

STUDENT SATISFACTION AND EXPERIENCES WITH DUAL EDUCATION
IN OCCUPATIONAL HYGIENEZharylkassyn Zh.¹, Rogova S.¹, Abitaev D.¹, Zhienbekova A.¹, Zhaketaeva N.¹,
Zharylkasynova A.¹, Nurzhanov S.¹, Zhamantayev O.¹

¹School of Public Health, Karaganda Medical University, Karaganda, Republic of Kazakhstan (100012, Republic of Kazakhstan, Karagan-da, 40 Gogol Str., e-mail: info@qmu.kz)

1. Zharylkassyn Zh., professor at the School of Public Health, NJSC "KMU", e-mail: zharylkassyn@qmu.kz
2. Rogova S., e-mail: s.rogoval@qmu.kz
3. Abitaev D., e-mail: abitaevd@qmu.kz
4. Zhienbekova A., e-mail: zhienbekoval@qmu.kz
5. Zhaketaeva N., e-mail: zhaketaeval@qmu.kz
6. Zharylkasynova A., e-mail: a.zharylkasynoval@qmu.kz
7. Nurzhanov S., e-mail: nurzhanovs@qmu.kz
8. Zhamantayev O., e-mail: zhamantayev@qmu.kz

Kazakhstan's higher medical education system has been transitioning toward competency-based learning models that emphasize integration between theoretical instruction and workplace practice. Dual education, which combines academic coursework with structured training at professional sites, represents a promising strategy for developing practical competencies in Public Health programs. However, systematic evaluation of its implementation in medical universities remains limited.

Key words: dual education, occupational hygiene, student satisfaction, practice-based learning, public health, competency-based training

Introduction. In recent years, Kazakhstan's higher medical education has undergone reforms aligning with the European Higher Education Area principles, emphasizing learning outcomes and practical competencies as per the Bologna Process [1, 2]. Current trends in higher education reform aim to reduce the number of contact hours for classroom teaching while expanding the share of independent student work. At the same time, a competency-based approach to professional education requires shifting the focus

toward practice and workplace-based learning. That is why dual training system has emerged as a strategic tool for bridging theory and practice in medical and public health education [3, 4]. In accordance with the Order of the Minister of Education and Science of the Republic of Kazakhstan “On approval of the Rules for organizing dual education”, dual training is defined as a form of vocational preparation that combines learning in an educational organization with mandatory periods of on-the-job training and professional practice at enterprises, with shared responsibility between the university, the student, and the host organization [5].

In simple words, dual education (also called dual vocational training) integrates formal schooling with on-the-job apprenticeships [6], and usually develops in the form of partnership between education institutions and work facilities. International experience confirms the effectiveness of such partnerships. Studies conducted in 17 European countries (Austria, Germany, Italy and etc.) showed that early exposure to professional environments increases employment rates and job satisfaction among graduates [7]. In the medical sector, dual training supports clinical reasoning and professional identity formation [8]. For example, Swiss nursing “relies on vocational education and training programmes ... reflecting the strong and successful tradition of the dual education system,” combining classroom programs with apprenticeships in health settings [9].

By design, dual programs tie training to real jobs and link graduates with employers. OECD data confirm that young people with vocational credentials typically enjoy higher employment rates than those with purely academic education (about 83% versus 73% employment for 25–34 year-olds in OECD countries) [10].

A distinctive feature of the dual education system is the gradual professional adaptation of students in real-world settings with minimal psychological discomfort. This approach facilitates smoother transitions from learning to employment and enhances students’ social and professional competencies [11, 12]. During dual training, students acquire not only technical skills but also communication and teamwork abilities, as they interact with professionals in real healthcare contexts. The quality of students’ performance under dual education also serves as an indicator of prior theoretical preparation and the effectiveness of curricular alignment [13]. Therefore, the integration of dual education elements into medical and public health training programs corresponds to international pedagogical trends and the national strategy for higher education modernization in Kazakhstan. It enables universities to develop graduates who are competent, adaptive, and ready for real-world professional demands.

This study aimed to explore student perceptions of integrating dual education elements into the Occupational Hygiene course for Public Health students at a leading medical university in Kazakhstan. We examined perceived benefits and systemic limitations of this model, contributing to ongoing discussions on optimizing competency-based education for future preventive medicine specialists.

Materials and methods. *Study design and rationale.* We conducted a convergent parallel mixed-methods study to evaluate student experiences with dual education

elements integrated into the Occupational Hygiene course at Karaganda Medical University during the 2023-2024 academic year. By combining structured survey responses with semi-structured interviews (Figure 1), we pursued to measure satisfaction levels across multiple dimensions and identify specific organizational barriers.

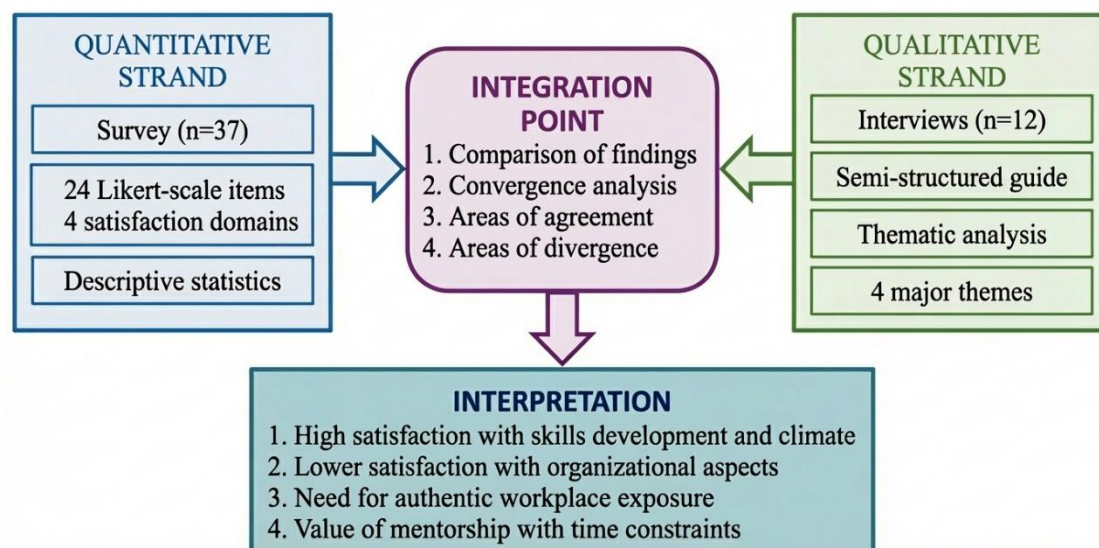


Figure 1. Mixed-methods study flowchart

Setting and context. Dual training was implemented at two institutional bases within Karaganda Medical University. The first was the School of Public Health, where theoretical instruction and laboratory exercises took place. The second was the Research Sanitary and Hygienic Laboratory of the Institute of Public and Occupational Health, which provided access to equipment and protocols used in actual sanitary surveillance activities. Selected practical sessions were also conducted at territorial health institutions that had signed formal partnership agreements with the university, though these placements were limited in frequency.

Participants and sampling. The study population consisted of all students enrolled in the Occupational Hygiene course during the spring semester of 2024. This included third-year students following the shortened educational program and fourth-year students in the standard program, both groups studying within the Public Health specialty at the School of Public Health. The total enrolled cohort comprised 37 students.

We employed total population sampling because the cohort size was small and we aimed to capture the full range of experiences within this specific educational intervention. Inclusion criteria were current enrollment in the Occupational Hygiene course, participation in at least 75% of dual training activities during the semester, and volun-

tary agreement to participate in the study. Exclusion criteria included students who had taken academic leave during the study period, and students who declined to participate when invited. No students met the exclusion criteria. All 37 enrolled students participated in the quantitative survey phase with a response rate of 100%. For the qualitative phase, we invited students to volunteer for interviews and continued recruitment until thematic saturation was achieved. Twelve students participated in individual interviews.

Quantitative data collection. We developed a structured questionnaire to assess student satisfaction with the dual education format. The instrument was constructed through a four-stage process. First, we reviewed published surveys used in studies of dual vocational education, as well as satisfaction scales applied in medical education research. Second, we conducted informal consultative meetings with five students who had completed the previous year's course to identify themes they considered important for evaluation. Third, a preliminary version containing 24 items was drafted by the research team. Fourth, three faculty members with expertise in public health education and survey methodology reviewed the instrument for content validity, suggesting revisions to wording and ensuring alignment with the study objectives.

The final questionnaire consisted of four sections corresponding to key aspects of the dual learning experience: organizational quality (six items addressing scheduling, clarity of expectations, and coordination between university and practice sites), reinforcement of theoretical knowledge (five items examining the extent to which practical activities helped consolidate classroom learning), development of practical skills (seven items evaluating hands-on training in sanitary inspection, laboratory techniques, and risk assessment), and socio-psychological climate (six items measuring comfort, support from mentors, and interpersonal relationships at training sites). Each item used a five-point Likert scale ranging from 1 (completely dissatisfied) to 5 (completely satisfied). Three open-ended questions were included at the end to allow students to describe what they valued most, what could be improved, and whether they would recommend dual training to future cohorts.

We pilot tested the questionnaire with eight students from a parallel specialty who were not part of the study sample but had experienced similar practice-based learning formats. Pilot participants completed the survey and then provided verbal feedback on item clarity and response burden. Minor adjustments were made to two items where students reported ambiguity. Internal consistency was assessed using Cronbach's alpha. The reliability coefficient for the overall scale was 0.84, with subscale values ranging from 0.76 (socio-psychological climate) to 0.88 (practical skills development), indicating acceptable to good internal consistency.

The survey was administered electronically using Google Forms during the final two weeks of the semester, after all dual training activities had been completed but before final examinations. Participation was voluntary and anonymous.

Qualitative data collection. Following the survey phase, we conducted individual semi-structured interviews to gain deeper insight into student perspectives. Inter-

view participants were recruited through a voluntary sign-up sheet distributed during class announcements and via email. We aimed for a diverse sample in terms of gender, academic performance level, and prior work experience. Interviews were scheduled at times convenient for students and held in private offices at the School of Public Health to ensure confidentiality. Each interview lasted between 20 and 32 minutes.

The interview guide was developed collaboratively by three members of the research team and organized around five thematic areas: motivations for choosing the Public Health specialty, perceptions of how dual training differed from conventional coursework, specific experiences with mentors and supervisors at practice sites, suggestions for improving the dual model, and reflections on professional readiness. The guide included primary questions with follow-up probes to encourage elaboration. For example, when discussing mentorship, the interviewer would ask students to describe a specific situation where mentor guidance was particularly helpful or, conversely, where they felt additional support would have been beneficial.

All interviews were conducted by two researchers who were not directly involved in teaching the Occupational Hygiene course to reduce potential bias related to evaluator-instructor relationships. Interviewers introduced themselves, explained the study aims, confirmed verbal consent, and emphasized that responses would not affect academic evaluation. Interviews were audio-recorded with participant permission. Recordings were transcribed by a professional transcription service. Transcripts were checked for accuracy by members of the research team and anonymized by removing any identifying details.

Data analysis. Descriptive statistics including frequencies, percentages, means, and standard deviations for each survey item and subscale were calculated in SPSS version 26.0. Given the small sample size and ordinal nature of Likert responses, we did not perform inferential statistical tests. Instead, we focused on describing patterns of satisfaction across the four evaluated dimensions. Responses to open-ended questions in the survey were coded inductively to identify recurring themes, and frequency counts were generated for the most common comments.

Qualitative data from interviews were analyzed using thematic analysis, and began with familiarization, during which two researchers independently read all transcripts in full. Next, initial codes were generated to label meaningful segments of text. These codes were applied systematically across the dataset. After coding was completed, the research team met to compare coding decisions, discuss discrepancies, and refine the codebook. Related codes were then grouped into broader themes.

Ethical considerations. The study protocol received approval from the Local Ethics Committee of Karaganda Medical University (reference number 2023-09/HE) and adhered to the principles of the Declaration of Helsinki. All participants provided informed consent. For the survey, consent was obtained electronically through an introductory statement requiring participants to confirm their agreement before proceeding to

the questions. For interviews, verbal informed consent was obtained and audio-recorded at the beginning of each session.

Results. *Participant characteristics.* All 37 students enrolled in the Occupational Hygiene course during the spring semester of 2024 completed the online satisfaction survey, representing the full cohort and yielding a 100% response rate. The group consisted of 23 students (62.2%) from the fourth-year standard program and 14 students (37.8%) from the third-year shortened program (Table 1). Among respondents, 28 were female (75.7%) and 9 were male (24.3%), reflecting the typical gender distribution in Public Health programs at the institution. The mean age was 21.4 years (standard deviation 1.2 years, range 19 to 24 years). Twelve students volunteered to participate in follow-up interviews. Among interview participants, eight were from the fourth-year cohort and four from the third-year cohort, with nine females and three males. Two interview participants reported having prior work experience in healthcare settings before entering university, while the remaining ten had no previous professional exposure to public health practice.

Table 1 - Participant characteristics (n=37)

Characteristic	Survey participants, n (%)	Interview participants, n (%)
Program level		
Fourth-year (standard program)	23 (62.2)	8 (66.7)
Third-year (shortened program)	14 (37.8)	4 (33.3)
Gender		
Female	28 (75.7)	9 (75.0)
Male	9 (24.3)	3 (25.0)
Age, years		
Mean (SD)	21.4 (1.2)	21.6 (1.3)
Range	19-24	20-24
Prior healthcare work experience		
Yes	Not collected	2 (16.7)
No	Not collected	10 (83.3)

Overall satisfaction with dual education. When asked to compare the dual learning format with traditional classroom-based instruction, 29 students (78.4%) indicated that dual training was more effective for their professional development. Six students (16.2%) perceived both approaches as equally useful, and two students (5.4%) expressed a preference for conventional teaching methods. Students who favored dual training most frequently cited in open-ended comments the opportunity to see how theoretical concepts apply in realistic settings, the chance to work with equipment and protocols

used in actual sanitary practice, and the motivational effect of engaging with professionals outside the university environment.

The overall mean satisfaction score across all 24 Likert-scale items was 4.21 (standard deviation 0.58), indicating generally high satisfaction with the dual education experience. When examined by the four predefined domains, satisfaction varied in both level and consistency, revealing specific strengths and areas requiring attention (Table 2).

Table 2 - Mean satisfaction scores by domain

Domain	Number of items	Mean score (SD)	Range	Cronbach's α
Organizational quality	6	3.87 (0.74)	2-5	0.79
Reinforcement of theoretical knowledge	5	4.15 (0.68)	2-5	0.81
Development of practical skills	7	4.38 (0.61)	2-5	0.88
Socio-psychological climate	6	4.41 (0.55)	3-5	0.76
Overall satisfaction	24	4.21 (0.58)	2-5	0.84

Note: Scores based on 5-point Likert scale (1=completely dissatisfied, 5=completely satisfied). SD=standard deviation.

Organizational quality. The organizational domain, comprising six items related to scheduling, communication of expectations, coordination between university and practice sites, clarity of learning objectives, adequacy of preparation before practical sessions, and overall logistical management, received a mean satisfaction score of 3.87 (standard deviation 0.74). This was the lowest-scoring domain among the four evaluated areas.

Regarding the location and facilities where practical training occurred, 24 students (64.9%) reported complete satisfaction with the organization of sessions at the university's Research Sanitary and Hygienic Laboratory. These students appreciated the availability of modern equipment, the structured nature of laboratory exercises, and the consistency of supervision. However, 13 students (35.1%) indicated partial satisfaction, specifying in open-ended responses that while the laboratory environment was well organized, they would have preferred more opportunities to conduct practical work in actual industrial or occupational health settings rather than solely within the university infrastructure. Representative comments included observations that laboratory simulations, although useful, did not fully capture the complexity and unpredictability of real workplaces, and that exposure to real industrial environments would better prepare them for post-graduation employment.

When asked specifically about the clarity of expectations and learning objectives for dual training activities, 26 students (70.3%) were completely satisfied, 9 students (24.3%) were moderately satisfied, and 2 students (5.4%) expressed dissatisfaction. The students who reported lower satisfaction mentioned that at the beginning of the

semester, the structure of dual training was not explained thoroughly, leading to initial confusion about what would be expected during practical sessions and how these activities would be assessed.

Satisfaction with the coordination between classroom instruction and practice-based learning was reported as complete by 27 students (73.0%), partial by 8 students (21.6%), and inadequate by 2 students (5.4%).

Reinforcement of theoretical knowledge. The second domain assessed whether dual training helped students consolidate and deepen their understanding of theoretical material presented in lectures. This subscale contained five items and yielded a mean satisfaction score of 4.15 (standard deviation 0.68). Twenty-eight students (75.7%) indicated complete satisfaction with how practical activities reinforced classroom learning, while nine students (24.3%) felt their expectations in this area were only partially met. No students reported dissatisfaction. When asked whether dual training improved their ability to apply hygiene standards and regulations in practical contexts, 31 students (83.8%) agreed strongly, 5 students (13.5%) agreed moderately, and 1 student (2.7%) remained neutral.

Satisfaction with the balance between theory and practice was reported as optimal by 30 students (81.1%), while 7 students (18.9%) felt that additional theoretical preparation would have been helpful before some practical sessions. These students suggested that brief pre-session seminars reviewing relevant regulations or methodologies could enhance their confidence and performance during practical activities.

Development of practical skills. The practical skills domain contained seven items evaluating training in sanitary inspection techniques, laboratory analysis methods, occupational risk assessment procedures, documentation and reporting skills, use of specialized equipment, interpretation of hygiene measurements, and communication with workplace representatives. This domain received the highest mean satisfaction score of 4.38 (standard deviation 0.61).

Thirty-two students (86.5%) expressed complete satisfaction with the development of practical skills through dual training. Four students (10.8%) reported partial satisfaction, and one student (2.7%) indicated dissatisfaction without providing explanatory comments in the open-ended section. Open-ended responses frequently mentioned gaining confidence in operating instruments such as noise level meters, air sampling devices, and photometric equipment, as well as learning standardized protocols for workplace inspections.

When asked specifically about confidence in performing occupational hygiene procedures independently after completing dual training, 30 students (81.1%) reported feeling confident or very confident, 6 students (16.2%) felt moderately confident, and 1 student (2.7%) remained uncertain. The variation in confidence levels appeared related to the extent of hands-on practice each student received, which depended partly on group size during laboratory sessions and the availability of equipment.

Satisfaction with mentorship and guidance during practical skill development was high, with 33 students (89.2%) expressing complete satisfaction. Students valued the accessibility of laboratory supervisors and their willingness to demonstrate procedures, answer questions, and provide corrective feedback. Four students (10.8%) indicated that while mentors were generally helpful, time constraints sometimes prevented in-depth discussions or personalized instruction, particularly when multiple students needed assistance simultaneously.

Socio-psychological climate. The socio-psychological climate domain included six items measuring comfort and sense of belonging at training sites, quality of interpersonal relationships with mentors and peers, emotional support during practical sessions, respect and encouragement from supervisors, overall psychological safety, and willingness to ask questions or admit uncertainty. This domain received a mean score of 4.41 (standard deviation 0.55), nearly equivalent to the practical skills domain.

Thirty-four students (91.9%) rated the socio-psychological climate positively, describing training environments as supportive, respectful, and encouraging. Three students (8.1%) provided neutral ratings but did not elaborate on specific concerns. No students reported negative experiences. Open-ended comments emphasized the importance of friendly and approachable mentors who created an atmosphere where students felt comfortable asking questions, making mistakes, and seeking clarification. One student noted that mentors treated them as junior colleagues rather than merely as students, which enhanced motivation and fostered a sense of professional identity.

When asked whether they would recommend dual training to students in future cohorts, 35 students (94.6%) responded affirmatively, 2 students (5.4%) were undecided, and none responded negatively.

Thematic analysis of student interviews. Analysis of the twelve semi-structured interviews produced four major themes (Table 3) that elaborated on the quantitative patterns and provided explanatory depth regarding student experiences with dual education.

Table 3 - Major themes from qualitative analysis

Theme	Description	Illustrative Quotation
1	2	3
Motivational value of practice-based learning	Students described enhanced engagement and professional relevance when theoretical knowledge was applied in practical contexts	“When you sit in a classroom and hear about permissible noise levels, it is just numbers on a slide. But when you go to the laboratory and actually measure sound intensity...suddenly those numbers mean something.”
Mentor accessibility and quality of feedback	Quality of mentorship emerged as a key determinant of satisfaction. Students valued patient explanation and professional context but noted time constraints limited individualized attention	“Our supervisor...did not just tell us to follow the protocol step by step. She explained the history of why certain standards were developed...That kind of teaching helps you understand the bigger picture, not just memorize techniques.”

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1	2	3
Organizational challenges related to scheduling and site availability	Students recognized logistical complexity but noted scheduling conflicts and limited external placements as areas requiring improvement	“We had a laboratory session scheduled on the same afternoon as an important seminar by visiting professor, so I had to choose which one to attend. That should not happen because both are important.”
Tension between laboratory-based and industrial field experiences	Students desire more exposure to authentic workplace environments with inherent unpredictability	“The university laboratory is excellent for learning basic techniques, but it is still a controlled academic environment. Real factories...have different dynamics...”

Theme 1: Motivational value of practice-based learning

Students consistently described dual training as more engaging and motivating than conventional lectures. They explained that seeing the practical application of theoretical knowledge made the subject matter feel relevant and worthwhile. One fourth-year student stated, “When you sit in a classroom and hear about permissible noise levels, it is just numbers on a slide. But when you go to the laboratory and actually measure sound intensity, adjust the equipment, and see how different environments produce different readings, suddenly those numbers mean something. You understand why the regulations exist and what happens if they are ignored”.

Several students mentioned that dual training helped them confirm their career choice. A third-year student who had been uncertain about specializing in occupational health explained, “I was not sure if this field was right for me because it seemed very bureaucratic and dry. But during the practical sessions I realized that the work is actually quite dynamic. It made me more confident about my future in this profession”.

The motivational effect extended beyond interest in the subject matter. Students reported feeling more responsible for their own learning when they knew they would need to apply knowledge in practical contexts. One student described preparing more thoroughly for practical sessions than for traditional exams, explaining, “If you do not understand the procedure correctly, you cannot just memorize an answer. You have to actually do something, and if you do it wrong, it is obvious. That made me study more carefully because I did not want to look incompetent in front of the mentor or my groupmates”.

Theme 2: Mentor accessibility and quality of feedback

The quality of mentorship emerged as a determining factor in student satisfaction. Students highly valued mentors who were patient, approachable, and willing to explain not only how to perform procedures but also why particular methods were preferred and what factors influenced decision-making in professional practice.

One student described an exemplary mentoring interaction: “Our supervisor at the laboratory did not just tell us to follow the protocol step by step. She explained the

history of why certain standards were developed, what mistakes people made in the past that led to those standards, and what can go wrong if you cut corners. She also encouraged us to ask questions even if they seemed basic. That kind of teaching helps you understand the bigger picture, not just memorize techniques”.

However, students also identified limitations. Several mentioned that while mentors were knowledgeable and supportive, the time allocated for each practical session was often insufficient for meaningful dialogue. One student explained, “We had three hours for the laboratory session, but with a group of eight students and only one mentor, each of us could only get a few minutes of individual attention. If you wanted to discuss something in depth or needed help troubleshooting a problem, you had to wait, and sometimes we ran out of time before everyone got their questions answered”.

Students expressed a desire for structured debriefing sessions following practical activities where they could reflect on what they learned, discuss challenging situations, and receive personalized feedback on their performance. One student suggested, “It would help if after every practical session we had thirty minutes to sit down with the mentor and talk through what we did, what went well, what we struggled with, and what we should focus on improving next time. Right now, we finish the tasks and then move on to the next class without really processing the experience”.

Theme 3: Organizational challenges related to scheduling and site availability

Students recognized that implementing dual training required significant logistical coordination, and while they appreciated the effort, they also noted organizational difficulties. Scheduling was a common concern. Several students mentioned that practical sessions sometimes conflicted with other courses or were scheduled at inconvenient times, making it difficult to fully participate. One student noted, “We had a laboratory session scheduled on the same afternoon as an important seminar by visiting professor, so I had to choose which one to attend. That should not happen because both are important”.

The limited availability of external practice sites was another recurring issue. Students understood that arranging placements at industrial enterprises involved negotiating access, ensuring safety, and coordinating with workplace supervisors who had their own responsibilities. However, they felt that the lack of field-based training was a significant gap. One student explained, “The university laboratory is excellent for learning basic techniques, but it is still a controlled academic environment. Real factories, construction sites, or healthcare facilities have different dynamics. There are time pressures, budget constraints, equipment that is not always properly maintained, and workers who may not cooperate with inspections. We need exposure to those realities”.

Another student mentioned the contrast between dual training in their program and experiences described by peers in other specialties: “My friend who studies in Italy told me that her dual program includes several weeks per semester working full-time at a partner company. She gets to see how the organization actually operates, builds relationships with her supervisor, and contributes to real projects. Our version of dual

training feels more like enhanced practical classes rather than genuine integration into a workplace”.

Theme 4: Tension between laboratory-based and industrial field experiences

Students expressed ambivalence about the balance between university-based laboratory training and external field placements. On one hand, they valued the safety, structure, and pedagogical intentionality of laboratory sessions. One student noted, “In the laboratory, the mentor can control the conditions, demonstrate techniques clearly, and make sure everyone gets hands-on practice. If we went to a busy factory, there might not be enough time or space for everyone to participate, and we might just end up observing rather than doing”.

On the other hand, students felt that excessive reliance on laboratory simulations limited the authenticity of their learning. A fourth-year student reflected, “When we conduct a workplace risk assessment in the laboratory, we are evaluating a scenario that was designed for teaching. The hazards are obvious, the documentation is organized, and everything follows the textbook procedure. But in a real workplace, you have to identify hazards that are not immediately visible, deal with incomplete information, and navigate situations where the employer might be defensive or uncooperative. Those are the skills we really need, and we cannot learn them in a university laboratory”.

Students also recognized the resource constraints that limited external placements. One student acknowledged, “I understand that the university cannot easily arrange for all of us to visit factories regularly. It requires permissions, insurance, transportation, and coordination with busy professionals. But maybe even two or three field visits per semester would make a big difference in how prepared we feel for our future work”.

Discussion. This study provides empirical evidence that introducing dual education elements into the Occupational Hygiene curriculum can enhance student satisfaction and perceived readiness for professional practice in Public Health programs. The majority of participating students rated the dual learning format as superior to conventional classroom instruction, with particularly high satisfaction regarding practical skill development and the supportive learning environment at training sites. These findings align with broader literature demonstrating that work-integrated learning approaches improve motivation and self-assessed competence among health professions students.

Our findings are consistent with international studies examining dual and cooperative education models in health professions training. Research conducted across European vocational education systems has consistently demonstrated that students who participate in workplace-based learning report higher employment readiness and smoother transitions into professional roles compared to those receiving exclusively classroom-based instruction. A comprehensive analysis of dual training outcomes in Germany, Austria, and Switzerland found that graduates from programs incorporating substantial workplace components achieved employment within three months of graduation at rates exceeding 85%, compared to approximately 65% for conventional

program graduates [14]. While our study did not measure actual employment outcomes, the high student satisfaction and self-reported confidence suggest that similar benefits may accrue in the Kazakhstan context.

The motivational advantages of practice-based learning observed in our study parallel findings from medical education research. Yardley and colleagues conducted a systematic review of early clinical exposure programs and found that students who engaged with clinical environments during preclinical years demonstrated increased motivation, clearer understanding of professional roles, and better integration of basic science knowledge with clinical reasoning [15]. Although our study focused on public health rather than clinical medicine, the underlying mechanism appears similar. When students observe how occupational hygiene principles protect worker health in real settings, the relevance of their studies becomes immediately apparent rather than remaining an abstract future possibility.

The importance of mentor quality emerged strongly in both our quantitative and qualitative data. This finding aligns with extensive literature on clinical supervision and workplace learning. Dornan and colleagues examined the characteristics of effective clinical learning environments and identified supervisor enthusiasm, availability, and willingness to explain reasoning as key determinants of student learning outcomes [16]. Their work emphasized that learning in authentic professional settings depends heavily on the social and relational dimensions of practice, not merely on physical presence in workplaces. Students in our study echoed these themes when describing how mentors who contextualized procedures within broader professional frameworks enhanced their understanding beyond what protocol memorization alone could achieve.

However, our students also reported time constraints that limited opportunities for individualized feedback and reflective discussion. This challenge reflects a common tension in workplace-based education documented across multiple health professions. There are arguments that busy clinical or public health practitioners often struggle to balance their service obligations with teaching responsibilities, leading to supervision that emphasizes task completion over deep learning [17]. They propose structured debriefing as an essential but frequently neglected component of workplace learning, allowing students to articulate what they observed, question assumptions, and develop metacognitive awareness of their developing competence. Our findings suggest that even in well-organized dual training programs, dedicated time for such reflection must be explicitly planned and protected rather than assumed to occur spontaneously.

The desire for more exposure to genuine industrial environments rather than university laboratories represents a noteworthy finding. While laboratory-based simulation offers obvious advantages in terms of safety, control, and pedagogical intentionality, students recognized that authentic workplaces present complexity that cannot be fully replicated in academic settings. This observation aligns with Billett's research on workplace learning, which distinguishes between "rehearsal" environments designed primarily for learning and genuine work settings where production demands,

interpersonal dynamics, and resource constraints introduce authentic challenges [18]. Simulated settings allow repeated practice and error correction without consequences, while authentic workplaces require students to develop adaptive expertise by responding to unpredictable situations. Our findings suggest that optimal dual education models should incorporate both, sequencing laboratory practice before workplace immersion to ensure students arrive at external sites with sufficient foundational competence to benefit from authentic exposure.

The organizational challenges identified by students reflect systemic barriers that affect dual education implementation in many countries. Research examining workplace-based learning across multiple European vocational education systems has consistently identified securing adequate external placements as one of the most significant obstacles to successful dual training programs [19]. In healthcare and public health specifically, workplace learning partnerships face additional complexity because host organizations must balance service delivery obligations with educational responsibilities while maintaining patient safety and data confidentiality. Research on clinical education has documented that workplace supervisors frequently experience role conflict between their professional duties and teaching commitments, leading to variable quality of student supervision depending on workload pressures [20]. In the occupational hygiene context, many enterprises operate with lean public health staff who may not have capacity to accommodate student learners regularly. Additionally, organizations may be reluctant to allow students access to production areas due to concerns about proprietary information, compliance with safety regulations, or potential liability if students are injured during workplace activities. These practical realities mean that universities cannot simply mandate increased workplace exposure without substantial effort to build partnerships, negotiate formal agreements addressing liability and confidentiality, provide training and support to workplace supervisors, and potentially offer financial or other incentives to offset the costs organizations incur when hosting students.

Conclusions. This study provides evidence that incorporating dual education elements into Public Health curricula can enhance student engagement, satisfaction, and perceived professional readiness. Students participating in the modified Occupational Hygiene course valued opportunities to apply theoretical knowledge in practice-based contexts, appreciated supportive mentorship from workplace supervisors, and reported increased confidence in performing professional tasks. These positive outcomes occurred despite organizational limitations including restricted access to authentic industrial settings and insufficient time for reflective learning. The findings suggest that dual education represents a viable approach for addressing the persistent theory-practice gap in health professions education. However, realizing its full potential requires substantial institutional commitment extending beyond pedagogical enthusiasm to include strategic partnership development, mentor preparation, curriculum redesign allocating adequate time for workplace learning and reflection, and sustainable resource allocation. Universities cannot simply append workplace experiences to existing programs and expect

transformation. Rather, dual education demands systemic changes in how institutions conceptualize their educational mission, structure their relationships with the professional community, and allocate their resources.

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ЕҢБЕК ГИГИЕНАСЫ БОЙЫНША ДУАЛЬДЫ БІЛІМ БЕРУ ЖАҒДАЙЫНДАҒЫ СТУДЕНТТЕРДІҢ ҚАНАҒАТТАНУЫ МЕН ОҚУ ТӘЖІРИБЕСІ

**Жарылқасын Ж.¹, Рогова С.¹, Абитаев Д.¹, Жиенбекова А.¹, Жакетаева Н.¹,
Жарылқасынова А.¹, Нұржанов С.¹, Жамантаев О.¹**

¹Қоғамдық денсаулық сақтау мектебі, «Қарағанды медицина университеті» КеАҚ, (100012, Қазақстан Республикасы, Қарағанды қ., Гоголь көшесі, 40, e-mail: info@qmu.kz)

1. Жарылқасын Ж., «ҚМУ» КеАҚ Қоғамдық денсаулық сақтау мектебінің профессоры, e-mail: zharylkassyn@qmu.kz
2. Рогова С., e-mail: s.rogova@qmu.kz
3. Абитаев Д., e-mail: abitaevd@qmu.kz
4. Жиенбекова А., e-mail: zhienbekova@qmu.kz
5. Жакетаева Н., e-mail: zhaketaeva@qmu.kz
6. Жарылқасынова А., e-mail: a.zharylkasynova@qmu.kz
7. Нұржанов С., e-mail: nurzhanovs@qmu.kz
8. Жамантаев О., e-mail: zhamantaev@qmu.kz

Тұжырым

Қазақстандағы жоғары медициналық білім беру жүйесі құзыреттілікке негізделген және теориялық дайындықты жұмыс орнындағы практикалық қызметпен ұштастыруға бағытталған оқыту үлгілеріне кезең-кезеңімен көшуде. Академиялық оқытуды кәсіби базалардағы құрылымдалған тәжірибемен біріктіретін дуальды білім беру қоғамдық денсаулық сақтау бағдарламаларында қолданбалы дағдыларды қалыптастырудың тиімді жолы ретінде қарастырылады. Соған қарамастан, медициналық университеттерде бұл тәсілді енгізу нәтижелеріне жүйелі баға беру әлі де шектеулі деңгейде қалып отыр.

Түйінді сөздер: дуальды білім беру, еңбек гигиенасы, студенттердің қанағаттануы, практикаға негізделген оқыту, қоғамдық денсаулық сақтау, құзыреттілікке негізделген дайындық

УДОВЛЕТВОРЕННОСТЬ СТУДЕНТОВ И ИХ ОПЫТ ОБУЧЕНИЯ ПО ДИСЦИПЛИНЕ «ГИГИЕНА ТРУДА» В УСЛОВИЯХ ДУАЛЬНОГО ОБРАЗОВАНИЯ

**Жарылкасын Ж.¹, Рогова С.¹, Абитаев Д.¹, Жиенбекова А.¹, Жакетаева Н.¹,
Жарылкасынова А.¹, Нуржанов С.¹, Жамантаев О.¹**

¹Школа общественного здравоохранения, НАО «Медицинский университет Караганды» (100012, Республика Казахстан, г.Караганда, Гоголя 40, e-mail: info@qmu.kz)

1. Жарылкасын Ж., «КМУ» профессор школы общественного здоровья НАО «КМУ», e-mail: zharylkassyn@qmu.kz
2. Рогова С., e-mail: s.rogoва@qmu.kz
3. Абитаев Д., e-mail: abitaevd@qmu.kz
4. Жиенбекова А., e-mail: zhienbekova@qmu.kz
5. Жакетаева Н., e-mail: zhaketaeva@qmu.kz
6. Жарылкасынова А., e-mail: a.zharylkasynova@qmu.kz
7. Нуржанов С., e-mail: nurzhanovs@qmu.kz
8. Жамантаев О., e-mail: zhamantaev@qmu.kz

Резюме

Система высшего медицинского образования Казахстана находится в процессе перехода к моделям обучения, основанным на формировании компетенций и ориентированным на интеграцию теоретической подготовки с практической деятельностью на рабочих местах. Дуальное образование, сочетающее академическое обучение со структурированной практической подготовкой на профессиональных базах, рассматривается как перспективный подход к развитию прикладных компетенций в программах по общественному здравоохранению. При этом остается ограниченной систематическая оценка внедрения данного подхода в медицинских университетах.

Ключевые слова: дуальное образование, профессиональная гигиена, удовлетворенность студентов, практико-ориентированное обучение, общественное здравоохранение, компетентностная подготовка