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Needs Analysis Report

Transforming Ukrainian Agricultural Education for the Digital Era (TUADIG)

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Summary

The purpose of this Needs Analysis was to identify key development needs for teacher competence, institutional practices, and alignment with labour-market expectations, in order to inform the design of future project trainings.

The analysis is based on two main data sources: a teacher survey (n=57) and an industry partner survey (n=13), complemented by existing documentation on VET development and digital transformation. The findings combine teachers' self-assessments of their current competence and development needs with stakeholder perspectives on emerging technologies, future skills requirements, and perceived gaps in current education provision.

The results show that simulation-based learning is already present in participating institutions, but its use remains uneven and often limited to specific contexts or individuals. It is primarily used for practical purposes, such as learning equipment operation and practising skills safely. Teachers generally demonstrate a solid pedagogical foundation and are confident in general teaching and digital tool use. However, important development needs emerge in the design and facilitation of simulation-based learning, particularly in creating structured, goal-oriented, and psychologically safe learning experiences. In addition, assessment and feedback practices in simulation contexts appear mainly teacher-led, with limited use of reflective, learner-centred approaches such as self-assessment, peer feedback, and structured debriefing.

In terms of digital competence, teachers report relatively strong skills in the use of general digital tools and learning environments, as well as positive attitudes towards adopting new technologies. However, competence in specialised and emerging agricultural technologies such as drones, precision farming systems, and immersive learning environments is significantly more limited. This gap is reinforced by institutional conditions, where access to advanced technologies is uneven and teaching still relies heavily on conventional machinery. According to stakeholders agriculture is increasingly digital, automated, and data-driven, and they identify clear future competence needs in areas such as smart machinery, data use, system integration, and autonomous technologies. They also assess that current education meets these needs only moderately well.

Based on these findings, the analysis highlights several key implications for training design. Future TUADIG trainings can prioritise sector-specific technological competence alongside strong pedagogical grounding. Particular emphasis should be placed on developing teachers' ability to design, facilitate, and assess simulation-based learning in meaningful ways. Training should also strengthen reflective and learner-centred practices, improve alignment between education and real work processes, and support the pedagogical integration of modern technologies. In addition, training design should account for varying starting points

among participants and support the development of shared institutional practices for using simulation equipment.

The analysis suggests that effective capacity building requires an integrated approach that combines technological competence, simulation pedagogy, and strong connections to labour-market needs. This approach will guide TUADIG in designing practical, relevant, and future-oriented training that supports the transformation of agricultural education in Ukraine.

Резюме

Метою цього аналізу потреб було визначення ключових потреб розвитку компетентностей викладачів, інституційних практик та відповідності вимогам ринку праці для подальшого врахування під час розроблення майбутніх навчальних заходів проєкту.

Аналіз базується на двох основних джерелах даних: опитуванні викладачів (кількість респондентів - 57) та опитуванні представників галузі (кількість респондентів - 13), доповнених наявною документацією щодо розвитку професійної освіти та цифрової трансформації. Результати поєднують самооцінку викладачами власних компетентностей і потреб професійного розвитку з баченням зацікавлених сторін новітніх технологій, майбутніх вимог до навичок та прогалин у чинній освітній підготовці.

Результати показують, що навчання на основі симуляції вже використовується в закладах-учасниках, проте його застосування залишається нерівномірним і часто обмежується окремими напрямками або окремими викладачами. Переважно воно використовується для практичних цілей, таких як навчання роботі з обладнанням і безпечно відпрацювання навичок. Загалом викладачі мають міцну педагогічну базу та впевнено використовують цифрові інструменти в освітньому процесі. Водночас виявлено суттєві потреби розвитку у сфері проєктування та симуляційного навчання, особливо щодо створення структурованих, цілеспрямованих і психологічно безпечних навчальних ситуацій. Крім того, оцінювання та надання зворотного зв'язку в умовах симуляції здебільшого залишаються орієнтованими на викладача, тоді як рефлексивні та студентоцентровані підходи, такі як самооцінювання, взаємооцінювання та структурований дебрифінг, використовуються обмежено.

Щодо цифрової компетентності, викладачі повідомляють про достатньо високий рівень володіння загальними цифровими інструментами та освітніми платформами, а також демонструють позитивне ставлення до впровадження нових технологій. Проте рівень компетентності у використанні спеціалізованих і новітніх аграрних технологій, таких як дрони, системи точного землеробства та імерсивні навчальні середовища, є значно

нижчим. Ця прогалина посилюється інституційними умовами, оскільки доступ до сучасних технологій є нерівномірним, а навчання все ще значною мірою спирається на використання традиційної техніки. За словами зацікавлених сторін, сільське господарство стає дедалі більш цифровим, автоматизованим та орієнтованим на дані. Представники галузі визначають чіткі майбутні потреби в компетенціях у таких сферах, як інтелектуальна техніка, використання даних, системна інтеграція та автономні технології. Водночас вони оцінюють здатність сучасної освіти задовольняти ці потреби лише як помірну.

На основі отриманих результатів аналіз визначає кілька ключових орієнтирів для розроблення навчальних програм. Майбутні тренінги TUADIG мають приділяти пріоритетну увагу розвитку галузевих технологічних компетентностей у поєднанні з міцним педагогічною підґрунтям. Особливий акцент слід зробити на розвитку здатності викладачів проєктувати, проводити та оцінювати симуляційне навчання змістовним і результативним способом. Навчання також має посилювати рефлексивні та студентоцентровані практики, покращувати відповідність освітнього процесу реальним виробничим процесам, підтримувати педагогічну інтеграцію сучасних технологій. Крім того, під час розроблення програм необхідно враховувати різний початковий рівень підготовки учасників та сприяти формуванню спільних інституційних практик використання симуляційного обладнання.

Аналіз свідчить, що ефективне нарощування потенціалу потребує комплексного підходу, який поєднує технологічні компетентності, педагогіку симуляційного навчання та тісний зв'язок із потребами ринку праці. Такий підхід стане основою для розроблення в межах проєкту TUADIG практичних, актуальних та орієнтованих на майбутнє навчальних програм, які сприятимуть трансформації аграрної освіти в Україні.

1. Background

Transforming Ukrainian Agricultural Education for the Digital Era (TUADIG) is a development project that supports the modernisation of agricultural vocational education and training (VET) in Ukraine. The project responds to changes in agriculture, where digitalisation, automation and data-driven farming practices are increasingly part of everyday work. At the same time, VET institutions are expected to prepare learners for a labour market that values both modern technical skills and the ability to adapt, solve problems and learn continuously. TUADIG focuses especially on strengthening the professional development of VET teachers, enabling them to integrate contemporary educational technologies and methods into teaching and learning.

To ensure that TUADIG responds to real and prioritised needs, this needs analysis was conducted to build a shared understanding of (1) teachers' own perceptions of their current competence and development needs in the project's key themes and (2) future-oriented skills and competence gaps recognised by industry partners. The analysis has a dual purpose. First, it captures industry perspectives on the most important future competences in modern agriculture and identifies the most significant skills gaps observed in current training and graduate readiness. Second, it builds learner understanding by exploring how teachers assess their own competence and confidence in competence-based education, simulation pedagogy and digitalisation-related topics. This combined perspective supports evidence-informed decisions on what kinds of capacity building, training content and practical support TUADIG should provide.

The needs analysis draws on both existing evidence and primary data collection. It is informed by prior reports and studies on the Ukrainian VET context and reform needs, and it is complemented by two targeted surveys conducted within the project. The teacher survey collected responses from 60 teachers across participating institutions, while the industry partner survey received 13 responses. Together, these data sources provide a structured view of current competence levels, perceived development priorities and the expectations of the labour market.

The scope of this needs analysis is aligned with TUADIG's main development areas: competence-based education, simulation pedagogy, immersive learning environments, and the technologies and devices needed to implement modern, digital and simulation-based learning. The findings are used as a foundation for designing and prioritising TUADIG professional development activities, ensuring that the project's trainings offer is practical, relevant and directly connected to the needs of teachers and the agricultural sector.

2. Data collection

The needs analysis was based on two main data sources: existing documentation and survey data.

2.1 Existing documentation

We drew on previous reports and studies examining the development needs of vocational education and training (VET) in Ukraine (such as Jeon 2025, Eurydice 2026), as well as the impacts of digitalisation and the green transition on the agriculture sector (Prihodko et al. 2023, Hrymak et al. 2024). In addition, the reviewed materials highlighted current developmental needs within the VET system, including the

pedagogical state, the extent to which cooperation with working life is realised, and the availability of digital learning solutions. This documentation provided the contextual foundation for both the design of the surveys and the interpretation of the findings.

This needs analysis was guided by a simple conceptual framework in which development needs are understood as gaps between current capacity and the competences, resources, and practices required in a changing professional context. In this report, the framework brings together three complementary perspectives. First, needs analysis is used to identify mismatches between current conditions and desired future performance, so that development measures can be targeted to the most relevant areas (Watkins, Meiers, & Visser, 2012). Second, teachers' digital and digital-pedagogical competence is approached as more than technical ability: it includes the purposeful pedagogical use of digital tools, the selection and creation of digital resources, assessment, learner support, and continuous professional learning (Redecker & Punie, 2017). Third, simulation-based learning is understood as a pedagogical approach in which learning is strengthened through structured practice, facilitation, feedback, reflection, and debriefing (Endacott et al., 2018). Together, these perspectives support the interpretation of the findings by linking teachers' self-assessed competence, institutional conditions, and labour-market expectations to the practical design of TUADIG activities.

2.2 Survey data

Two targeted surveys were conducted as part of the project.

The **teacher survey** (60 respondents) was addressed to vocational education agriculture teachers in the four participating VET institutions to understand their current use of simulation-based learning, their self-assessed competence in digital and emerging agricultural technologies, and their competence development needs for the TUADIG training design.

The **industry partner survey** (13 respondents) targeted labour market stakeholders within TUADIG's cooperation network to capture labour market perspectives on future technologies, competence needs, current skill levels, and implications for vocational education. Their perspectives provided up-to-date insights into current skills needs in the agricultural sector and the changes affecting them.

The surveys were conducted as part of the project's internal data collection activities, and participation was voluntary. Both surveys were administered online via Webropol in March–April 2026. The survey language was Ukrainian. The dissemination of the surveys was coordinated by Ukrainian partners.

2.3 Respondents

Teacher respondents

The analysis below is based on 57 responses (out of 60 total survey respondents) who gave permission to use their responses for research.

As shown in Figure 1, respondents were predominantly teachers/trainers (52 respondents; 91%), with smaller shares of administration/management (4; 7%), instructors/coaches (2; 4%), and developers/RDI experts (1; 2%).

Role

Number of respondents: 57, selected answers: 60

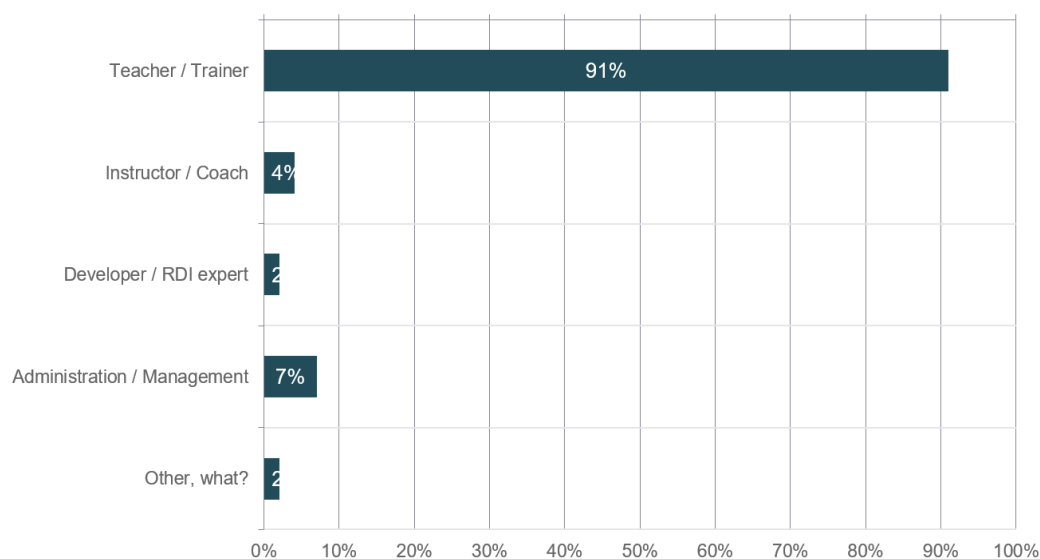


Figure 1. Professional role of teacher survey respondents.

Figure 2 illustrates teachers' experience in designing and implementing learning situations using different technologies (including hybrid and online learning) was mixed: 38% reported 1–5 years of experience and another 39% reported more than 10 years, while 14% had 5–10 years and 9% less than one year.

Experience in designing and implementing learning situations using different technologies (including hybrid and online learning).

Number of respondents: 57

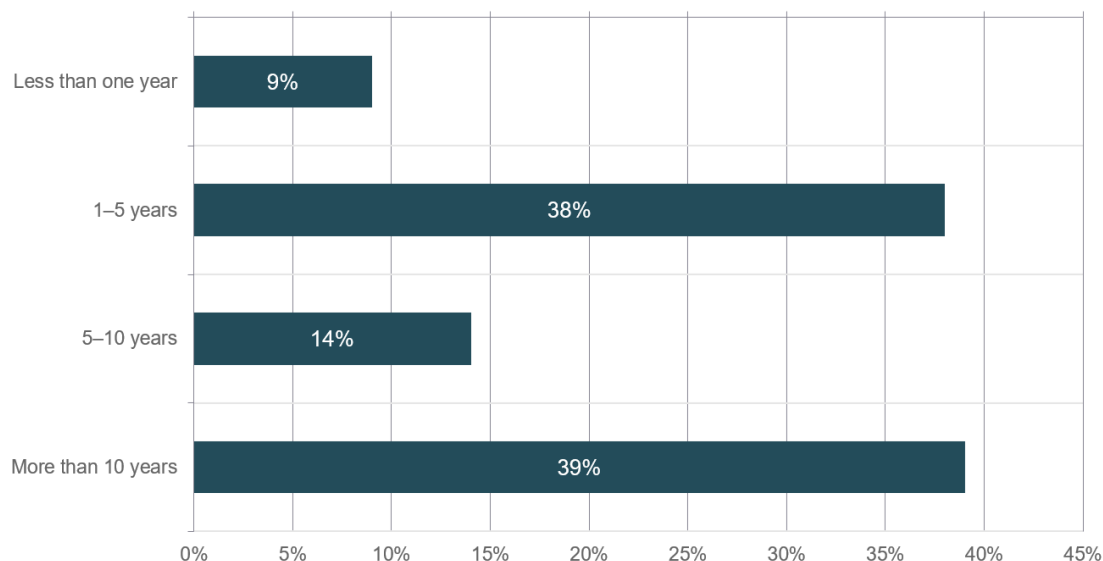


Figure 2. Teacher respondents' experience in designing and implementing learning situations using different technologies.

In terms of general instructor experience (also beyond simulation instruction), 39% reported more than 10 years and 28% less than one year. A further 24% reported 1–5 years and 9% 5–10 years (Figure 3).

Experience as an instructor (also other than simulation instruction).

Number of respondents: 57

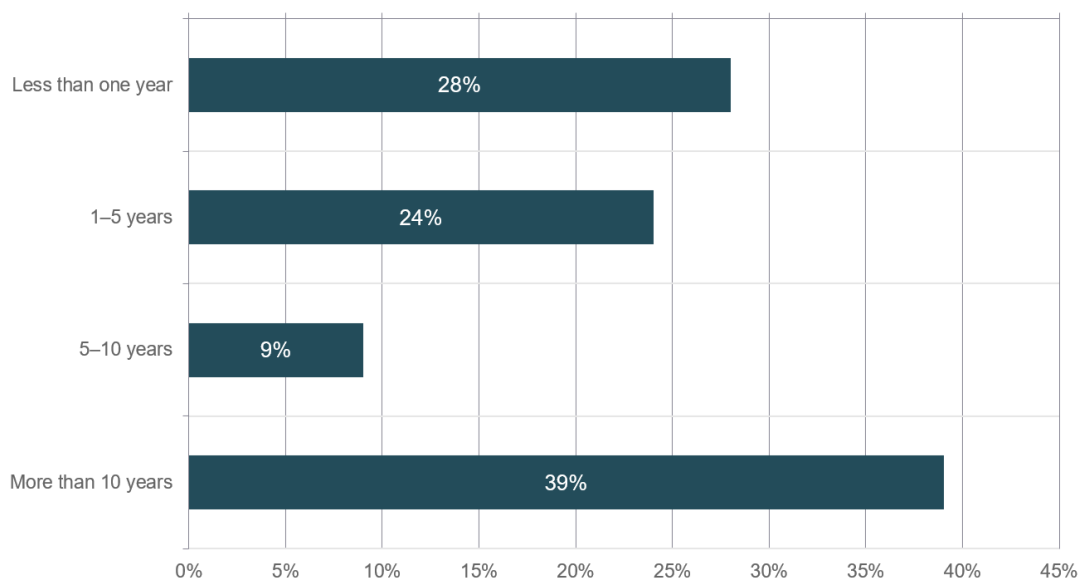


Figure 3. Teacher respondents' general instructor experience.

Industry respondents

The analysis below is based on 13 respondents. Figure 4 shows the respondents represented mainly farms/farmers (69%), with smaller shares from machinery contractors/service providers (8%), agricultural technology or service companies (8%), advisory/development organisations (8%), and other organisations (8%).

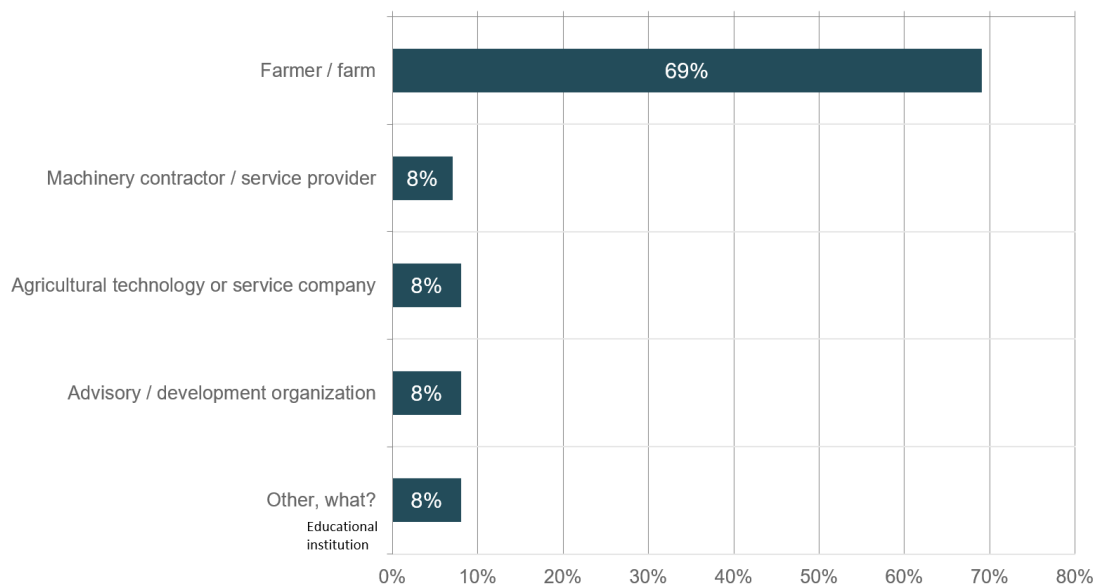


Figure 4. Organisation type of industry partner survey respondents.

In terms of role, respondents most often identified as employers/supervisors (46%) or experts/employees (31%), with smaller shares of entrepreneurs (8%) and other roles (15%) as shown in Figure 5.

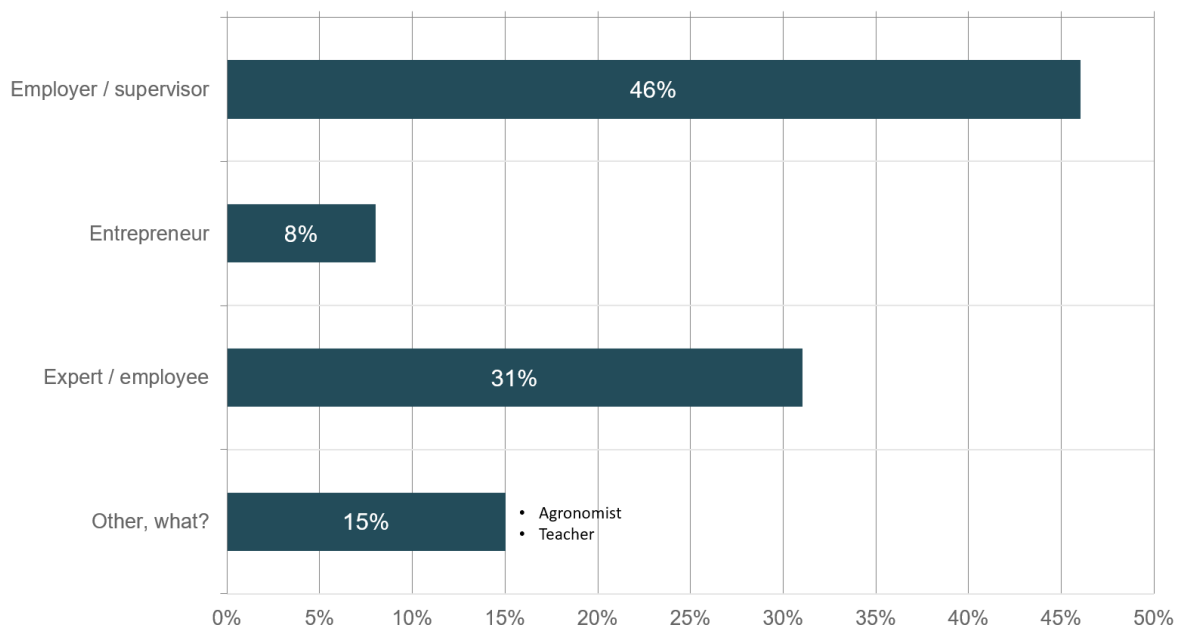
Your role

Figure 5. Role of industry partner survey respondents.

2.4 Analysis of the data

The survey data was analysed mainly using descriptive methods. Quantitative responses were examined through frequencies, percentages, and, where relevant, average values in order to identify the most common patterns, strengths, and development needs among respondents. The results from the teacher survey and the industry partner survey were first reviewed separately and then compared to identify converging themes and possible differences between educational and labour-market perspectives.

The open-ended responses were generally brief and did not provide sufficient depth for systematic thematic analysis. They were therefore used mainly as supplementary material to provide additional context and to support the interpretation of the quantitative findings.

The purpose of the analysis was not statistical generalisation but to produce a practical and evidence-informed understanding of the current situation and the most important priorities for TUADIG trainings design.

2.5 Reliability

Participation in the surveys was voluntary, and the responses were processed confidentially. The results are reported in a way that does not allow individual respondents to be identified, and quotations are presented at a general level (e.g. “teacher”, “industry partner”).

Reliability is strengthened using multiple data sources and by the parallel examination of the perspectives of teachers and industry partners. At the same time, it should be noted that the data are based on respondents’ assessments and experiences and on target groups reached through the project network, which may affect the generalisability of the findings.

3. Simulation pedagogy practices in organisations

The findings suggest that simulation pedagogy is already present in the participating educational institutions, but its use remains uneven in scope, visibility, and degree of integration.

Figure 6 illustrates the organisational level of simulation usage. Simulation appears to be used most often occasionally (32%), while 26% of respondents report that it is used systematically within the curriculum and 17% indicate that it is used as part of individual courses. At the same time, 25% of respondents are unable to say how extensively simulation is used in their organisation.

Level of simulation use in your organisation

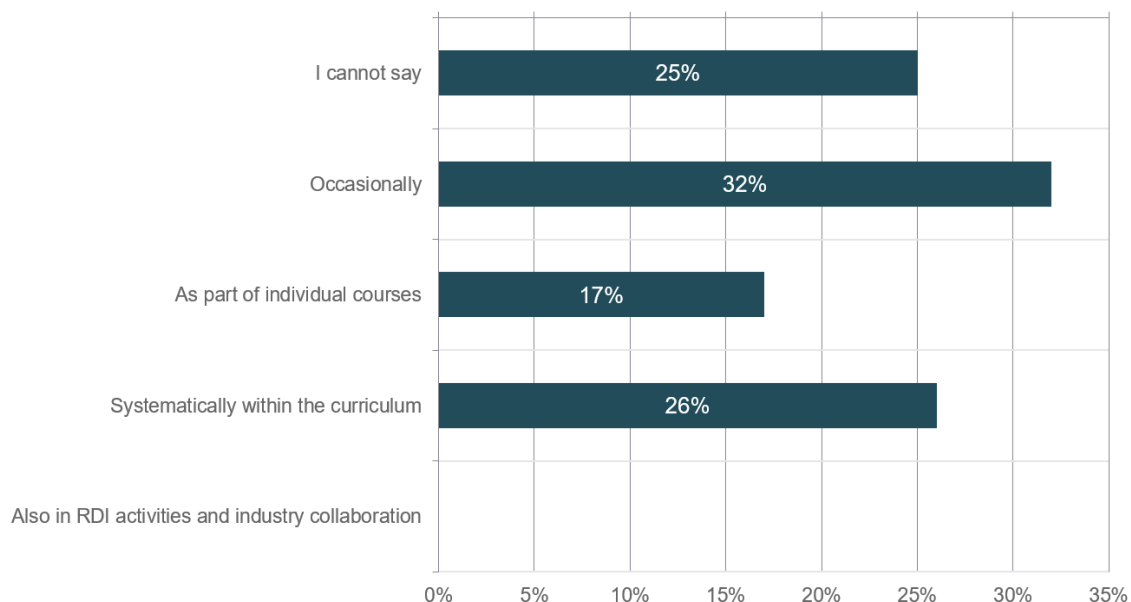


Figure 6. Extent to which simulation pedagogy is used in participating organisations.

This indicates that simulation-based learning is not yet a fully transparent or consistently embedded practice across institutions. Rather, the results suggest a mixed situation in which some organisations have already integrated simulation into teaching in a more structured way, while in others its use is more limited, localised, or less visible to staff.

A similar pattern can be seen in Figure 7 at the level of individual teachers' work. Nearly half of the respondents (47%) report that simulation-based learning is not currently

included in their job, while 44% say that it is included occasionally and only 9% report regular involvement.

Does your current job include simulation-based learning in any form?

Number of respondents: 57

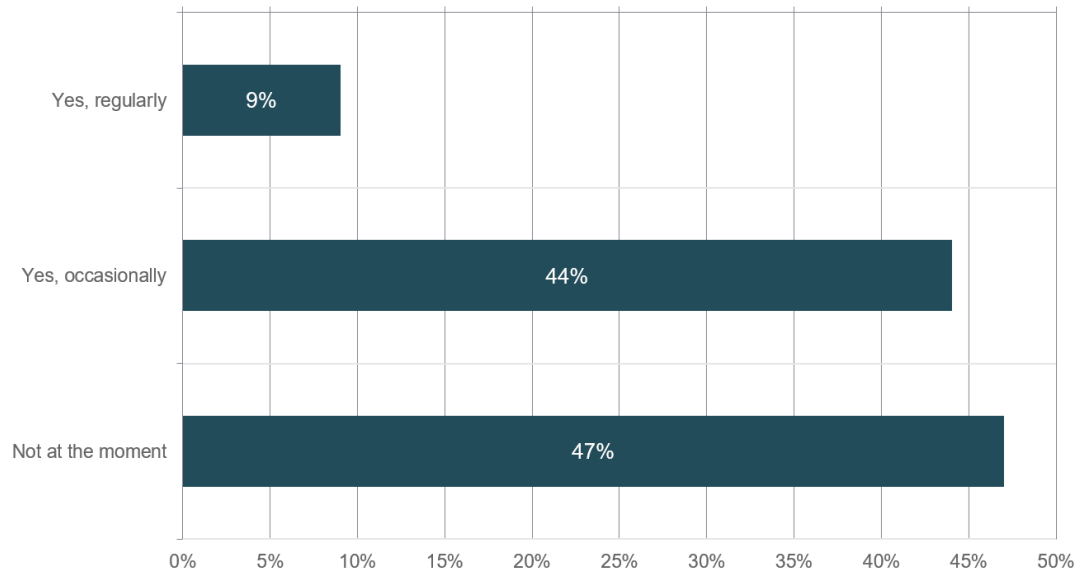


Figure 7. Extent to which simulation-based learning is included in teachers' own work.

This suggests that although simulation pedagogy exists within many institutions, it is not yet an established part or a routine of teachers' everyday professional practice. Instead, participation in simulation-based learning appears to be concentrated among certain teachers, subjects, or teaching contexts. Taken together, these findings point to an organisational landscape in which simulation pedagogy is developing, but where access, participation, and implementation are still uneven. This might be due to the lack of equipment (See Chapter 6. Institutional equipment, digital systems, and simulation facilities).

The findings concerning the primary use of simulations provide a more detailed picture of how simulation is currently positioned in teaching practice (Figure 8). The most common reported use is learning basic equipment operation (51%), followed by safe practice and making mistakes without risk (28%) and practising rare or critical situations (18%). In addition, 23% of respondents indicate that they cannot say what simulations are primarily used for.

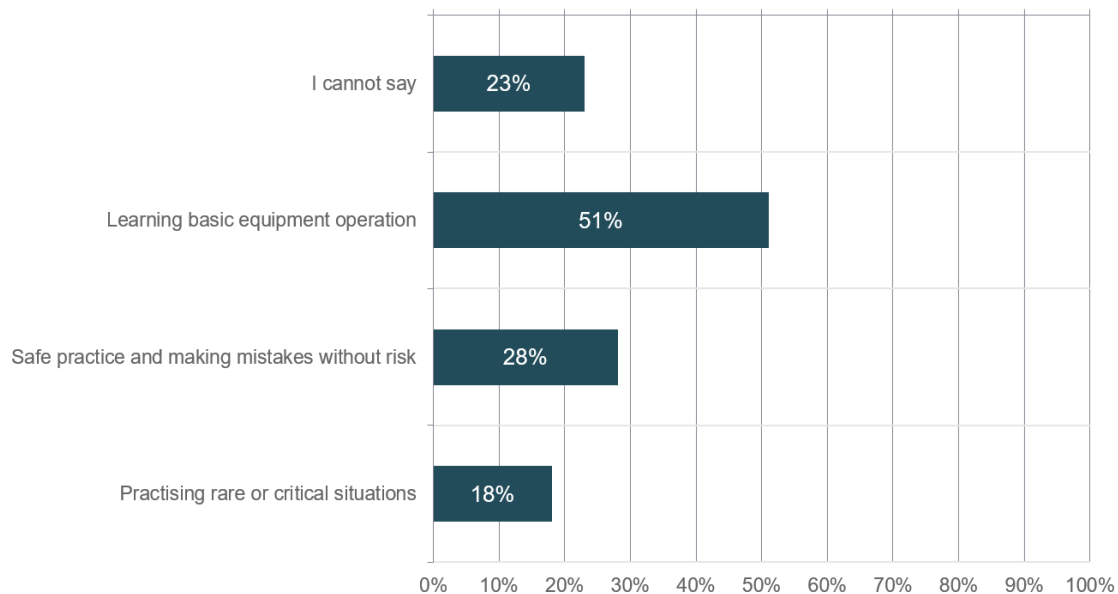
Simulations are primarily used for

Figure 8. Primary uses of simulation in participating organisations.

Overall, simulation is currently used above all for practical, skill-oriented, and operational purposes. This is fully consistent with the central pedagogical value of simulation: it allows learners to practise procedures, actions, and decision-making in a protected environment where mistakes do not lead to real-world harm. At the same time, the emphasis on basic equipment operation suggests that simulation is often positioned at the level of procedural training and familiarisation, rather than being used more broadly as a tool for advanced pedagogical inquiry, collaborative problem-solving, or reflective professional judgement.

The open-ended responses support and enrich this interpretation. They show that simulation is being used in a wide variety of subject areas and educational contexts, including driving instruction and road traffic situations, machinery and tractor studies, natural sciences and virtual laboratory work, chemistry, IT and programming, business planning, and laboratory-based learning more generally. Several responses also indicate that simulations are used to strengthen theoretical understanding, support the application of knowledge and skills in practice, and develop broader cognitive abilities such as critical thinking and spatial thinking.

This suggests that simulation pedagogy is not confined to one type of discipline or one pedagogical aim. Instead, it is being applied across diverse fields, often in ways that combine conceptual learning with practical rehearsal. Particularly in the natural sciences and technical fields, simulations seem to be valued as a way to demonstrate phenomena or processes that may be difficult, expensive, or unsafe to reproduce in

real conditions. In driving education and equipment-related learning, the emphasis appears to be on procedural fluency, safety, and repeated practice.

4. Teachers' simulation-pedagogical competence

Taken together, the survey results suggest that simulation-based learning is present in the participating organisations, but its use is still uneven, often occasional, and strongly dependent on the teacher's role. The data also indicates that teachers report moderate to fairly good confidence in several general pedagogical areas, but there are clear development needs in the practical design, facilitation, and assessment of simulation-based learning.

4.1 Strengths identified

The self-assessment chart in Figure 9 shows that respondents generally evaluate their competence positively in several areas related to teaching and assessment. Across ten statements (e.g., defining learning objectives, supporting active engagement, competence-based education, assessment criteria, phases of simulation-based learning and debriefing), average scores were consistently high, ranging from 3.5 to 4.0, with an overall average around 3.8.

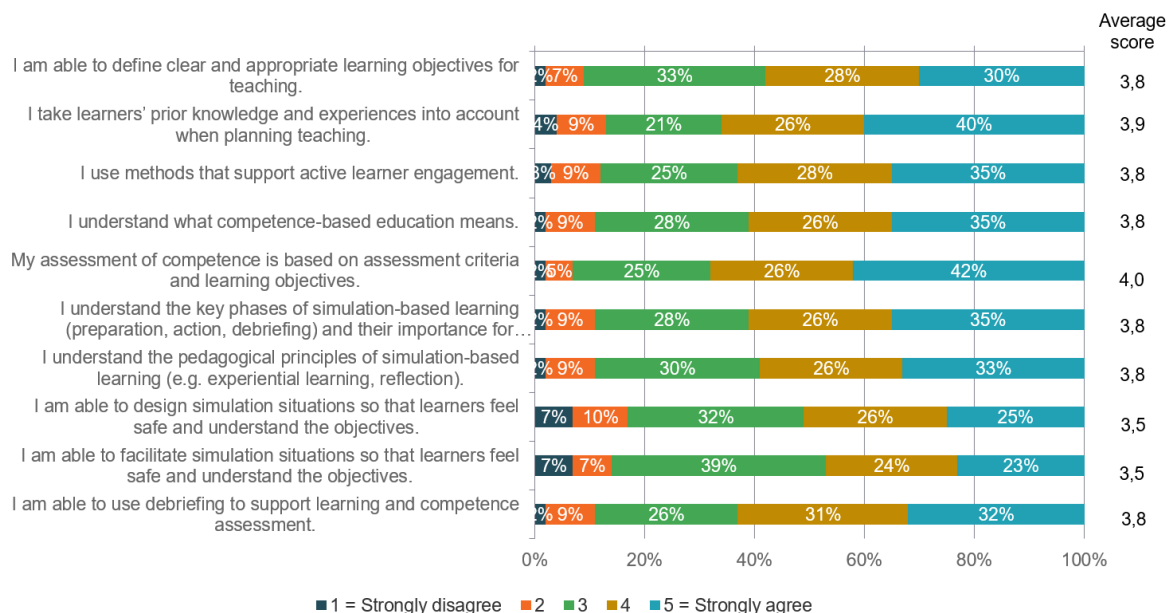


Figure 9. Teachers' self-assessed simulation-pedagogical competence.

These findings suggest that many teachers already have a good pedagogical foundation for simulation-based learning. The results indicate that most of respondents understand the principle of constructive alignment, recognise the importance of learner-centred planning, and value active participation, interaction, and experiential learning as key elements of teaching. This is a significant strength, as simulation-based learning relies heavily on these pedagogical principles.

4.2 Main development needs emerging from the data

Although the overall self-assessment is relatively positive, the data also reveal several important areas where competence development is needed.

Need to strengthen pedagogical understanding specifically related to simulation

There are still many who do not feel confident in the pedagogical foundations of simulation-based learning itself. The relatively large midpoint responses in the statements regarding simulation pedagogy indicate that understanding is often partial rather than fully secure. In practical terms, this suggests that many teachers may know the main concepts, but they may not yet be able to apply them consistently in instructional design and implementation.

Practical competence in simulation design and facilitation

The clearest development need concerns the practical implementation of simulation-based learning, especially the design and facilitation of safe and purposeful simulation situations.

The weakest results in the self-assessment chart were in ability to design and facilitate simulation situations in a way that learners feel safe and understand the objectives. Although many respondents assessed their competence at a moderate level, the relatively high proportion of neutral responses and the presence of negative responses suggest that these skills are not yet firmly established for all teachers. While many teachers see themselves as somewhat capable, a substantial proportion is uncertain or lack confidence in designing and facilitating simulation scenarios. The lack of confidence in facilitating is especially significant because facilitation is central to simulation pedagogy.

This points to a need for targeted competence development that moves beyond theory and provides hands-on, practice-oriented development which strengthens teachers' practical confidence in planning and leading simulation-based learning in a

pedagogically meaningful and psychologically safe way. This could mean topics such as:

- how to design scenario,
- tips for learner briefing,
- ways to build psychological safety,
- role distribution,
- guidance during the simulation,
- and management of the learning process before, during, and after the simulation.

Assessment and feedback practices appear teacher-led and insufficiently systematic

The findings related to assessment and feedback in Figure 10 suggest that simulation-based learning in the participating organisations is still largely guided by teacher-led practices and that more systematic and pedagogically varied approaches would be beneficial.

How is learning in simulation situations assessed in your organisation?

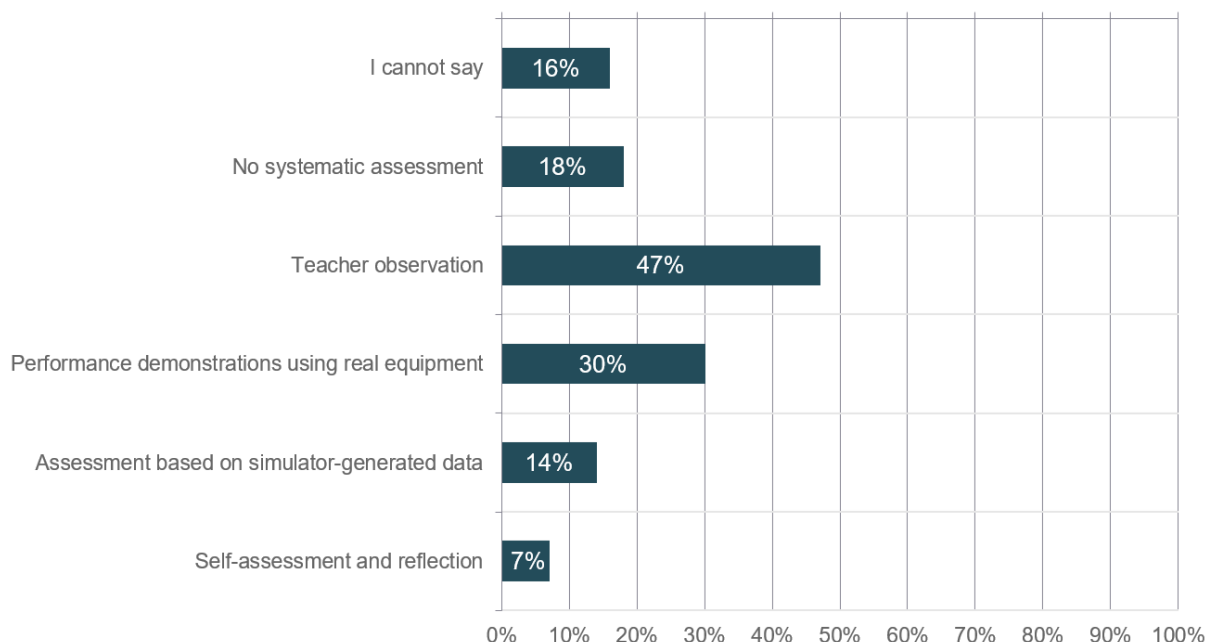


Figure 10. Assessment methods used in simulation situations.

Assessment of learning in simulation situations was most often based on teacher observation (47%) and performance demonstrations using real equipment (30%), while only 14.0% reported assessment based on simulator-generated data.

Notable is that self-assessment and reflection were mentioned only rarely. In addition, a notable proportion of respondents indicated that there is no systematic assessment in place or that they are unable to say how learning is assessed in their organisation.

This suggests that assessment practices may not yet be sufficiently explicit, consistent, or shared across the organisational context. A similar pattern can be seen in the feedback-related responses.

How is feedback provided in simulation situations?

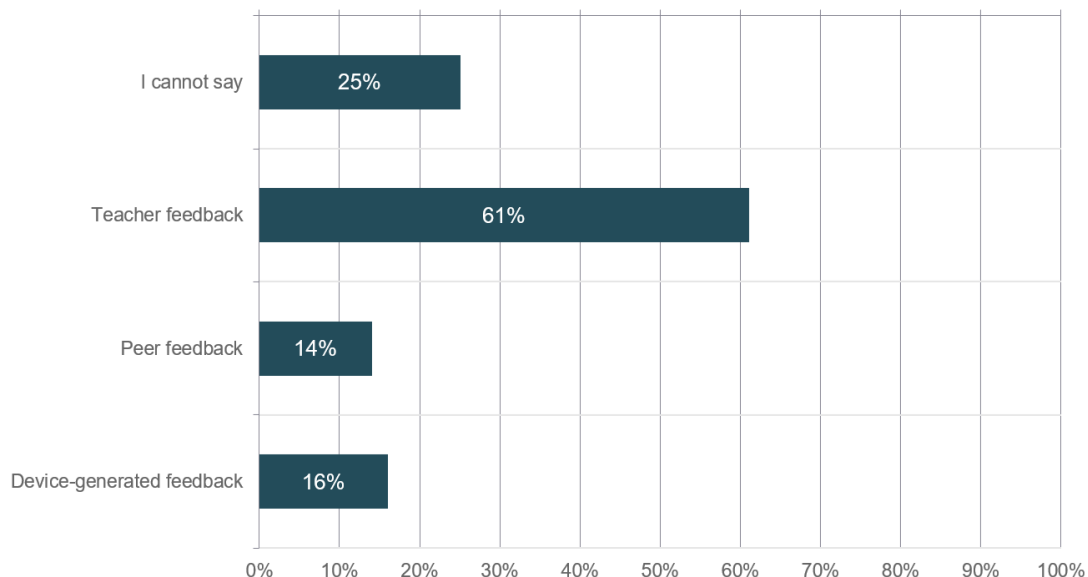


Figure 11. Ways in which feedback is provided in simulation situations.

When asked how feedback is provided in simulation situations (Figure 11), 61% of respondents reported that feedback is given by the teacher, 16% reported device-generated feedback, and 14.0% reported peer feedback. In addition, 25% selected “I cannot say.”.

Feedback in simulation situations is provided mainly by teachers, whereas peer feedback appears to play a much smaller role. Although teacher feedback is clearly important in simulation-based learning, the limited use of peer-based, reflective, and technology-supported feedback may reduce opportunities to make feedback a more active and learner-centred part of the learning process.

This is particularly important in simulation pedagogy, where learning does not depend only on performing an action, but also on analysing, interpreting, and reconstructing the experience afterwards (that is, debriefing). Self-assessment, peer assessment, peer feedback, and reflection are essential because they help learners make their thinking visible, recognise strengths and areas for improvement, compare their own performance with learning objectives or professional criteria, and learn from the observations and perspectives of others.

In simulation-based learning, reflection and dialogue are central mechanisms through which experience is transformed into deeper understanding, professional judgement, and transferable competence. If these elements remain underused, the educational value of simulation may remain narrower than its full pedagogical potential would allow.

The relatively high proportion of respondents who could not say how feedback is provided suggests that feedback practices may not be clearly defined, consistently implemented, or well communicated across the organisation. Taken together, these findings indicate a clear need to strengthen competence in both assessment and feedback within simulation-based learning. Future professional development should therefore focus on supporting teachers in the use of more systematic assessment criteria, structured observation, reflective and self-assessment practices, peer-based feedback processes, and pedagogically meaningful feedback and debriefing methods that engage learners more actively in the evaluation of their own learning.

5. Teachers' digital and digital pedagogical competence

The findings suggest that teachers have a reasonably strong general foundation in digital teaching, but that their competence is considerably more uneven when more specialised or emerging agricultural technologies are concerned.

Overall, the results present a picture of teachers who are already familiar with common digital learning environments and generally positive towards the use of technology in teaching. At the same time, the data also indicate a clear need for further professional development, particularly in the pedagogical use of newer technologies and in more specialised technology domains connected to simulation-based learning and sector-specific digitalisation.

5.1 Strengths identified

A clear strength emerging from the data is teachers' competence in the use of general digital tools in teaching. Most respondents assess their competence in this area as moderate or high, which suggests that digital tools are already a meaningful and relatively established part of everyday teaching practice (Figure 12).

How would you assess your current competence?

Number of respondents: 57

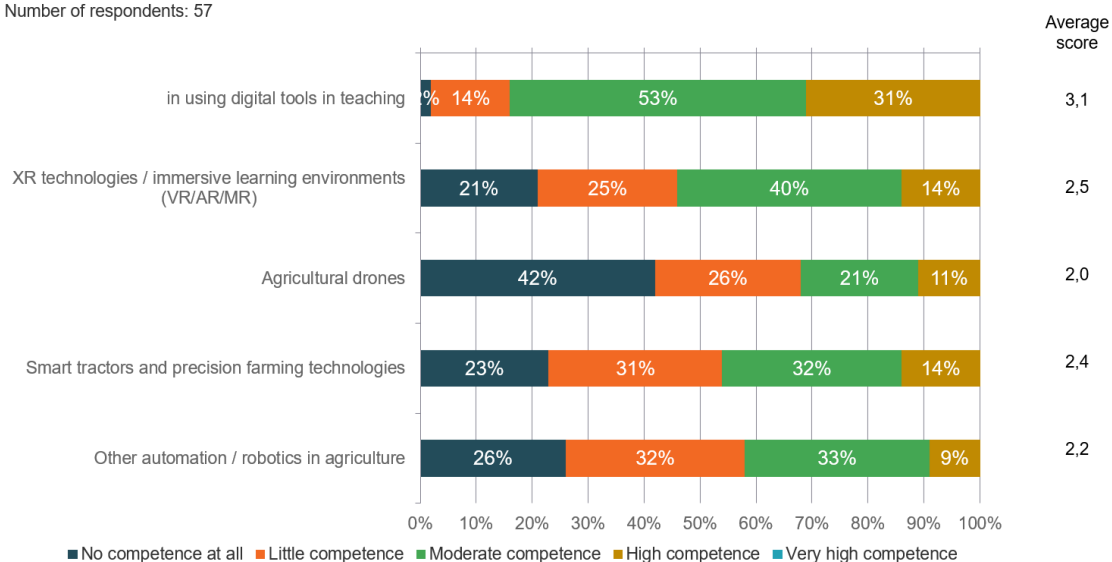


Figure 12. Teachers' self-assessed competence in different digital and emerging technologies.

This interpretation is further supported by the results on digital pedagogy in Figure 13. A large majority of respondents agree that they are proficient in using digital learning environments and tools in teaching, such as Microsoft 365, Moodle, Google Workspace, and Zoom. Similarly, most respondents report that they are able to select digital solutions based on pedagogical objectives and that they regularly use digital methods in their teaching.

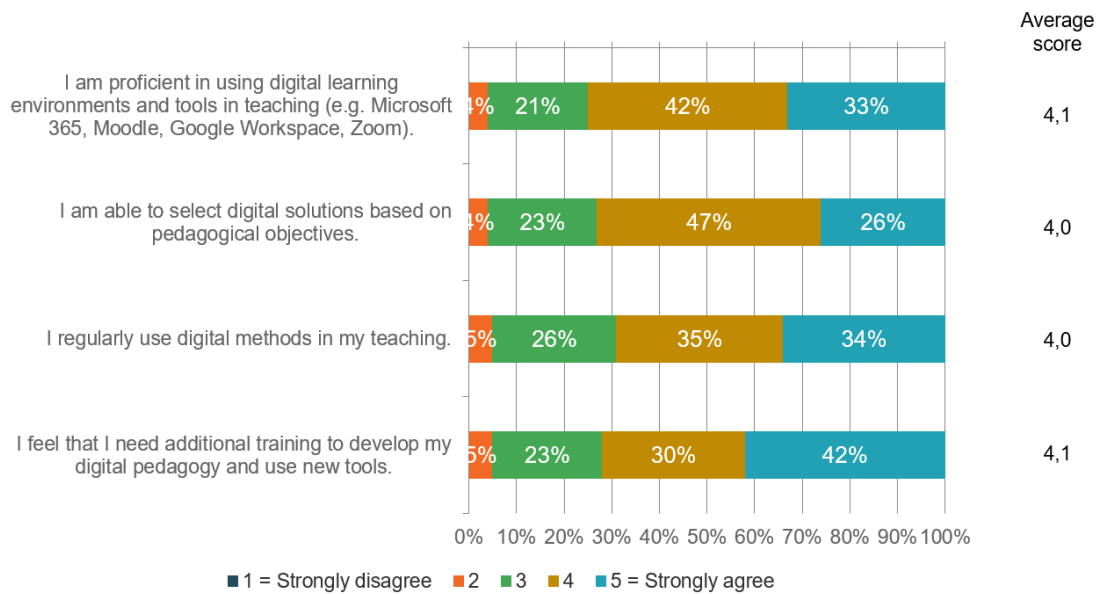


Figure 13. Teachers' self-assessed digital pedagogical competence.

Taken together, these findings indicate that many teachers already possess a solid basis in digital pedagogy and are able to connect technology use to teaching and learning goals rather than using digital tools as isolated technical additions.

Another important strength concerns teachers' attitudes towards technology and digital development. The technology acceptance data in Figure 14 show that respondents are highly open to adopting new technologies in teaching and strongly believe that new technologies can improve teaching quality and learning outcomes. Most also express a clear intention to use new technologies in the near future. In addition, a substantial proportion of respondents indicate that they are willing to act as pilot users and share experiences with colleagues. This is a particularly valuable finding from a development perspective, because it suggests that teachers' attitudes are not a major barrier to future digital innovation. On the contrary, the data indicate a positive and development-oriented mindset that can provide a strong basis for institutional change and peer-supported learning.

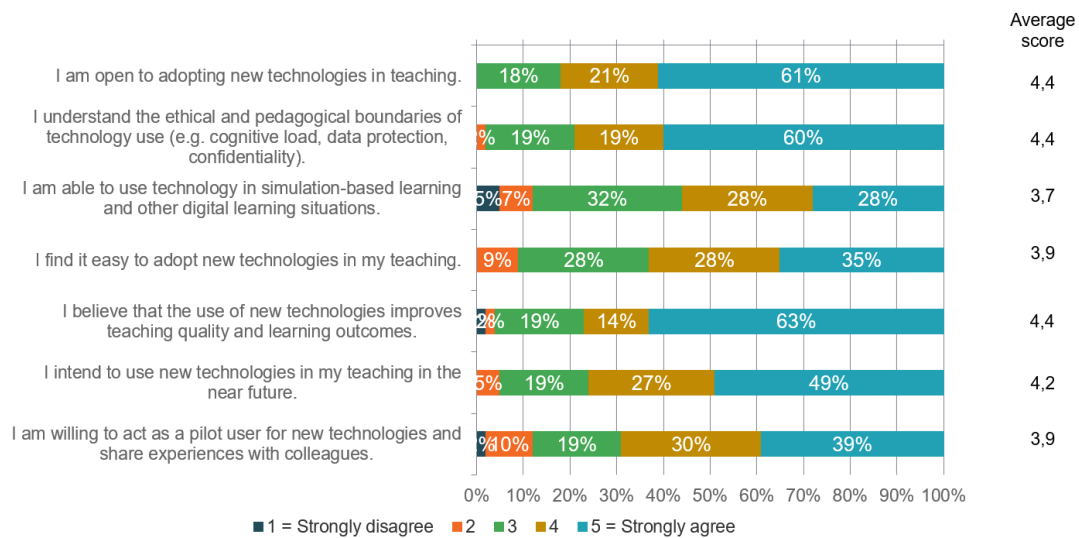
Technology Acceptance in Teaching

Figure 14. Teachers' attitudes towards adopting new technologies in teaching.

A further strength is teachers' awareness of the ethical and pedagogical boundaries of technology use. Most respondents agree strongly that they understand issues such as cognitive load, data protection, and confidentiality in relation to digital teaching. This suggests that teachers' digital competence is not limited to technical functionality alone, but also includes an understanding of responsible and pedagogically sound technology use. This is especially important in digital and simulation-based learning environments, where the effective use of technology must be balanced with considerations related to accessibility, student wellbeing, privacy, and the overall quality of the learning experience.

5.2 Main development needs emerging from the data

Despite these strengths, the findings also reveal clear and significant development needs.

Competence in specialised and emerging technologies

The most visible gap concerns competence in specialised and emerging technologies.

As seen in Figure 15, while the respondents rated their competence in using digital tools in teaching relatively high (average 3.1), self-assessments are notably lower in areas such as XR technologies and immersive learning environments, agricultural drones, smart tractors and precision farming technologies, and other forms of automation or robotics in agriculture. In several of these areas, a large proportion of

respondents place themselves at the lowest end of the competence scale. This suggests that teachers' digital competence is currently strongest in general-purpose teaching technologies, whereas competence in more specialised technologies relevant to simulation-based learning and professional fields remains limited for many respondents.

How would you assess your current competence?

Number of respondents: 57

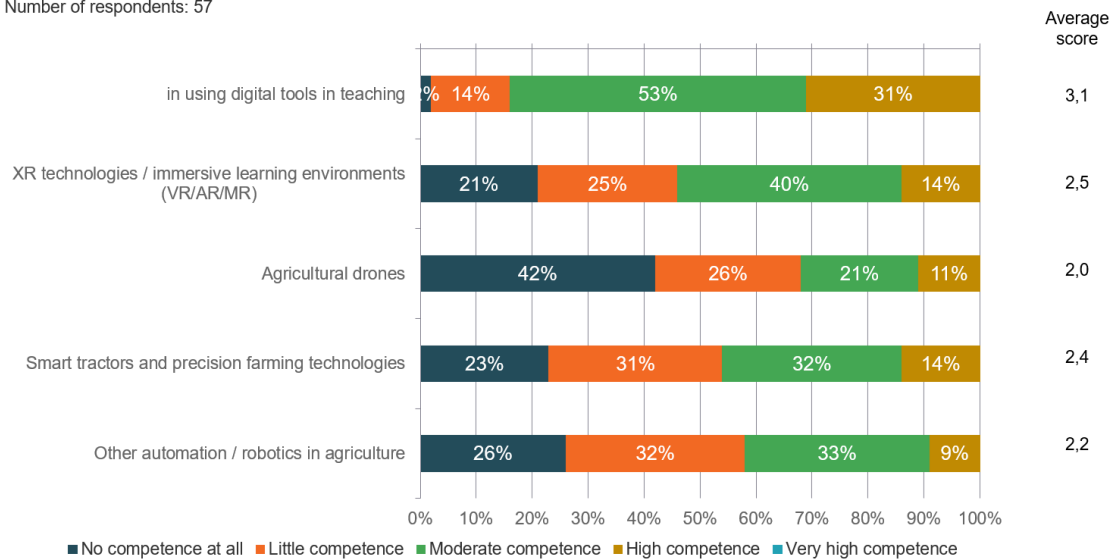


Figure 15. Teachers' competence in specialised and emerging agricultural technologies.

The key development challenge is not digital competence in general, but the ability to teach and use sector-specific digital and automated technologies that are becoming increasingly central in agriculture.

Practical confidence in applying technology in simulation-based learning

A second important development need relates to practical confidence in applying technology in simulation-based learning and other digital learning situations. Although a majority of respondents assess their competence positively, a substantial proportion select the midpoint, and a smaller but still meaningful group report low confidence. A similar pattern can be seen in responses concerning the ease of adopting new technologies in teaching. This suggests that teachers may be open to using new technologies and recognise their value, but do not always feel fully confident in applying them in practice.

Additional training

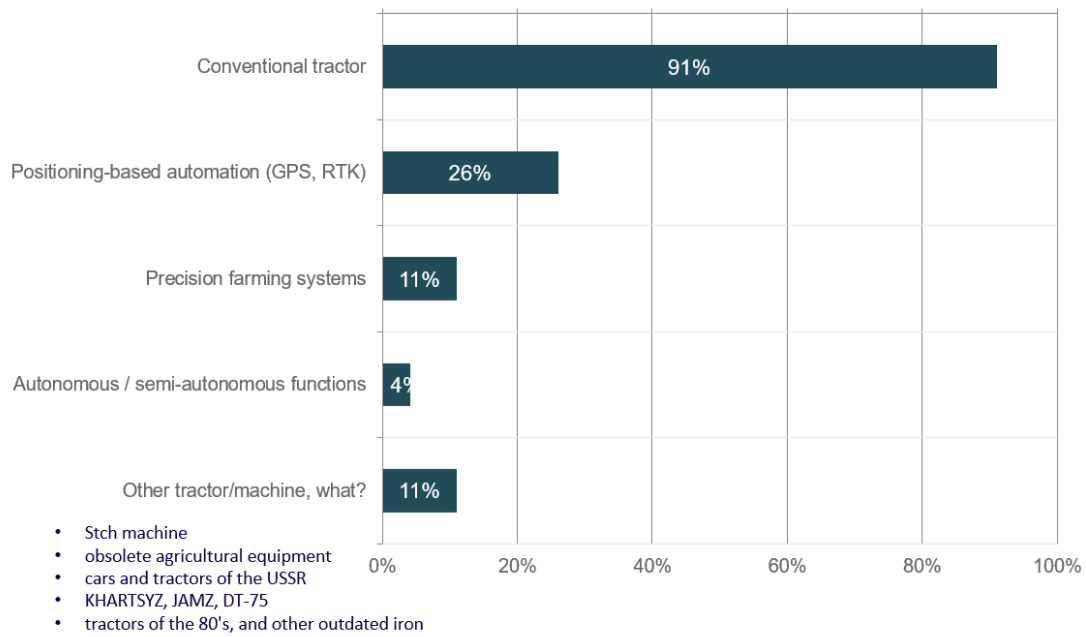
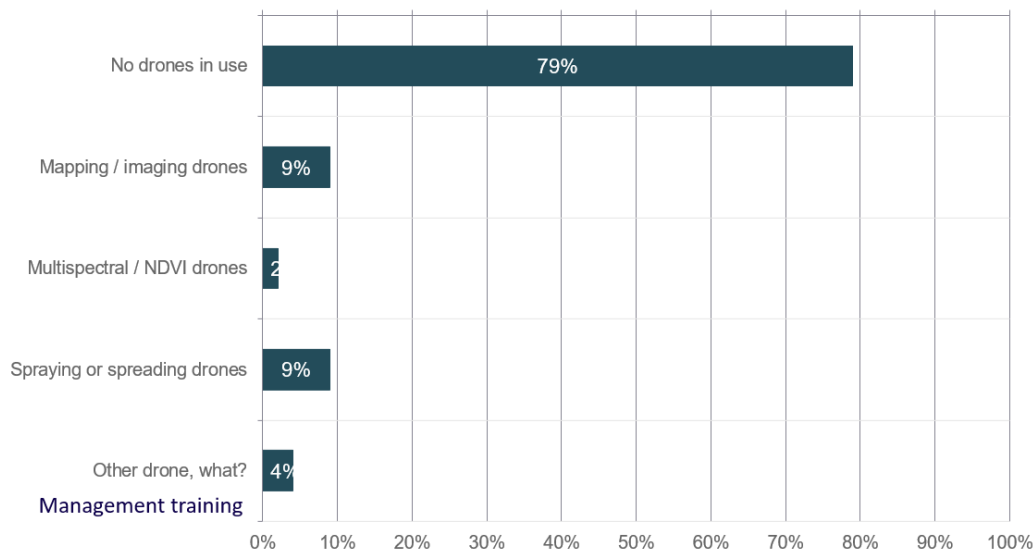
A third development need is linked to the strong and explicit demand for additional training. A clear majority (52 %) of respondents agree that they need further training to develop their digital pedagogy and to use new tools. This is one of the most important findings in the data, because it shows that teachers themselves recognise that their current competence, while meaningful, is not sufficient for future needs. The result suggests an awareness that digital pedagogy is continuously evolving and that teachers need ongoing opportunities to update both their technological and pedagogical knowledge. This is particularly relevant in fields where digitalisation, automation, and simulation technologies are developing rapidly and are changing the expectations placed on teaching.

6. Institutional equipment, digital systems, and simulation facilities

Figures 16 and 17 suggest that some of the participating educational institutions already have a basic infrastructure for practical and simulation-related teaching, but the level of technological modernisation varies considerably.

Teaching is still strongly based on conventional machinery, particularly conventional tractors, which are used in the great majority of institutions. Real tractors and machines also appear to play a central role in current teaching practice, highlighting the continuing importance of hands-on learning in this field.

At the same time, more advanced technologies remain much less common, and the use of drones in particular is still very limited, with most organisations reporting that they are not used in teaching or training. This creates a clear development need that is directly relevant to the project: by acquiring drone and tractor simulators for schools, the project can help bridge the gap between traditional equipment-based teaching and the emerging technological demands of the field.

Tractors and machinery**Figure 16.** Availability of agricultural equipment used in teaching and training.**Drones****Figure 17.** Availability of digital and advanced agricultural technologies in teaching and training.

When asked how well their equipment corresponds to current industry use, responses varied: the majority, 60%, reported that it partially corresponds, while 14% said it does not correspond, 15 % that it does correspond well and 11% said it represents the state of the art (Figure 18).

How well does your equipment correspond to current industry use?

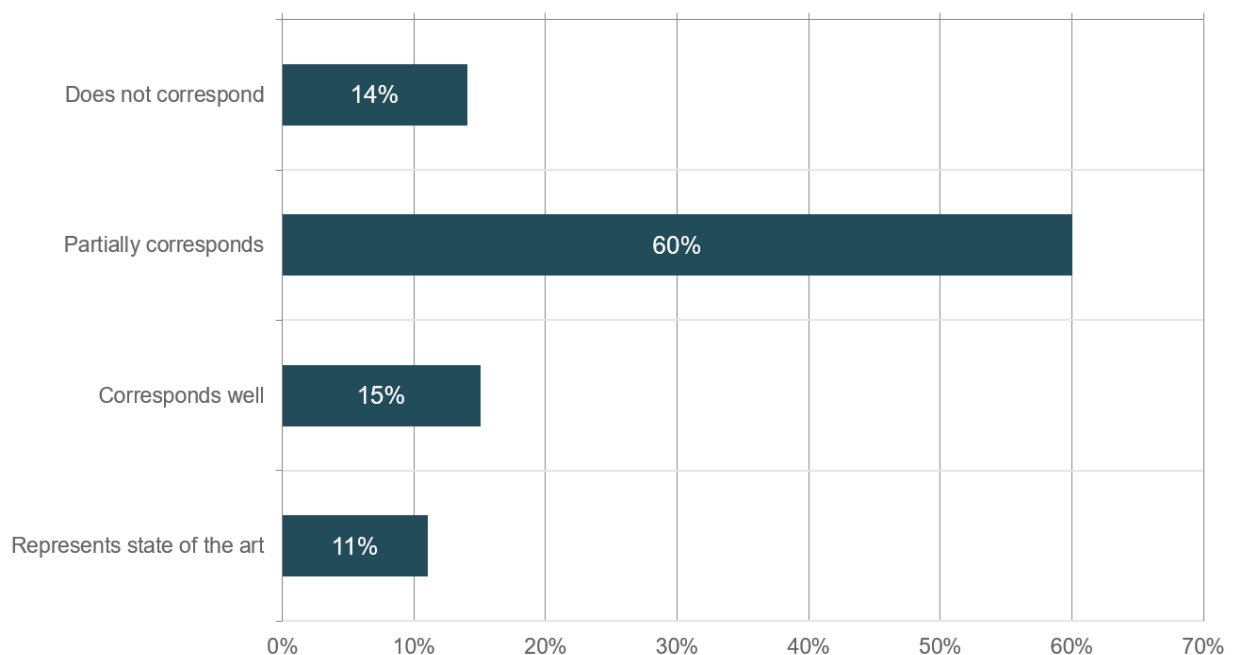


Figure 18. How well institutional equipment corresponds to current industry use.

The open-ended responses reinforce that some institutions still rely on clearly outdated machinery, including old tractors and obsolete agricultural equipment. This suggests that while basic practical training is well established, access to more contemporary and digitally advanced technologies is uneven.

Machine-specific software or interfaces are often used. Basic simulators or physical training equipment are also present in a substantial number of institutions, although their age varies.

Which digital systems are used in your organisation?

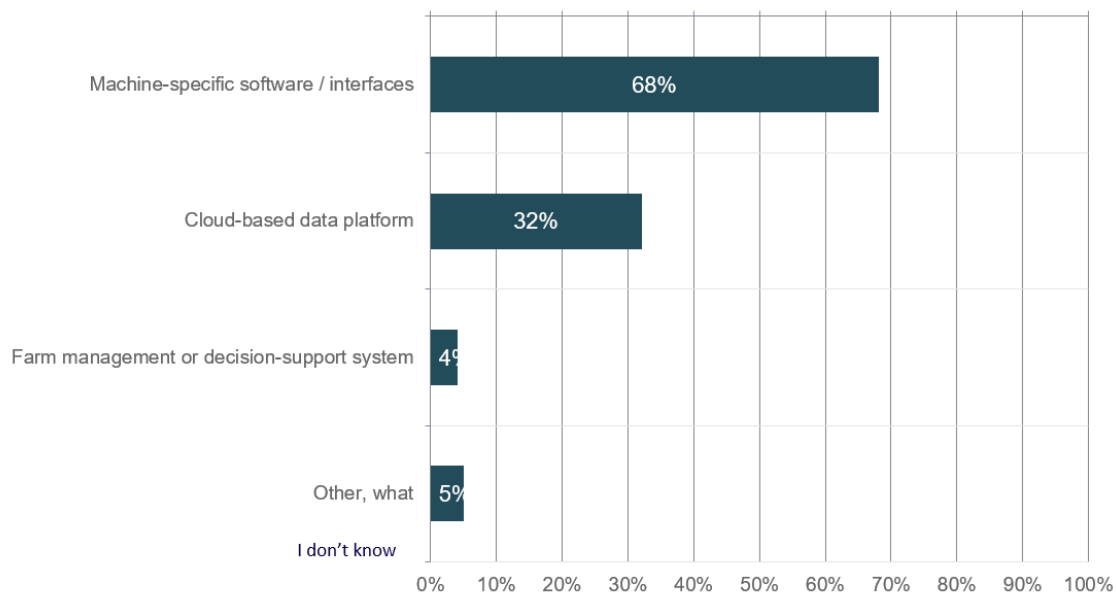


Figure 19. Types of simulation equipment and software available in participating institutions.

The findings concerning simulation environments show a similarly mixed picture. As presented in Figure 20 below, nearly half of the respondents report that their organisation has a dedicated simulation facility, and some also mention multi-purpose laboratories, flexible teaching spaces, or online programs used for simulation purposes. Yet, over half of respondents (53%) could not say what kind of simulation facilities are available.

What kind of simulation facilities does your organisation have in use?

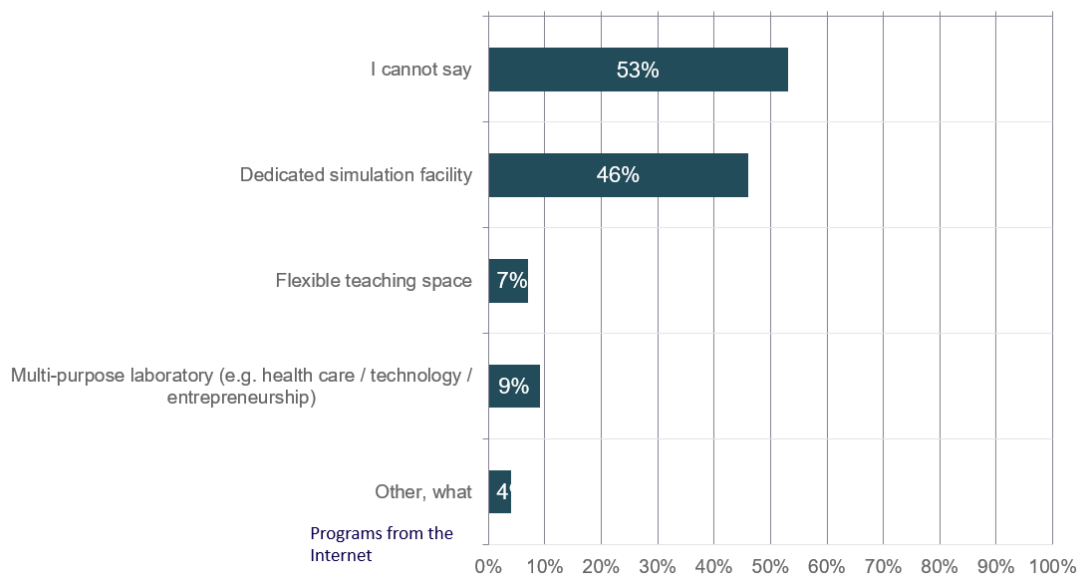


Figure 20. Types of simulation facilities available in participating institutions.

In teaching practice, different solutions were used with clearly different frequencies (Figure 21). Simulators and digital exercises, as well as simulation combined with real practice, are used with some regularity in part of the field.

How often are the following used in teaching?

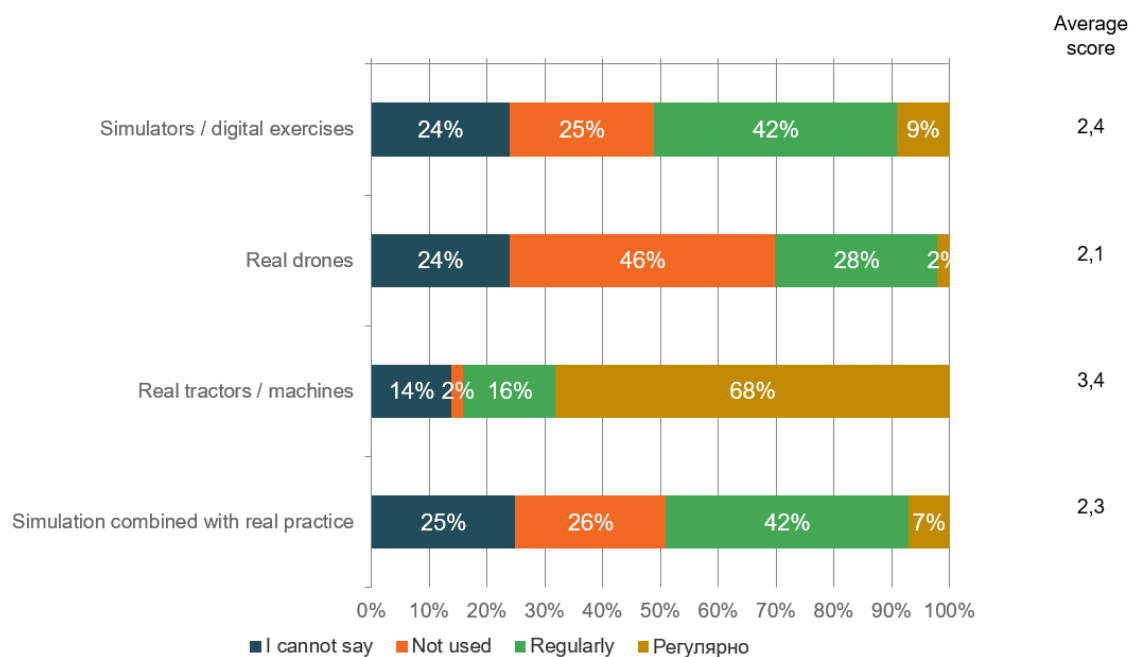
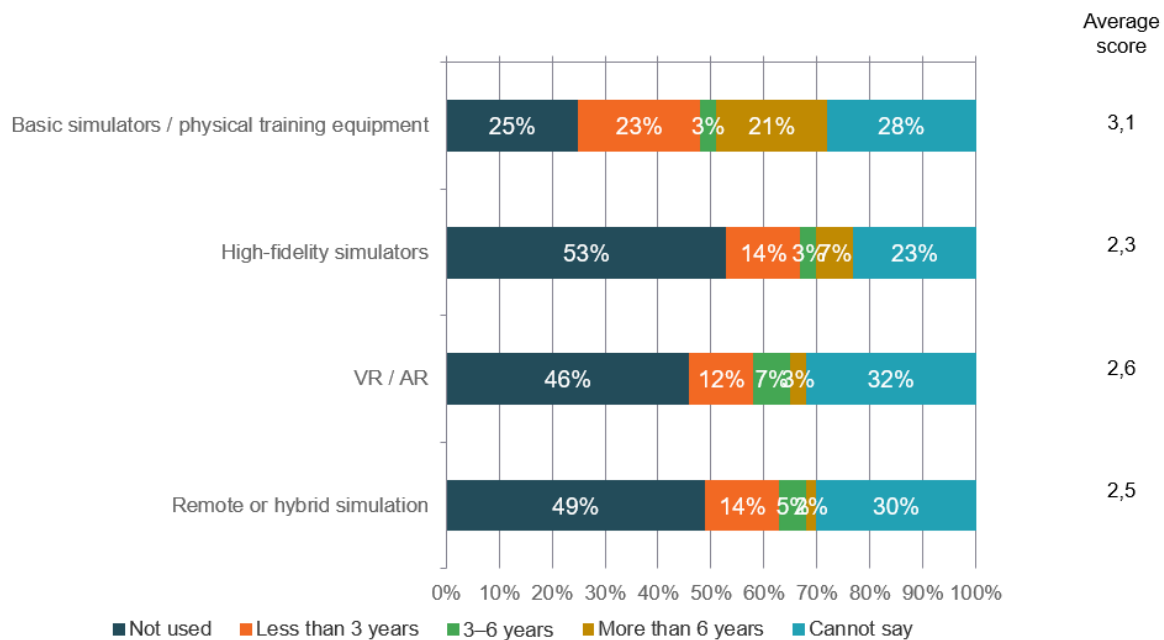


Figure 21. Frequency of use of different simulation solutions in teaching practice.

However, the availability of more advanced simulation technologies remains limited, as seen in Figure 22. High-fidelity simulators, VR/AR, and remote or hybrid simulation are still not used in many institutions, and where they are available, they appear to be less widespread than more basic forms of simulation.

Simulation equipment – equipment in use and age

Select the age category that best describes each type of equipment.

**Figure 22.** Availability of advanced simulation technologies in participating institutions.

Another important feature of the current situation is that staff awareness of available equipment and facilities appears incomplete. Across several questions, a relatively large proportion of respondents selected “I cannot say,” especially when asked about simulation facilities (Figure 20), the age of simulation equipment (Figure 22), or the frequency with which certain tools are used in teaching (Figure 21). This suggests that simulation-related resources may not yet be sufficiently visible, shared, or systematically communicated across organisations. In other words, some institutions may already possess useful equipment and facilities, but these resources do not yet appear to function as fully transparent and widely recognised organisational assets.

The issue is not only limited access to advanced equipment, but also the fact that current learning environments do not always reflect the technological realities of contemporary agriculture.

7. Stakeholder views on digital transformation, competence needs, and the relevance of current education

The stakeholder data suggests that agriculture is expected to become increasingly digital, automated, and data-driven, while current education is seen as responding to these changes only partly adequately. Because the number of responses is small (n = 13), the findings should be treated as indicative, but the overall patterns are clear enough to identify key priorities for future development.

7.1 Expected technological developments

Stakeholders expect particularly strong growth in agricultural drones, IoT sensors, satellite-based precision farming, farm management software, and renewable energy solutions on farms (Figure 23). Robotics and autonomous machinery are also seen as important, although with more uncertainty.

Digital transformation and the role of technology in agriculture

Rate how widely the following technologies are **adopted in agriculture** in the coming years.

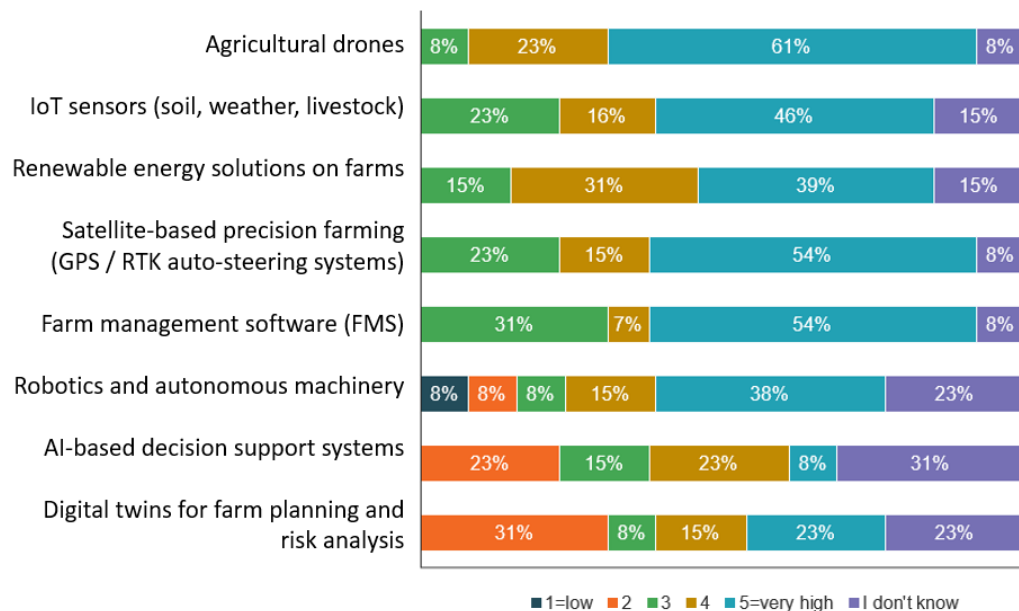


Figure 23. Stakeholders' expectations of future technological developments in agriculture.

7.2 Future competence needs and current gaps

The most important future competence needs identified by stakeholders are illustrated in Figure 24. Those are smart machinery operation and digital equipment handling, digital system integration and interoperability, and precision farming methods and tools. Other highly valued areas include drone-related competence, data literacy and agricultural data analytics, cybersecurity, and the ability to operate or supervise autonomous machinery and robotic systems.

Competence needs now and in the future

Rate the **importance** of the following **competences** in agriculture now and in the coming years.

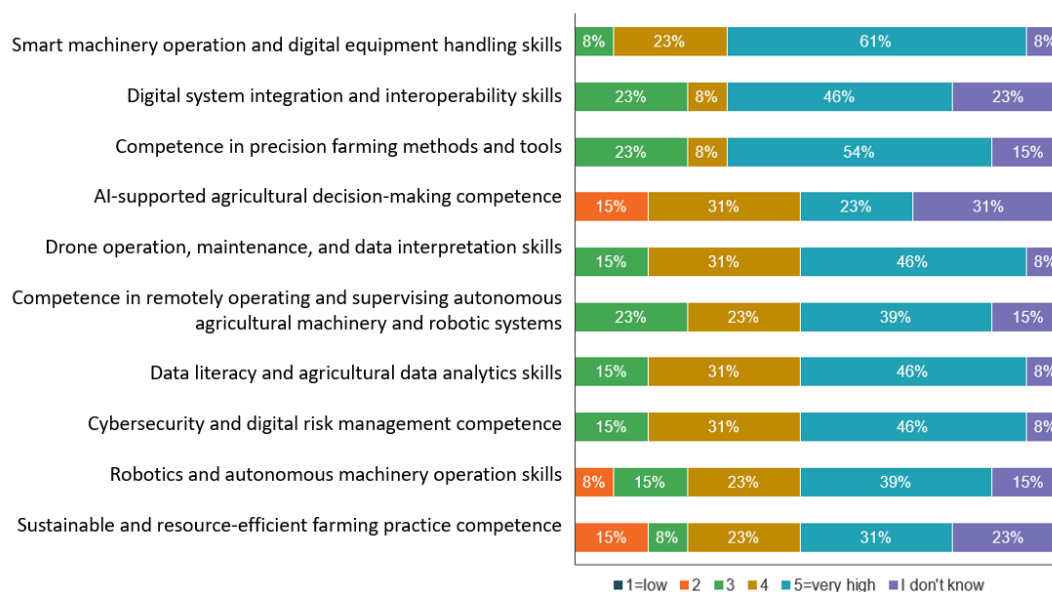


Figure 24. Stakeholders' views on future competence needs in agriculture.

When stakeholders assess the current competence level of employees and new entrants, the picture is notably more moderate, as seen in Figure 25. The clearest perceived gaps concern drones, AI-supported decision-making, digital system integration, robotics, and precision agriculture. The open-ended responses reinforce the same themes. This suggests a clear gap between the competences that agriculture is expected to require and those that are currently available.

Current level of competences Rate the current competence level of employees / new entrants

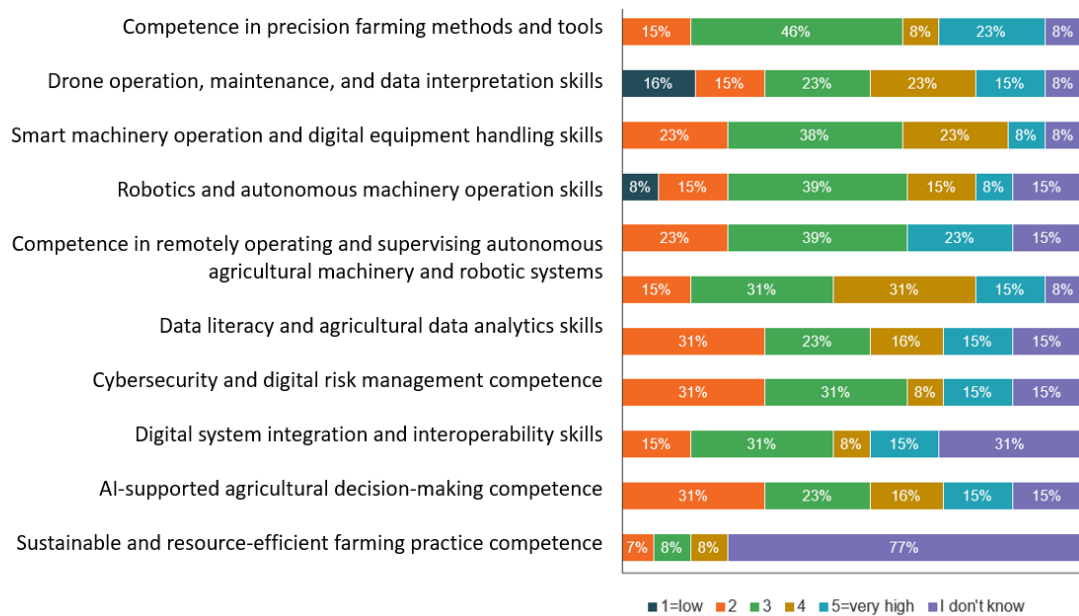


Figure 25. Stakeholders' assessment of current competence gaps in agriculture-related technologies.

7.3 How well does current education respond?

Stakeholders assess current education as meeting the sector's technological competence needs only moderately well (Figure 26).

How well does current education meet the sector's technological competence needs?

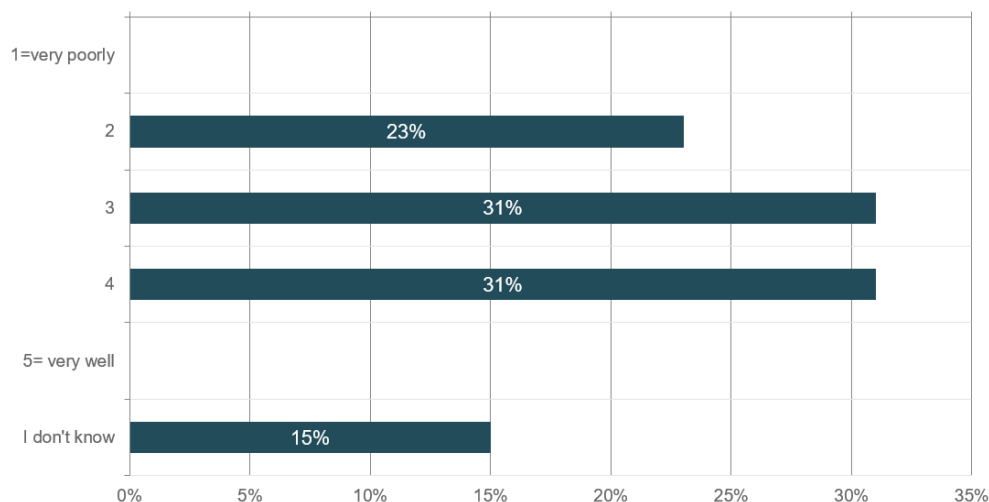


Figure 26. Stakeholders' overall assessment of how well current education responds to technological competence needs.

The results in Figure 27 show that when asked to rate how well current education provides key technology-related competences, responses were concentrated around moderate (rating 3) and rather low (rating 2) levels, and no competence area received any “very high” ratings (5 = 0%). The most consistently “moderate” area was precision farming methods and tools (61% rated 3), followed by smart machinery operation and digital equipment handling (46% rated 3) and sustainable and resource-efficient farming practice (46% rated 3). In several emerging areas, a substantial share rated provision as low (rating 1–2): for example drone operation (23% rated 1; 31% rated 2) and cybersecurity/digital risk management (23% rated 1; 23% rated 2). Uncertainty was also notable, especially for AI-supported agricultural decision-making (31% “I don’t know”) and several other areas where 23% selected “I don’t know” (e.g., robotics, remote supervision of autonomous systems, data analytics, cybersecurity, and system integration).

Rate how well current education provides the following competences

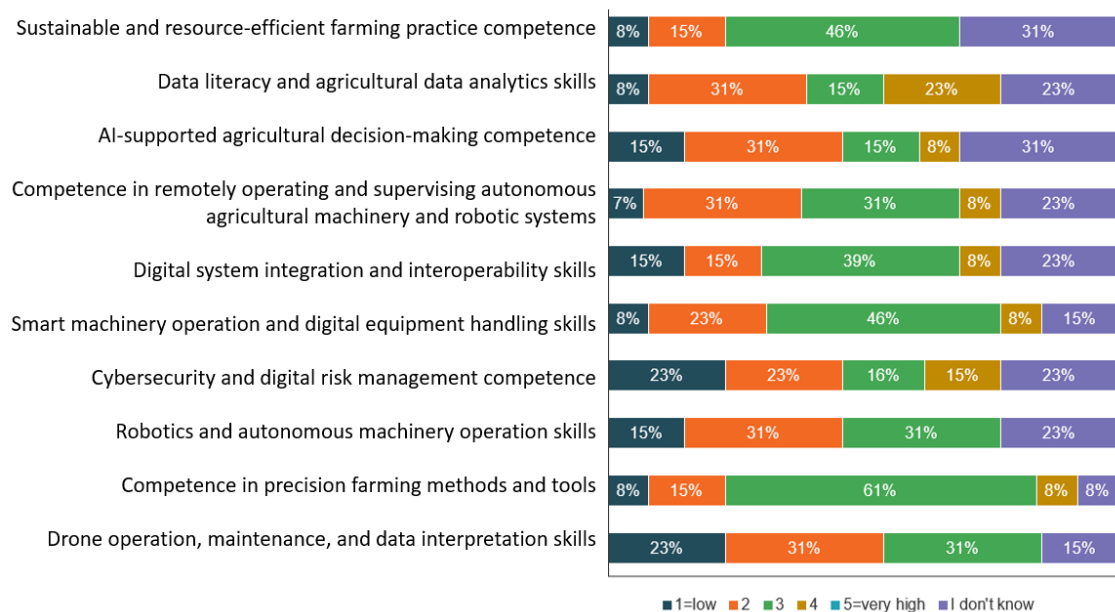


Figure 27. Stakeholders' assessment of how well current education provides key technology-related competences.

To better meet labour market needs, respondents suggested more practical and applied learning, where theoretical knowledge is developed through hands-on work on modern equipment. They also emphasized strengthening skills related to robotics and autonomous technology, and modernising the material and technical base (including renewing agricultural machinery). They also highlighted the need to increase students'

willingness to cooperate with the agricultural sector, ensure education covers the latest technologies and techniques, and place greater emphasis on practical skills development, communication with employers, and dual education.

8. Implications for TUADIG trainings design

The findings suggest that future trainings should be designed not only as technical instruction on new equipment, but as a broader competence development process that strengthens sector-specific technological skills, simulation pedagogy, and the ability to connect teaching more closely with current and emerging labour market needs. Across the data, a consistent pattern emerges: teachers generally have a reasonable basis in digital teaching and pedagogy, but their competence is less developed in relation to specialised agricultural technologies, simulation design and facilitation, and systematic assessment and feedback practices.

At the same time, institutions often rely on conventional machinery, have only limited access to advanced technologies such as drones and immersive simulation, and do not always have clearly shared practices for how simulation-related resources are used. Stakeholders, in turn, expect agriculture to become increasingly digital, automated, and data-driven, and they highlight clear future needs in areas such as drones, precision farming, robotics, AI-supported decision-making, data use, and digital system integration.

Taken together, these findings imply that trainings should be designed around the idea of helping institutions move towards more authentic, technologically current, and pedagogically meaningful learning environments.

8.1 Trainings should focus on sector-specific technological competence, not only general digital skills

Teachers appear relatively confident in the use of general digital tools and learning environments, but both the teacher data and the stakeholder data point to clear development needs in areas such as drone operation and maintenance, smart machinery, precision farming, autonomous systems, data analytics, AI-supported decision-making, and digital system interoperability. This means that trainings should go beyond generic digital pedagogy and provide teachers with concrete competence in the technologies that are becoming increasingly relevant in agricultural work.

In practical terms, this suggests that trainings should include:

- the basic operating logic and pedagogical use of drone and tractor simulators,
- understanding of how these simulators relate to precision farming, machine automation, and data-rich work processes,
- opportunities to interpret simulator-based outputs and connect them to real agricultural tasks,
- and support in translating new technologies into teaching situations that are understandable and relevant for learners.

8.2 Trainings should strengthen skills to design and facilitate simulation situations in practice

The findings also show that teachers need support not only in using simulation technologies, but in implementing simulation-based learning as a pedagogical process. The clearest pedagogical development needs concern the design and facilitation of simulation situations, as well as the ability to ensure learner safety, make objectives explicit, and guide learning before, during, and after the simulation.

For this reason, trainings should include:

- how to design simulation scenarios with clear learning outcomes,
- how to brief learners and create psychological safety,
- how to facilitate simulation sessions in ways that support active participation,
- and how to debrief simulation experiences so that learners can reflect on actions, decisions, and outcomes.

This is particularly important for the project, because the educational value of drone and tractor simulators will depend not only on whether teachers can operate the equipment, but on whether they can use it to create meaningful learning experiences. The project should therefore treat simulator training and simulation pedagogy training as inseparable.

8.3 Trainings should strengthen assessment, feedback, and reflective learning in simulation

The current data suggest that assessment and feedback practices in simulation-based learning are still strongly teacher-led, while self-assessment, peer feedback, reflective processes, and the use of simulator-generated data remain less common. This is a

significant issue, because in simulation pedagogy learning is not based only on doing, but also on analysing, interpreting, and reflecting on the experience afterwards.

Future trainings should therefore strengthen teachers' competence in:

- using structured observation and clear assessment criteria in simulation,
- linking simulation tasks to intended learning outcomes and professional standards,
- using debriefing as a core learning process rather than only as informal discussion involving learners in self-assessment and peer feedback,
- and, where appropriate, using data produced by simulators as part of feedback and learning reflection.

This would help ensure that simulation-based learning supports not only procedural practice, but also judgement, reasoning, and the transfer of learning to real work situations.

8.4 Trainings design should reflect different starting points among teachers and institutions

The findings clearly show that teachers and institutions are not starting from the same point. Some teachers already use simulation or digital methods regularly, while others have little or no current involvement. Similarly, some institutions have dedicated simulation facilities or more up-to-date equipment, whereas others still rely heavily on older machinery and have limited access to advanced technologies.

This suggests that trainings should consider participants with different levels of prior knowledge. A useful approach would be to provide:

- include additional or optional materials for participants with different levels of prior knowledge

8.5 Trainings should be closely connected to authentic work processes and labour market needs

One of the strongest cross-cutting messages in the data is the need to improve the alignment between education and the realities of contemporary agriculture.

Stakeholders emphasise that current education only partly meets the sector's technological competence needs, and they call for more modern equipment, stronger

practical learning, and closer collaboration with employers. This means that trainings design should be explicitly guided by authenticity and work relevance.

For the project, this implies that drone and tractor simulators should be used to support learning tasks that mirror real or emerging workplace demands, such as:

- operating machinery safely,
- interpreting digital information,
- practising decision-making in realistic field situations,
- handling rare or risky situations without real-world consequences,
- and linking machine operation to wider systems such as data, planning, and precision farming.

Trainings for teachers should therefore also include support in designing authentic, work-linked simulation scenarios, rather than only abstract or technical exercises.

8.6 Trainings should support participants in building work-life cooperation in their own contexts

The stakeholder data show a very strong consensus on the importance of cooperation between companies and education providers. This implies that TUADIG trainings should support participants in identifying how such cooperation can be developed and implemented in their own institutions and regional contexts. Rather than assuming a single model of collaboration, the trainings should encourage participants to reflect on what kinds of partnerships, employer contacts, and co-development practices are realistic and meaningful in their own setting.

In practical terms, this means that TUADIG trainings should guide participants to:

- identify relevant employer partners
- identify competences and realistic simulation scenarios that could be developed together with working life,
- plan practical ways of linking drone and tractor simulation to authentic workplace tasks and competence requirements

In this way, the trainings would strengthen not only pedagogical and technological competence, but also participants' ability to build locally relevant forms of employer collaboration.

8.7 Trainings should help schools create shared practices for using the simulators

The institutional data indicate that one challenge is not only the availability of equipment, but also the visibility and shared use of existing resources. Many respondents were unsure what simulation facilities or technologies their organisation had, how often they were used, or who used them.

Trainings design should therefore be supported by organisational measures such as:

- identifying responsible teachers or local champions,
- planning how simulators will be integrated into courses and timetables,
- ensuring that staff know what equipment exists and how it can be used,
- and creating shared institutional practices for booking, maintaining, and pedagogically using the simulators.

Without these structures, new equipment may remain underused or concentrated in the hands of only a small number of teachers.

8.8 Trainings design principles for wartime conditions in Ukraine

In the Ukrainian wartime context, training should be designed for flexibility, continuity, and resilience. Because studying might be disrupted by power outages or unstable internet, materials especially in online course should be mobile-friendly, low-bandwidth, and available for offline or downloadable use whenever possible.

Training should also be offered in short, manageable modules that can be completed asynchronously, making participation more realistic under conditions of heavy workload and emotional strain.

9. Conclusion

The main implication for training design is that future provision should be practice-oriented, technology-specific, pedagogically grounded, and closely connected to working life. Trainings should not focus only on how to operate drone and tractor simulators, but on how to use them as part of meaningful teaching that supports current and future agricultural competence. To achieve this, the project should combine equipment modernisation, teacher competence development, simulation

pedagogy, and stronger work-life alignment. This integrated approach is the most likely to ensure that the investment in simulators leads to sustainable changes in teaching practice and to better preparation for the technological transformation of agriculture.

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