times since the onset of symptoms.
  - Vomiting: the patient has already vomited three times since the onset of symptoms. If she eats, vomits what she has eaten. Manages to drink without vomiting.
- She took her temperature this morning but she doesn't have a fever.

Apart from a few mild abdominal cramps, which are bearable, the patient experiences no other symptoms.

- No red flags to report. She hasn't been on a trip recently.
- The patient is an architect and several people in her office have had gastroenteritis with similar symptoms over the last two weeks. The patient is therefore not at all surprised to be experiencing such symptoms.
- The patient occasionally takes Irfen® (ibuprofen) for headaches. No current or recently completed course of antibiotics.
- The patient is allergic to iodine and penicillin.
- She is not pregnant or breastfeeding (contraception: condoms).
- As she had recently moved house, she no longer had any medication at home. So she took nothing to relieve herself.

**For students playing the patient:** Please follow the written script as closely as possible (including caesura) to ensure uniformity.

**Objectives**

**General objectives :**

- Carrying out pharmaceutical triage using a systematic approach to history-taking (LINDAAFF type), making appropriate, exhaustive and well-founded decisions (whether to refer to a doctor or to prescribe medication), and following up to take account of the patient's additional needs and progress (cure or complication).
- Applying interview techniques that combine listening, questioning and teaching skills.

**The pharmacist must :**

- Ensure that the patient is suffering from simple gastroenteritis, with no red flags.
- Suggest specialities to the patient according to the symptoms described.
- Make the patient aware of the risk of dehydration (heat, diarrhoea, vomiting).
- Give them dietary hygiene measures and additional advice relating to diarrhoea and vomiting.

**Fig. C2.** Document for the students assessing the simulation. This information is given to the students responsible for the assessment, together with the Document for the student playing the pharmacist (see Fig. C1) and the grid (see Fig. C4). All documents are previously commented by the teachers.

**Document for the student playing the patient (Excerpt)**  
 Pharmaceutical triage case

**Scenario**  
*(The patient's text is in italic).*

**General remark**  
The patient must give a precise answer to the question asked and the answer given must be as specific as possible (avoid giving information that the pharmacist has not asked for)! If the pharmacist asks open-ended questions, the patient asks the pharmacist to clarify the question (e.g. if the question is "Do you have any other health problems?", turn it around and ask "What problems can you think of?").

**Understanding the problem**

Characterisation of the problem, preliminary assessment of the situation	
<b>What is it all about?</b>	Patient suffering from gastroenteritis (diarrhoea, vomiting), probably contracted at work (epidemic of gastroenteritis among colleagues). No red flags. Can be managed by pharmacies.
<b>Are there any other parameters that need to be taken into account?</b>	The patient is allergic to iodine and penicillin.

**Assessment of the content**

Questions asked by the pharmacist	Information provided in response to questions from the pharmacist
Who is it for?	<i>It's for me.</i>
How long have you been experiencing diarrhoea and vomiting?	<i>Since last night.</i>
Is this the first time you've experienced these symptoms?	<i>No, it's not the first time, but it's been several years since I've had vomiting and diarrhoea at the same time.</i>
How often do these symptoms recur?	<i>It's been several years since I've had vomiting and diarrhoea at the same time.</i>
Diarrhoea	
Can you describe your bowel movements?	<i>What do you mean by this?</i>
Are your stools liquid?	<i>Yes, my stools are very liquid.</i>
How often have you had a bowel movement since the onset of symptoms?	<i>I've already been to the toilet four times.</i>
Other symptoms?	<i>What symptoms are you thinking of?</i>
Abdominal cramps?	<i>Yes, I feel slight abdominal cramps but they are bearable.</i>
Lower abdominal pain?	<i>The answer to all these questions is "no".</i>
Blood/mucus/mucus in stools?	
Weakness?	
Confusion?	
Alternating diarrhoea and constipation?	
Vomiting	
How many times have you vomited since the onset of symptoms?	<i>I've already thrown up three times.</i>
In relation to eating, when do you vomit / Do you vomit what you eat?	<i>When I eat, I vomit immediately afterwards.</i>
If you drink, do you vomit the liquid?	<i>No, I can drink small amounts of liquid without vomiting. This morning I drank about a decilitre of sugar-free black tea.</i>
Do you vomit large quantities?	<i>The first time I threw up, yes, but the next two times much less so.</i>
Other symptoms ?	<i>What symptoms are you thinking of?</i>
Nausea ?	<i>Yes, I also feel nauseous.</i>
Headaches ?	<i>The answer to all these questions is "no".</i>
Stiff neck ?	
Recent trauma ?	
Cough ?	
Respiratory infection ?	
Chest pain ?	
Nosebleed ?	
Vomiting blood ?	
Intense abdominal pain ?	
Dizziness ?	
Balance problems ?	<i>I took my temperature this morning around 7am and I didn't have a fever.</i>
Fever ?	
Have you been travelling recently?	<i>No. My last trip was a year ago and I went to the Côte d'Azur.</i>

(...)

Interrupt after **maximum 4 minutes**, question 1

(Q1) The patient says: *Could you tell me what's wrong with me?*

If the pharmacist...	The patient says...
... wishes the patient to go to her doctor or to emergency, Regie 1 indication (R1)	<i>Can't you get me anything from the pharmacy? I'm not going to a GP for that!</i>
... offers alternative medicine (homeopathy, Bach flowers, spagyria, anthroposophy, etc.), Regie 2 indication (R2)	<i>Can you suggest anything else?</i>

(...)

**Fig. C3.** Excerpt of the Document for the student playing the patient, focussing on interactions. The complete vignette (including documents displayed in Fig. A and Fig. B) is given to the student who will play the patient and is previously commented by the teachers.

Grid for assessing the simulation (Excerpt)							
Pharmaceutical triage case							
Keywords separated by "/": one keyword is enough to have the points							
<b>1. Assessment of the context</b>	Yes	No	Comments	32 pts			
<b>Information on the patient's request</b>							
Who is it for?				2 / item	0-2-4-6		
How long have you been experiencing these symptoms?				max. 6 pts			
First time you have experienced these symptoms / How often do they recur?							
<b>Diarrhoea</b>							
How often have you had a bowel movement since the onset of symptoms?				2	0-2		
<b>Other symptoms / red flags</b>							
Abdominal cramps				2 / item	0-2-4		
Lower abdominal pain							
Blood / mucus / mucus in stools							
Weakness							
State of confusion							
Alternating diarrhoea and constipation							
<b>Vomiting</b>							
How often have you had a bowel movement since the onset of symptoms?				2 / item	0-2-4-6		
When you eat, when do you vomit / Do you vomit what you eat?				max. 6 pts			
When it comes to taking liquids, do you throw them up?							
<b>Other symptoms / red flags</b>							
Nausea				2 / item	0-2-4		
Headache							
Stiff neck							
Recent trauma							
Cough							
Respiratory infection							
Chest pain							
Nosebleed							
Vomiting blood							
Intense abdominal pain							
Dizziness							
Balance disorders							
<b>Other symptoms</b>							
Fever ?						5 / item	0-5-10
Recent trip ?				max. 10 pts			
<b>2. Pharmaceutical history</b>	Yes	No	Comments	14 pts			
(...)							
<b>3. Triage decision</b>	Yes	No	Comments	30 pts			
(...)							
<b>4. Recommendations for used drug(s) (if managed in the pharmacy)</b>	Yes	No	Comments	22 pts			
(...)							
<b>5. Additional advice and pharmaceutical follow-up</b>	Yes	No	Comments	31 pts			
(...)							
<b>6. Social skills, communication, ethics</b>	Yes	No	Comments	9 pts			
(...)							
<b>Total points</b>				150 pts			
General impression of examiners immediately after the examination:							
<input type="checkbox"/> Clearly a success (Rated 4.75 - 6)							
<input type="checkbox"/> Sufficient (Score 4 - 4.5)							
<input type="checkbox"/> Just insufficient (Note 3.5 - 3.75)							
<input type="checkbox"/> Clearly inadequate (Score 1 - 3.25)							
<b>Additional comments:</b>							

Fig. C4. Excerpt from the grid used for assessing the simulation. The general impression is based on the Swiss grading system, which is out of 6 points. In this case, the prevention step is not relevant and is not covered in the document.

References

1. Lim AS, Lee SWH, Karunarathne N, Caliph S. Pharmacy Students' perceptions and performance on the use of an online virtual experience tool for practicing objective structured clinical examinations. *Am J Pharm Educ.* 2020;84(11):7920. <https://doi.org/10.5688/ajpe7920>.
2. Farahani I, Farahani S, Deters MA, Schwender H, Laeer S. Efficacy of an objective structured clinical examination training approach for training pharmacy students in diabetes mellitus counseling: a randomized controlled trial. *Pharmacy.* 2020;8(4):229. <https://doi.org/10.3390/pharmacy8040229>.
3. Flood M, Strawbridge J, Sheachnasaiigh EN, et al. Supporting pharmacy students' preparation for an entry-to-practice OSCE using video cases. *Curr Pharm Teach Learn.* 2022;14(12):1525–1534. <https://doi.org/10.1016/j.cptl.2022.10.010>.
4. Mak V, Malone D, Karunarathne N, Yao W, Randell L, Vu T. A video-based reflective design to prepare first year pharmacy students for their first objective structured clinical examination (OSCE). *Healthcare (Basel).* 2022;10(2):280. <https://doi.org/10.3390/healthcare10020280>.

5. Katoue MG, Schwinghammer TL. Competency-based education in pharmacy: a review of its development, applications, and challenges. *J Eval Clin Pract.* 2020;26(4):1114–1123. <https://doi.org/10.1111/jep.13362>.
6. Chisnall B, Vince T, Hall S, Tribe R. Evaluation of outcomes of a formative objective structured clinical examination for second-year UK medical students. *Int J Med Educ.* 2015;6:76–83. <https://doi.org/10.5116/ijme.5572.a534>.
7. Lien HH, Hsu SF, Chen SC, Yeh JH. Can teaching hospitals use serial formative OSCEs to improve student performance? *BMC Res Notes.* 2016;9(1):464. <https://doi.org/10.1186/s13104-016-2266-1>.
8. Alkhateeb NE, Al-Dabbagh A, Ibrahim MI, Al-Tawil NG. Effect of a formative objective structured clinical examination on the clinical performance of undergraduate medical students in a summative examination: a randomized controlled trial. *Indian Pediatr.* 2019;56(9):745–748. <https://doi.org/10.1007/s13312-019-1641-0>.
9. Madrazo L, Lee CB, McConnell M, Khamisa K, Pugh D. No observed effect of a student-led mock objective structured clinical examination on subsequent performance scores in medical students in Canada. *J Educ Eval Health Prof.* 2019;16:14. <https://doi.org/10.3352/jeehp.2019.16.14>.
10. Lee MHM, Phua DH, Heng KWJ. The use of a formative OSCE to prepare emergency medicine residents for summative OSCEs: a mixed-methods cohort study. *Int J Emerg Med.* 2021;14(61):1–8. <https://doi.org/10.1186/s12245-021-00383-4>.
11. Al-Hashimi K, Said UN, Khan TN. Formative objective structured clinical examinations (OSCEs) as an assessment tool in UK undergraduate medical education: a review of its utility. *Cureus.* 2023;15(5), e38519. <https://doi.org/10.7759/cureus.38519>.
12. Hopwood J, Myers G, Sturrock A. Twelve tips for conducting a virtual OSCE. *Med Teach.* 2021;43(6):633–636. <https://doi.org/10.1080/0142159X.2020.1830961>.
13. Hsia SL, Zhou C, Gruenberg K, Trinh TD, Assemi M. Implementation and evaluation of a virtual objective structured clinical examination for pharmacy students. *J Am Coll Clin Pharm.* 2021;4(7):837–848. <https://doi.org/10.1002/jac5.1448>.
14. Grover S, Pandya M, Ranasinghe C, Ramji SP, Bola H, Raj S. Assessing the utility of virtual OSCE sessions as an educational tool: a national pilot study. *BMC Med Educ.* 2022;22:178. <https://doi.org/10.1186/s12909-022-03248-3>.
15. Lim GHT, Gera RD, Hany Kamel F, Thirupathirajan VAR, Albani S, Chakrabarti R. “we need more practice”: evaluating the role of virtual mock OSCEs in the undergraduate Programme during the COVID pandemic. *Adv Med Educ Pract.* 2023;14:157–166. <https://doi.org/10.2147/AMEP.S381139>.
16. Chan SCC, Choa G, Kelly J, Maru D, Rashid MA. Implementation of virtual OSCE in health professions education: a systematic review. *Med Educ.* 2023;57(9):833–843. <https://doi.org/10.1111/medu.15089>.
17. Kristina SA, Wijoyo Y. Assessment of pharmacy Students' clinical skills using objective structured clinical examination (OSCE): a literature review. *Sys Rev Pharm.* 2019;10(1):55–60. <https://doi.org/10.5530/srp.2019.1.9>.
18. Federal Office of Public Health. Federal Pharmacy Exam. Available online: <https://www.bag.admin.ch/bag/fr/home/berufe-im-gesundheitswesen/medizinualberufe/eidgenossische-pruefungen-universitaerer-medizinualberufe/eidgenossische-pruefung-in-pharmazie.html>; 2024 (accessed on 18 September 2023).
19. Efron SE, Ravid R. *Action Research in Education: A Practical Guide.* 2nd ed. New York: The Guilford Press; 2020:2–173.
20. Koshy V. *Action Research for Improving Educational Practice: A Step-by-Step Guide.* 2nd ed. London: Sage Publications Ltd; 2010:4–30.
21. Ivankova NV. *Mixed Methods Applications in Action Research: From Methods to Community Action.* Thousand Oaks, CA: Sage; 2015:12–273.
22. Aberson CL. *Applied Power Analysis for the Behavioral Sciences.* 2nd ed. New York: Routledge; 2019:2.
23. Code of ethics and professional conduct for the Geneva Institutions of Higher Education. Available online: <https://www.unige.ch/ethique/charte>; 2024 (accessed on 18 September 2023).
24. Biggs J. Constructive alignment in university teaching. *HERDSA Rev High Ed.* 2014;1:5–22.
25. Stamov Roßnagel C, Fitzallen N, Lo Baido K. Constructive alignment and the learning experience: relationships with student motivation and perceived learning demands. *High Educ Res Dev.* 2021;40(4):838–851. <https://doi.org/10.1080/07294360.2020.1787956>.
26. Deng B, Fenn NE, Plake KS. Impact of a teaching objective structured clinical examination (TOSCE) on student confidence in a pharmacy skills laboratory. *Curr Pharm Teach Learn.* 2019;11(2):145–154. <https://doi.org/10.1016/j.cptl.2018.11.009>.
27. von der Embse N, Jester D, Roy D, Post J. Test anxiety effects, predictors, and correlates: a 30-year meta-analytic review. *J Affect Disord.* 2018;227:483–493. <https://doi.org/10.1016/j.jad.2017.11.048>.
28. Brand HS, Schoonheim-Klein M. Is the OSCE more stressful? Examination anxiety and its consequences in different assessment methods in dental education. *Eur J Dent Educ.* 2009;13(3):147–153. <https://doi.org/10.1111/j.1600-0579.2008.00554.x>.
29. Martin RD, Naziruddin Z. Systematic review of student anxiety and performance during objective structured clinical examinations. *Curr Pharm Teach Learn.* 2020;12(12):1491–1497. <https://doi.org/10.1016/j.cptl.2020.07.007>.
30. Longyhore DS. Pharmacy student anxiety and success with objective structured clinical examinations. *Am J Pharm Educ.* 2017;81(1):7. <https://doi.org/10.5688/ajpe8117>.
31. Hadi MA, Ali M, Haseeb A, Mohamed MMA, Elrggal ME, Cheema E. Impact of test anxiety on pharmacy students' performance in objective structured clinical examination: a cross-sectional survey. *Int J Pharm Pract.* 2018;26(2):191–194. <https://doi.org/10.1111/ijpp.12389>.
32. Jacob M. Active Cognitive Tasks: Synthesising frameworks for active learning online. In: Garnham W, Gowers I, eds. *Active Learning in Higher Education: Theoretical Considerations and Perspectives [Online]*. London: Routledge; 2023:46–56; Chapter 5.
33. Freeman S, Eddy SL, McDonough M, et al. Active learning increases student performance in science, engineering, and mathematics. *PNAS.* 2014;111(23):8410–8415. <https://doi.org/10.1073/pnas.1319030111>.
34. Wiseheart M, Küpper-Tetzl CE, Weston T, Kim ASN, Kapler IV, Foot-Seymour V. Enhancing the quality of student learning using distributed practice. In: Dunlosky J, Rawson KA, eds. *The Cambridge handbook of cognition and education [Online]*. New York: Cambridge University Press; 2019:550–584; Chapter 22.
35. Leigh G, Steuben F. Setting learners up for success: Presimulation and Prebriefing strategies. *Teach Learn Nurs.* 2018;13(3):185–189. <https://doi.org/10.1016/j.teln.2018.03.004>.
36. INACSL Standards Committee, McDermott DS, Ludlow J, Horsley E, Meakim C. Healthcare simulation Standards of best practice. TM Prebriefing: preparation and briefing. *Clin Simul Nurs.* 2021;58:9–13. <https://doi.org/10.1016/j.cens.2021.08.008>.
37. Brooks AW. Get excited: reappraising pre-performance anxiety as excitement. *J Exp Psychol Gen.* 2014;143(3):1144–1158. <https://doi.org/10.1037/a0035325>.
38. Jamieson JP, Mendes WB, Blackstock E, Schmader T. Turning the knots in your stomach into bows: reappraising arousal improves performance on the GRE. *J Exp Soc Psychol.* 2010;46(1):208–212. <https://doi.org/10.1016/j.jesp.2009.08.015>.
39. Cook-Sather A, Bovill C, Felten P. *Engaging Students as Partners in Learning and Teaching: A Guide for Faculty*. Vol. Chapter 1. San Francisco: Jossey Bass; 2014:1–14.