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TIIU LEIBUR

Potential of learning analytics to support teachers' professional development and application for professional qualifications

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Potential of learning analytics to support teachers' professional development and application for professional qualifications

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Institute of Education, Faculty of Social Sciences, University of Tartu, Estonia

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Article I: participating in the development of methodology, formulating the research questions, conducting the study, collecting the data, analyzing and reporting the data, and writing the article as a main author in cooperation with other authors.

Article II: participating in the development of methodology, formulating the research questions, conducting the study, collecting the data, analyzing and reporting the data, and writing the article as a main author in cooperation with other authors.

Article III: participating in the development of methodology, formulating the research questions, conducting the study, collecting the data, analyzing and reporting the data, and writing the article as a main author in cooperation with other authors.

LIST OF ABBREVIATIONS

CPD – continuing professional development
DBR – design-based research
EQR – European Qualifications Framework
EstQF – Estonian Qualifications Framework
LA – learning analytics
PD – professional development
PS – professional standard
PQ – professional qualification
VAC – Vocational Assessment Committee
VC – Vocational Committee

1. INTRODUCTION

1.1. Research problem

The world around us is constantly changing, and both societal and economic challenges are affecting education. The professional development (PD) and qualification of teachers are growing issues in educational leadership, impacting many countries (Sutcher et al., 2016; Ladd & Sorensen, 2016; Cardichon et al., 2020). Retaining teachers while supporting their PD is a key challenge in education today (OECD, 2020). Societal changes, teacher shortages, and technological advancements necessitate new teaching models and adaptations (Hargreaves & Fullan, 2020). The concept of learning has evolved, as has the willingness of teachers to consider learners' personal learning needs, adapting the content and goals of learning to align with learners' prior knowledge, abilities, and progress (Chounta et al., 2022). Given the critical role of teachers in shaping students' learning experiences and outcomes (Cardichon et al., 2020; Li et al., 2022), ensuring high-quality teaching is paramount. However, assessing teacher competency is complex and contested (Zeggelaar et al., 2020), with two opposing perspectives: while some view it as a matter of political and national interest (Popkewitz, 2000), others see it as an opportunity to enhance teaching quality and professional development (Kraft & Gilmour, 2016).

A major challenge in teacher PD is ensuring continuous, relevant, and accessible growth. Barriers such as limited time, resources, and institutional support can hinder access to high-quality PD (Darling-Hammond et al., 2017). Moreover, misalignment between PD initiatives and classroom practice limits their impact (Desimone & Garet, 2015). In many countries, teachers are required to periodically demonstrate their qualifications and competencies (OECD, 2019). However, formal assessments may not fully capture the dynamic nature of teaching, resulting in a disconnect with real-world practice (Kennedy, 2016).

However, tools that provide a comprehensive overview of teachers' PD and support lifelong learning remain scarce. Such a tool should enable teachers to visualize their progress, gather data from various systems for competence verification, and receive immediate feedback aligned with professional standards. Additionally, it should help identify PD needs, support continuous self-improvement (Simons & Ruijters, 2014), and assist teachers in assessing their qualification levels and setting growth goals.

In this doctoral study, learning analytics (LA) capabilities were applied to address these gaps. The use of LA to measure teachers' professionalism has been limited (Gabbi, 2022). Most research focuses on LA as a tool for monitoring teacher behavior in technology-enhanced environments (Gabbi, 2022) or face-to-face classrooms (Saar et al., 2022), without clearly demonstrating LA's role in supporting teacher PD. Implementing an LA solution offers an opportunity to bridge this gap by introducing a systematic, data-driven approach to PD. This thesis examines the role and potential of LA in enhancing teacher PD. By

leveraging data-driven insights, LA can provide targeted feedback, enabling teachers to assess competencies, identify areas for growth, and systematically improve their qualifications. The study makes a significant contribution to the field by demonstrating how technology-driven approaches can support continuing professional development (CPD), foster effective teaching practices, and improve educational outcomes.

PD frameworks should support skill development while enabling teachers to document and reflect on their growth. Qualification verification systems should promote authentic, reflective practices that enhance teacher agency and instructional quality (Timperley, 2011). Addressing these challenges requires flexible PD opportunities and comprehensive, context-aware assessment frameworks to empower teachers to meet professional requirements and shape sustainable professional identities.

Supporting teachers' professional development presents significant challenges due to the lack of systematic, data-driven tools that enable educators to assess their competencies, identify development needs, and verify their qualifications. This doctoral study investigates how learning analytics can address these challenges by offering a context-aware, visual, and feedback-oriented solution. To achieve this, the study integrates professional development theory with national professional standards' performance indicators, the theoretical framework of the Learning Professional (Simons & Ruijters, 2014; Pedaste et al., 2019), and the Learning analytics model (Greller & Drachsler, 2012). Within this framework, LA can effectively support the PD process by identifying teachers' characteristics, goals, and motivations, while providing concise visual feedback on competencies (Chatti et al., 2012). Furthermore, the integration of a web-based technological solution enhances assessment and feedback mechanisms, thereby promoting lifelong learning.

1.2. Focus of the research

The overall aim of this thesis is to develop and test the impact of a learning analytics application (*Kutsepeegel*) in supporting teachers' professional development through self-reflection. To develop the LA application that addresses teachers' professional development needs and enables evidence-based assessment of their professional skills in relation to qualification requirements, a preliminary study was necessary. Given that this process involves multiple stakeholders – teachers seeking to attain professional qualifications and experts evaluating applicants' professional competence against national qualification standards – it was crucial to investigate the earlier experiences, needs, and expectations of both target groups regarding the proposed technical solution. Based on the findings, a model for the application was developed and tested with all relevant stakeholders.

The solution was proposed to enable teachers to effectively identify their developmental needs, thereby promoting continuous self-improvement (Simons & Ruijters, 2014). Additionally, the application would enable teachers to assess

their level of professionalism based on the competence-based performance indicators outlined in the professional standards. Given that self-reflection has traditionally been a time-consuming and labor-intensive process for teachers, and given the lack of a secure platform for storing data, a need has emerged for an LA-based self-assessment module. Such a module would support teachers in assessing their professionalism based on a professional standard (PS) – a document that outlines the activities, skills, knowledge, and attitudes necessary for practicing in a given profession (Kutsekoda, 2024). The digital application would also allow people with a master's degree who are already working or want to start working as teachers to apply for the qualification.

The analysis of one's own competencies is essential for teachers, serving as a foundation for reflection and feedback within the ongoing process of self-development, which is integral to a teacher's professional development trajectory. Integrating LA with the functionality of a digital application provides computational and methodological support, facilitating competency-based self-development and the evaluation of one's professional practices (Vatrapu et al., 2011). Such a system must effectively assist teachers in advancing their professional development in alignment with the competencies and standards established by professional qualification requirements.

The dissertation covers three studies (Table 1).

Table 1. The goals and research questions of the thesis

The aim of the thesis is to develop the learning analytics application *Kutsepeegel* and to evaluate the perceptions of teachers and qualification experts regarding its functionalities in supporting evidence-based self-reflection and professional development.		
Goals of the Studies	**Research Questions**	**Articles**
1. To explore teachers' perceptions of the current qualification application process and their expectations for it in supporting their professional development.	1. What shortcomings do different target groups perceive in the current professional standards and application process?	Article 1
	2. What are the expectations and needs of different target groups regarding professional standards and application procedures?	Article 1
2. To develop a learning-analytical solution to address the teachers' needs and expectations for the support of their PD.	3. What are the needs and expectations of different target groups regarding the digital application *Kutsepeegel* in supporting teachers' professional development and application for the profession?	Article 2
	4. What should be the design and functionalities of *Kutsepeegel* to support teachers' professional development and the application process?	Article 2

Goals of the Studies	Research Questions	Articles
3. To test the functionalities and purpose of *Kutsepeegel* and reflect on the user experience.	5. How do teachers and professional assessors evaluate the usefulness and effectiveness of the digital application in supporting their professional development and identifying their professional developmental needs when applying for a qualification?	Article 3

The research questions are addressed in the following original publications. The first two research questions are addressed in Study I, which investigated the experiences and perceptions of Estonian teachers and qualification assessors regarding the application process for professional standards qualifications, focusing on identifying challenges and expectations related to understanding qualification requirements, demonstrating evidence-based competencies, and enhancing self-analysis skills in support of teachers' professional development.

I. Leibur, T., Saks, K., & Chounta, I.-A. (2021). Towards Acquiring Teachers' Professional Qualification Based on Professional Standards: Perceptions, Expectations and Needs on the Application Process. *Education Sciences, 11*(8), 1−19. https://10.3390/educsci11080391

The third and fourth research questions are addressed in Study II, which explored teachers' expectations for a digital application designed to support self-analysis, self-assessment, and the qualification application process. This study highlights the need for a tool that enhances teachers' professional development, self-esteem, and recognition as lifelong learning professionals.

II. Leibur, T., Saks, K., & Chounta, I.-A. (2023). Towards a conceptualized model of supporting teachers' application process for acquiring professional qualifications. *International Journal of Educational Research Open, 4*, 100236. https://10.1016/j.ijedro.2023.100236

The fifth research question is addressed in Study III, which investigated the user experience of qualified teachers and professional assessors in utilizing a digital application with a Learning analytics module, assessing how the application supports teachers' self-development, self-assessment, and progression towards higher qualification levels by facilitating continuous monitoring, feedback, and analysis of professional development.

III. Leibur, T. and Saks, K. (2025). Leveraging Learning Analytics to Support Teachers' Professional Development: Insights from a Digital Application. *Frontiers in Education, 10*, 1639217. https://10.3389/feduc.2025.1639217

2. THEORETICAL BACKGROUND

2.1. Teacher Professionalism

Teacher professionalism has been explored extensively in sociological literature, resulting in a variety of definitions and taxonomies (e.g., Hargreaves, 2000; Snoek, 2011). These diverse perspectives have led to competing views and concepts of professionalism, which have evolved over time. The so-called "New Professionalism," as described by Hargreaves (2000), introduces additional challenges for teachers, expanding their role beyond traditional expectations. Teachers are now viewed as knowledge providers, advisors, supervisors, supporters, social workers, problem solvers, and advocates for inclusive education. Society's expectations of teacher professionalism are particularly high, especially considering that learning requirements are outcome-based. Consequently, teachers must cope with growing emotional, intellectual, and technological demands. Therefore, collegiality, cooperation, and the adoption of new forms of communication and collaboration are essential aspects of teacher professionalism (Hargreaves & O'Connor, 2018).

Lifelong learning and continuous professional development are vital components of teacher growth, emphasizing the need for ongoing career development (European Council, 2009). Hargreaves (2006) describes the development of professionalism through four eras: pre-professional, autonomous professional, collegial professional, and post-professional or postmodern professional stage. In the first era, known as the pre-professional era (1940–1960), teaching was not yet a professional vocation. The role of the teacher was largely authoritarian, and teachers worked in isolation (lack of collaboration). School management was hierarchical, and teacher self-development was not a priority. The second era, i.e., the era of autonomous professionalism (1960–1980), was characterized by increasing teacher autonomy and considerable pedagogical freedom for teachers. The third era (1980–1990) responded to growing demands for educational accountability by introducing more centralized control through the use of standards, testing, and reporting mechanisms. Education policy focused heavily on outcomes, transparency, and efficiency. At the same time, there was a growing interest in establishing a stronger professional culture within schools (Müller & Cook, 2024). However, these reforms also limited teacher autonomy, aligning teaching more closely with measurable performance indicators. The fourth era of collaborative professionalism (2000s to present) was characterized as an era of teacher collaboration, shared responsibility, and professional learning. It was also an era of continuous professional development, reflection, and innovation aimed at collectively improving student learning outcomes. Meanwhile, Müller and Cook (2024) see the complexity of this era, highlighting the positive side of supporting PD, but on the other hand, they see it as an era of deprofessionalization, where teachers work under constant pressure and excessive workload.

Eraut (1994), Hargreaves and Goodson (1996), and Evans (2008) describe "New Professionalism" as a combination of performance standards, public accountability, lifelong professional development, collaboration, and innovation. The concept of the "New Professionalism" (Eraut, 1994; Hargreaves & Goodson, 1996; Evans, 2008) reflects a paradigm shift in the teaching profession, moving beyond traditional notions of autonomy and routine practice to one that is more collaborative, accountable, and development-oriented. This modern interpretation incorporates professional standards and public accountability, emphasizing the need for lifelong professional learning, shared practice, and innovation in pedagogy. Such a model positions teachers not just as implementers of policy, but as active, reflective practitioners engaged in continuous improvement and collective responsibility for educational outcomes. Central to this vision is the promotion of collaborative cultures among educators and a strong orientation toward innovation and responsiveness in meeting the evolving needs of learners and society. Sachs (2005) and Kolleck et al. (2021) support this perspective by conceptualizing teacher professionalism as grounded in collegial relationships and collaborative practices. In contrast, organizational professionalism highlights leadership, control mechanisms, and external accountability frameworks.

Holroyd (2000) reminds us that professionalism is not an absolute construct, but rather a historically contingent and socially constructed concept. Thus, teachers' identities in the 21st century reflect a more adaptive, interconnected, and reflexive understanding of their role, not only as educators, but also as key actors in shaping educational outcomes and social progress.

Teacher professionalism is both an individual and institutional process (Wermke & Höstfält, 2014) and serves as a means of implementing change (Evans, 2008). It includes individual growth, collegial collaboration, and organizational professionalism, emphasizing effectiveness and accountability (Sachs, 2005). One strategy to promote professionalism is the implementation of professional standards and competence frameworks in teacher education, continuous professional development, and performance appraisal. Such standards define clear expectations, guide assessment, and focus on key aspects of teaching (OECD, 2020).

The OECD highlights that from 2021, teachers must engage in CPD at least at one level of education to maintain and enhance teaching quality. Nonetheless, fewer than half of EU countries have aligned their professional requirements with national or central standards of teacher professionalism (OECD, 2022). Professional standards serve as a national framework that defines the knowledge, skills, and professional development expected of teachers (Figueroa et al., 2017). However, Asterhan and Lefstein (2024) critique the association of professionalism with rigid national norms and standards, suggesting that teachers who deeply grasp such standards are better equipped to apply them in practice. Darling-Hammond (1999: 39) argues that professional standards are not a "magic bullet" for resolving educational problems, such as outdated curricula, unequal resource allocation, and a lack of social support.

Teachers' professional development is a lifelong journey shaped by personal motivation and developmental needs (Khan & Khan, 2025). It begins with the acquisition of teaching skills and evolves based on a teacher's commitment to self-improvement. This ongoing process helps define a teacher's professional identity and development trajectory. Although teachers bear the primary responsibility for maintaining their professionalism, the education system and employers also play crucial roles in offering support (Sachs, 2005).

For the purposes of this study, PD is approached as a structured and intentional process whereby teachers engage in systematic self-analysis and continuous improvement of their professional competencies, guided by established professional standards that serve as a reference framework for quality teaching.

2.1.1. Teacher Professional Development

Teacher professional development is a fundamental component of educational reform and continuous professional growth. The increasing complexity of modern education necessitates ongoing development among educators, as rapid technological advancements and social and political changes impose evolving demands on education systems (Samundeeswari et al., 2024). Economic changes have led to the globalization of society, increased competition between schools, and a market-oriented approach (Gewirtz et al., 2009, cited in Snoek, 2011). Consequently, teachers are expected to demonstrate greater accountability, adaptability, and professional competence. Recognizing these challenges, policymakers and educational institutions have increasingly focused on the lifelong development of teachers throughout their careers (Panitsides & Anastasiadou, 2015).

Day (1999) defines PD as a reflective process in which teachers continuously examine, renew, and expand their commitment to the moral goals of teaching as agents of change, individually and collaboratively. Through this process, educators develop and refine pedagogical knowledge and skills, plan instructional strategies, and engage with students, colleagues, and the broader educational community throughout their careers. Conversely, Bolam (2002) views PD as the continuous development of professional expertise, emphasizing its role in sustained knowledge development throughout a teaching career. Although the concepts of PD vary, scholars generally converge on several key aspects: PD serves as a mechanism of teacher self-improvement (Feiman-Nemser, 2001), enhances instructional effectiveness (Gall & Renchler, 1985), and ultimately contributes to student academic achievement (McLaughlin & Zarrow, 2001). Despite differences in terminology and emphasis, these perspectives share the idea that PD is a continuous, dynamic, and lifelong learning process (Collinson et al., 2009) which plays a critical role not only in improving teachers' academic performance and instructional efficiency but also in strengthening their professional identity, commitment, and job satisfaction (European Commission, 2013).

Teachers' PD is an ongoing process embedded in their daily practice and influenced by both individual initiative and systemic educational structures (Feiman-Nemser, 2001). The growing emphasis on inclusive education and competency-based curricula leads to the need for personalized teaching and learning, fostering continuous self-improvement (OECD, 2018). These evolving demands significantly impact teachers' roles, requiring them to master diverse pedagogical methodologies, support students with special educational needs, and remain informed about educational innovations, etc. Collaboration with different stakeholder groups and professional communities is essential in facilitating effective PD. PS serves as a benchmark for defining professional development, providing guidelines for self-assessment, continuing professional development, and professional qualification (PQ) levels. PS functions as an evaluation tool, enabling teachers to systematically analyze their competencies and development trajectory (Ingvarson, 2010).

Research on European teachers' career trajectories (Eurydice, 2018) indicates that competence frameworks are mainly used for teacher education, curriculum development, defining learning outcomes, and serving as a reference for in-service training. However, they are rarely used to support teachers' career progression, as many European countries lack structured pathways for teachers' advancement (Snoek et al., 2019). Therefore, effective PD requires alignment between individual aspirations and national educational priorities, ensuring a coherent approach to teachers' developmental needs within the framework of PS. Educators must remain informed about curriculum developments, evolving pedagogical methodologies, and the shifting demands of the teacher profession (Darling-Hammond, 2005). Thus, teachers' PD is a multifaceted process encompassing both practical teaching experiences and continuous learning. On the one hand, PD fosters the development of critical thinking, problem-solving abilities, and expanded pedagogical knowledge; on the other hand, it enables educators to impart acquired expertise to students, cultivating their intellectual, personal, and academic growth.

In the context of evolving professionalism, the roles of teacher, mentor, and supervisor are expanding (Sim et al., 2012), underscoring the importance of collaboration and partnerships between schools and universities (Martin et al., 2011). PD is fundamentally rooted in teachers' commitment to continuous learning, fostering collaboration among educators, researchers, and practitioners, and ensuring the integration of theoretical knowledge with practical application (McMahon et al., 2015). Academic knowledge enables educators to engage with educational theories, remain informed about global pedagogical advancements, and critically assess expert insights and research findings (Hargreaves, 2000). A defining characteristic of professionalism across various frameworks is its emphasis on specialized expertise, ethical responsibility, and unwavering dedication to high standards of practice. Despite institutional efforts to support PD, the responsibility for sustaining and enhancing professional competency lies with educators themselves (Simons & Ruijters, 2014). Teachers must actively allocate time and effort to engage in their CPD. However, sustained institutional and

employer support remains crucial in fostering a strong and competent teaching profession (Sachs, 2005).

2.1.2. Teacher as Learning Professional

This dissertation is grounded in the concept of professionalism, which reflects the expectations of today's competitive knowledge society, where teachers are required to engage in continuous professional development throughout their careers (Simons & Ruijters, 2014). According to Simons and Ruijters (2014), a learning professional is an individual committed to ongoing learning, both to enhance their professional practice and to acquire knowledge from others. This concept positions teachers as specialist knowledge workers, utilizing their expertise to create value for themselves, their organizations, and society as a whole. Professionalism extends beyond formal education and accreditation from professional associations; it encompasses a lifelong commitment to self-improvement and continuous learning, reinforcing the idea that education does not conclude upon obtaining a qualification but remains an ongoing process of professional growth.

Simons and Ruijters (2014) originally identified eight key characteristics of professionalism: commitment, integrity, broad knowledge, action theory, competencies, professional communities, autonomy, and authority. Within this framework, commitment and integrity are classified as core requirements, while autonomy and authority are regarded as advantages. Consequently, professionalism is defined through four overarching dimensions: commitment to continuous self-improvement, critical reflection and analytical thinking, engagement with theories and research to enhance expertise, and participation in professional communities and interdisciplinary collaboration.

Learning professionals actively pursue lifelong development, critically evaluate and refine their practices, and engage in collaborative knowledge exchange within their professional networks. Reflective practice serves as a foundational element, enabling educators to integrate specialized expertise with practical application (Ahmad et al., 2025). In essence, professionalism is a conscious and voluntary commitment, requiring educators to continually develop the competencies that uphold their status. Sustaining professional excellence necessitates ongoing engagement with self-improvement, research, and collaborative learning within academic and professional communities (Darling-Hammond et al., 2017).

Contemporary education policy increasingly emphasizes standardization across both educational systems and teacher qualification requirements, reflecting a broader alignment between state interests and the advancement of teacher professionalism (Hargreaves, 2000; Sachs, 2003). This external regulatory influence plays a critical role in defining professional boundaries within the teaching profession (Sachs, 2003).

Building on this framework, the concept of the learning professional has been integrated into Snoek's characterization of professionalism, specifically in relation to compliance with professional standards. The attributes of professionalism

identified by Snoek (2011) and Pedaste et al. (2019) closely align with those presented by Simons and Ruijters (2014), particularly in their shared emphasis on continuous professional learning. While Snoek approaches professionalism from a systemic and policy-driven perspective, Simons and Ruijters focus on individual learning strategies within professional practice. From an educational policy standpoint, both perspectives provide critical insights into the conceptualization and development of teacher professionalism.

Simons and Ruijters (2014) and Pedaste (2019) have distinguished between the benefits and requirements of professionalism. In Snoek's theory, all criteria of professionalism are defined as attributes, whereas Pedaste and Simons categorize professionalism through qualities, requirements, and benefits, highlighting their interconnected nature and mutual influence. This distinction represents the primary difference between the three conceptualizations of professionalism. While Simons and Ruijters considered the learning professional in a broader context (e.g., learning in the workplace), Pedaste and his colleagues added a pedagogical output to the concept of the learning professional, i.e., they opened the concept from the teacher's perspective by considering the teacher as a learning professional.

Pedaste and his colleagues (2019) highlight the strong correlation between professional standards for proficient students and the core characteristics of professionalism. Building on this relationship, the authors integrated these formulated objectives into their professionalism model, emphasizing the advancement of professional qualifications as a fundamental goal. This addition underscores the importance of self-definition and continuous professional development, reinforcing the learning professional's commitment to lifelong growth.

The theoretical framework outlined above comprises four sub-constructs; therefore, it is essential to analyze the features, aims, requirements, and benefits of the model (see Figure 1). The requirements are based on ethical principles, which are dedication and desire to work as a teacher, i.e., to be a lifelong learner (Simons & Ruijters, 2014; Pedaste et al., 2019; Snoek, 2011). These basic professional values are expressed by positive relationships with other teachers and parents; creating equal opportunities, considering other people and their interests; dealing with ethical issues and resolving value conflicts among students; commitment to PD and developing professional assessment; a sense of responsibility for both personal and collective actions, and maintaining confidentiality (Artur et al., 2005). This means that teachers are expected to accept the social and moral context of their work. The requirements are closely related to professional qualities, which draw attention to the teacher's qualifications and the use of PS to regulate the teacher's work. The modern output-based and results-oriented education system is also reflected in teacher qualification requirements, encompassing outcomes and competencies, and referring to the importance of teachers' further PD (Snoek et al., 2009). Teachers, as professionals, are expected to possess a strong academic knowledge base (Abbott, 1988), comprising pedagogical knowledge, content knowledge, and technical knowledge (Hargreaves & Goodson, 1996). By supporting continuous professional development based on experience,

teachers are expected to be able to analyze and reflect on their work in light of their professional experience (Simons & Ruiters, 2014; Snoek et al., 2009) and adapt and improve it. Collaboration as a second quality element focuses on new forms of relationships based on societal expectations, i.e., collaboration with colleagues, students, and parents (Hargreaves, 1996), as well as collaboration outside the profession (Whitty, 2008). Participation in professional learning communities enables and supports both collaborative learning and sharing of experiences between teachers and professionals (Bolam & McMahon, 2004). At the same time, belonging to a learning community can open up new opportunities for self-development (e.g., mentoring novice teachers or colleagues).

Figure 1. The concept of model of learning professionals (based on Simons & Ruijters, 2014; Pedaste et al., 2019)

The aims, as shown in the theoretical model, accompany teachers throughout their careers, i.e., are related to readiness for lifelong learning (Hargreaves, 1996; Evans, 2014). Aim setting ensures competitiveness in an ever-evolving knowledge society. The importance and need for lifelong learning are also emphasized by ETUCE (2008) and the EU Report (2020), which highlight the importance of continuous, systematic integration of professional development into the teaching profession, allowing teachers to improve their qualifications. Realizing these goals keeps teachers at work in their field, which is also extremely important (Pedaste et al., 2019).

Adhering to the aforementioned aims, characteristics, and requirements (Figure 1) should enhance teachers' independence and authority as learning professionals, while also providing opportunities for qualification advancement. It is essential to recognize the interconnected nature of these elements, as the alignment of requirements, characteristics, aims, and benefits collectively forms a comprehensive framework of professionalism.

Based on the concept of the learning professional, the four criteria described above can be summarized as a set of quality tool standards for teachers that support teacher learning, encompassing both theoretical professional learning and

continuous professional learning, including experiential learning, knowledge creation, and community development (Figure 1). Pedaste et al. (2019) emphasize the strong interconnection between professional standards and developmental objectives, highlighting their mutual influence in shaping effective teaching practices.

A learning professional is recognized as a continuously evolving, reflective, and collaborative practitioner, committed to ongoing knowledge enhancement, skill development, and improved educational outcomes. This professional approach is characterized by a dedication to innovation, fostering the creation of new strategies and solutions to address complex educational challenges. Pedaste et al. (2019) applied this framework to the Estonian teacher education curricula, further expanding the conceptualization of the learning professional to align with national educational priorities.

Adhering to the aforementioned goals, characteristics, and requirements fosters greater independence and authority among educators as learning specialists, while also providing opportunities for professional qualification enhancement. Recognizing the interconnected nature of requirements, characteristics, goals, and advantages is essential, as they collectively form a comprehensive framework of professionalism. Through a critical examination of existing assumptions and beliefs, learning specialists can challenge and refine their thought processes and professional practices, leading to deeper and more enduring transformations in their pedagogical approach.

2.2. Competency Framework and Professional Standards

Teacher professional development constitutes a fundamental component in shaping school culture. While the government holds a constitutional mandate to uphold the quality of education, the realization of this objective necessitates collaborative engagement among the ministry, educational institutions, and teaching professionals, with due recognition of their respective roles and responsibilities (Snoek, 2017). In establishing professional standards, the consensus is that a satisfactory level of performance serves as a benchmark, where the attainment of an acceptable standard is regarded as the objective. These standards are based on the evaluation of teachers' pedagogical performance and professional accreditation processes (MCEECDYA, 2020). Moreover, professional standards function as an instrumental mechanism for teachers' self-assessment and professional reflection. PS encapsulate the breadth of teacher competencies, thereby facilitating the evaluation of pedagogical practice (Sachs, 2015) and advancing both instructional efficacy and the certification of teaching methodologies (Darling-Hammond et al., 2012).

Qualifications frameworks delineate the formal acquisition of knowledge through structured educational pathways, such as bachelor's, master's, or doctoral studies. In contrast, professional standards govern the ongoing refinement of competencies, including knowledge, skills, and attitudes, among both novice

educators and experienced practitioners, fostering their professional evolution. These standards may, but do not necessarily, culminate in formal academic advancements within the teaching profession, thereby underpinning continuous professional development (Toledo-Figueroa et al., 2017). Thus, as a continuation of a teacher's professional career, professional standards complement the qualifications acquired in teacher education programs, promoting the lifelong development of teachers.

Competency-based PS are described as "what teachers need to know and be able to apply in practice", as well as "how their assessment of knowledge is valued" (Guerriero, Toledo-Figueroa et al., 2017, p. 83). Professional standards are established based on clearly defined quality criteria and simultaneously serve as benchmarks for occupational competence (The InTASC Model, 2013). Thus, professional standards are dynamic constructs that evolve in response to societal demands. Their formulation necessitates a logical and systematic approach, ensuring linguistic precision to prevent redundancies and inconsistencies. Furthermore, professional standards must undergo periodic revision, informed by ongoing research and advancements in professional knowledge, to maintain their relevance and efficacy (Ingvarson, 2012).

Professional standards can also be handled as a decision-making tool grounded in shared understandings and values (Sykes & Plastrik, 1993). Their implementation necessitates not only the establishment of evaluative measures but also a systematic approach to evidence collection and the determination of the extent to which predefined criteria are met, thereby informing performance assessment (Kordaczuk-Wąs, 2024) Furthermore, PS serve as indicators of teacher competencies, facilitating the evaluation of pedagogical knowledge at the point of entry into the profession (Sachs, 2015). They also play a crucial role in fostering instructional improvement and supporting the formal certification of teaching practices (Darling-Hammond et al., 2012; Kleinhenz & Ingvarson, 2007). As integral components of teacher competency frameworks, professional standards provide educators with structured guidance to navigate professional challenges and advance lifelong development in the field of education (Toledo-Figueroa et al., 2017). As an evaluative instrument within the framework of professional evaluation, PS delineates an aspirational model of the ideal educator. While this benchmark can serve as a catalyst for continuous professional self-improvement, it may also contribute to a sense of uncertainty among some teachers regarding their ability to meet these expectations (Ball, 2003).

Related studies conducted across various national contexts (Toledo-Figueroa et al., 2017) highlight the importance of professional standards in promoting professional success. These standards encompass multiple dimensions: content and knowledge correspond to cognitive competencies, applied skills align with functional competencies essential for the effective translation of knowledge into practice, and professional standards further integrate ethical and value-based competencies. Consequently, PS does not serve as a competitive framework but rather delineates aspirational benchmarks that highly qualified educators should

endeavor to attain through continuous professional development. When evaluating the efficacy of professional assessment, it is essential to provide teachers with a professional certification that is grounded in the evaluation of respected, knowledgeable, and experienced colleagues. Such certification provides a comprehensive assessment of the candidate's competencies. While professional certification remains voluntary, its primary function is to validate that practitioners adhere to elevated professional standards and possess advanced qualifications (Ingvarson, 2002).

A qualification represents an officially recognized competency, signifying an individual's acquisition of specific rights and obligations (EstQF, 2016). The European Qualifications Framework (EQF) is an 8-level framework systematically organized based on learning outcomes for all types of qualifications. This framework serves to improve the transparency, comparability, and transferability of qualifications, thereby facilitating the assessment of competencies across different nations and educational institutions. By encompassing all qualification types and levels, the EQF provides a structured approach to evaluating individuals' knowledge, comprehension, and practical abilities. Proficiency levels progress incrementally, with Level 1 representing the foundational stage and Level 8 denoting the most advanced expertise. Most importantly, the EQF maintains a close alignment with national qualifications frameworks, thereby providing a comprehensive and structured representation of qualifications across Europe. This integrative approach is increasingly supported through the development of qualifications databases, further promoting accessibility and coherence (EQF, 2024).

The European Qualifications Framework also serves as the foundation for the Estonian Qualifications Framework (EstQF). The professional standards for teachers, introduced in Estonia in 2005, emphasize the role of educators as reflective practitioners and lifelong learners. These standards were designed to support teachers' professional development throughout their teaching careers (Pedaste et al., 2019). The EstQF (explained in more detail in Section 2.2.2) aims to support teacher education, competency assessment, and continuous professional learning throughout educators' careers (Pedaste et al., 2019). The importance of a teacher's competency model lies in its ability to establish unified principles for guiding teacher development while ensuring transparency and clarity in the evaluation of pedagogical competencies (Roelofs & Sanders, 2007). The PS provides educators with a framework for self-analysis, fostering a shared understanding of professional competencies and enhancing collaboration across different target groups (Kriewaldt, 2008). The results of previous studies have shown that teachers who have received a professional certificate feel greater professional recognition (Ingvarson, 2012).

2.2.1. Professional Standards and Their Implementation

Professional standards are regarded as a valuable mechanism for teacher development, which can lead to certification. However, concerns have been raised

regarding their potential limitations, particularly in constraining teachers' practical activities, which may affect student outcomes. To be effective, professional standards should encompass broad competencies and complex skill sets rather than focusing on micro-level competencies or personality traits. Additionally, they must account for the interplay between personal and contextual factors – including social influences, the education system, and school-level dynamics – that shape teacher performance (Toledo-Figueroa et al., 2017).

The European Survey on Teacher Careers (Eurydice, 2018) highlights the predominant role of competence frameworks in teacher education, particularly in curriculum development, graduation criteria, and in-service training. The survey revealed that only a limited number of European countries employ competence frameworks to support teachers' career progression, while around half lack a structured pathway for advancement (Snoek et al., 2019). Furthermore, teacher competency frameworks and professional standards are increasingly utilized as performance management tools to monitor teaching effectiveness and align educational outcomes with national priorities (Chiang & Trezise, 2020).

Internationally, the implementation of professional standards varies. For example, Australia adopts a subject-specific approach, requiring teachers to attain accreditation at a foundational level of professional competence, with professional development as the central goal. The United Kingdom mandates professional standards and integrates them into salary structures, defining competencies across five hierarchical levels, ranging from newly qualified teachers to advanced teachers. The United States emphasizes "effective teaching" with the goal of reaching new levels of student achievement, ensuring that all students are equipped to pursue higher education or enter the workforce in an evolving global landscape (Lin, 2021).

Comparative analyses reveal that national frameworks prioritize distinct aspects of teacher development. For instance, Scottish standards place more emphasis on cognitive, social, and emotional growth, whereas English and Australian models focus on physical, social, and intellectual development. American standards encompass social, physical, emotional, and intellectual dimensions. Research by Toledo-Figueroa and colleagues (2017) identifies differentiated instruction, student engagement, feedback mechanisms, and classroom management as core components of professional standards. Additionally, adaptability – through the application of diverse teaching strategies and responsiveness to student variability – is a key feature of effective teaching practices.

Despite variations, the fundamental purpose of professional standards remains consistent across countries: they establish criteria for evaluating teaching effectiveness, delineate essential competencies, and facilitate the practical application of pedagogical knowledge. Professional standards also include personal competencies (i.e., behavioral adaptability in specific situations) and ethical competencies (i.e., adherence to professional and moral principles). While some national frameworks explicitly define these aspects in distinct sections, others integrate them into broader competency descriptions.

In Estonia, professional standards play a pivotal role in supporting teacher development throughout both pre-service training and career progression (Pedaste et al., 2019). Teachers who acquire professional certification report increased professional recognition, which may, in turn, enhance their motivation to assess their professional development and pursue higher qualifications. Thus, rather than serving as an exclusive "elite" standard, professional standards constitute an attainable benchmark for all qualified educators, fostering continuous professional growth through continuous professional development. Certification not only validates a teacher's competency but also carries psychological significance – providing educators with formal recognition based on the assessment of their practice by experienced, knowledgeable, and professionally trained colleagues. Ultimately, professional certification confirms that a teacher has met higher professional standards and can effectively apply pedagogical knowledge in educational settings (Ingvarson, 2002).

2.2.2. Applying for Teacher Qualification, the Estonian Context

The professional standards for teachers, introduced in Estonia in 2005, emphasize the role of educators as reflective practitioners and lifelong learners. Initially, the professional standards were formulated as single-level criteria, outlining teachers' competencies without differentiating between levels of expertise. The standards categorized teachers' competencies into three domains: (1) planning and management of the learning process, including the creation of a conducive learning environment, instructional guidance, and the analysis and assessment of student development; (2) pedagogical proficiency, which includes interpersonal competencies, communication and collaboration skills to support student motivation; and (3) professional development and self-analysis. However, this framework did not establish a clear distinction between novice and experienced teachers (Pedaste et al., 2019), limiting its capacity to address the progressive nature of teacher development.

In Estonia, professional standards are developed through cooperation between labour-market stakeholders, including employers, employees, professional associations, experts, and education providers. This collaborative process ensures that competence requirements reflect the needs of the labour market and the professional community. Professional standards describe the knowledge, skills, and competences required to perform a specific occupation and serve as the basis for assessing professional competence and awarding qualifications. They are also used for developing vocational and higher education curricula. The development and coordination of these standards is managed by the Estonian Qualifications Authority within the Estonian occupational qualifications system, where sector skills councils approve and update standards to ensure their relevance and quality (European Commission & Cedefop, 2022; Kutsekoda, 2024). Professional qualification standards therefore function as an important link between the education system and labour-market needs in Estonia (Cedefop, 2020).

Since 2013, the professional standards for teachers in Estonia have undergone continuous development, spearheaded by the Education Professional Council (*Hariduse Kutsenõukogu*). This evolution facilitated the differentiation between novice and experienced teachers, leading to the establishment of distinct competency levels. Through collaboration with various stakeholders (teachers, education experts, etc.), the current PS was formulated and formally approved by the Estonian Qualifications Authority (*Kutsekoda)*. A key innovation within this framework was the introduction of a structured description of professional activities at four hierarchical levels: Teacher (level 6), Teacher (level 7), Senior Teacher (level 7.1), and Master Teacher (level 8) (Kriewalt, 2008). The current professional standards describe teachers' competencies across multiple domains, including planning, teaching, and learning activities; designing the learning environment; supporting learning and development; reflection and professional self-development; guidance and supervision; and research and development. Additionally, the framework incorporated both recurring and optional competencies. Since 2024, efforts have been underway to update the professional standards, and the revised version is being applied from September 2025.

The new professional standards (implemented from 1 September 2025) allow teachers in auxiliary and hobby education, in addition to kindergarten and school teachers, to apply for the profession. Until 2025, there were four professional standards for teachers at three levels: level 6, level 7 (two standards, i.e., teacher and senior teacher), and level 8. From September 1, 2025, five standards at four levels will apply, as a new level 5 standard was added. Teachers at Level 5 can work as assistant teachers in schools or kindergartens and as initial hobby education teachers in hobby schools. Although they do not independently carry out all teaching-related responsibilities, they can work with a degree of independence, particularly in hobby education, where they supervise learners and implement the curriculum. Full professional independence in teaching is expected from Level 6 onwards. (Kutse ja kvalifikatsioon, 2024)

The majority of kindergarten teachers and hobby school teachers are expected to meet the professional standard of Teacher, Level 6. However, this does not limit their career progression, as they can continue advancing according to the professional standards at Levels 7 and 8.

Teachers of general subjects in general education schools and vocational education institutions are required to meet the Teacher, Level 7 standard. At the same qualification level, the Senior Teacher, Level 7 standard represents a more demanding role, requiring higher competence and greater professional responsibility.

The Master Teacher qualification corresponds to Level 8. A Master Teacher is expected to demonstrate outstanding competence, comparable in scope to doctoral-level expertise within the field of education, although holding a doctoral degree is not a formal requirement for obtaining this professional qualification. (Trull, 2025)

According to Pedaste (2025), the five-level system provides a strong framework for building a coherent teacher career model. It also promotes collaboration,

as teachers' professional responsibility increasingly extends beyond their individual classroom to the wider teaching community.

The new teacher professional standards define the main goal of a teacher as supporting and guiding learners' development in ways that promote both their personal growth and social well-being. This includes fostering the acquisition of knowledge and skills as well as the formation of values. A teacher's work is organised around several key areas: self-development, work with learners, collaboration with colleagues, contribution to the organisation, and engagement with the wider community, including parents.

A significant change in the new standards is the explicit emphasis on the teacher's own well-being and professionalism. As Pedaste (2025) explained, ensuring a teacher's self-care competence has been brought to the forefront: teachers must first take care of themselves in order to effectively support learners, colleagues, and the community. While supporting learners remains the most extensive area of competence and occupies the largest share of a teacher's working time, high-quality teaching begins with the teacher's own well-being and professional capacity.

Another important update concerns professional competencies (Figure 14). The previous standards included 11 cross-cutting competencies (Figure 2), whereas the new standards define a set of general skills that are assessed during the granting and renewal of professional qualifications.

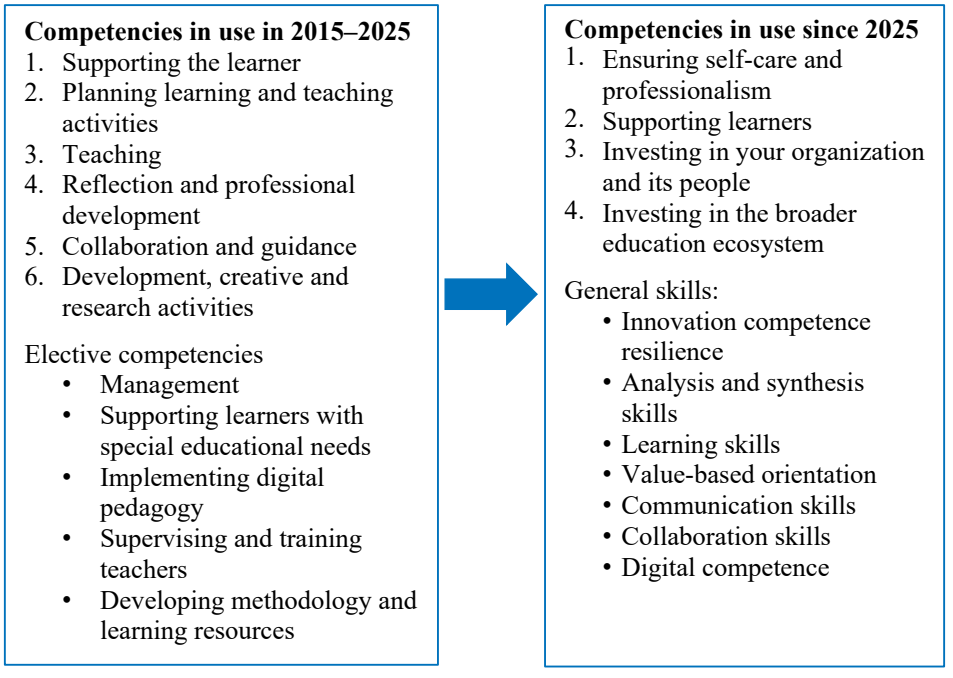

Figure 2. Changes in competencies before and after September 1, 2025

These include analysis and synthesis skills, learning skills, innovation competence, values-based orientation, resilience, communication skills, cooperation skills, and digital competence.

In addition, the new standards introduce a separate section on future skills. This section outlines the direction in which the teaching profession is evolving and highlights the competences that are expected to become increasingly important in the years ahead.

The research underpinning this thesis was conducted in accordance with the PS that were in effect during the preceding period (i.e., 2013–2025), and delineates teacher competencies across the domains of planning, teaching, and learning activities; designing the learning environment; supporting learning and development; reflection and professional self-development; guidance and supervision; and research and development activities (see Figure 14 first column). Additionally, the framework incorporates recurring competencies and optional competencies, which vary according to qualification level. For instance: Teacher (Level 7) – supporting students with special educational needs (SEN) and implementing digital pedagogy; Senior Teacher (Level 7.1) – specializing in either leadership, teacher supervision and training, methodology development, learning resource creation, digital pedagogy or supporting learners with SEN; Master Teacher (Level 8) – specializing in teacher supervision and training, methodology development, learning resource creation, digital pedagogy, or supporting learners with SEN. Since 2014, teachers have had the opportunity to apply for professional qualifications through the Teachers' Union, which organizes Vocational Assessment Committees (VACs) comprised of master-level educators serving as assessors.

The current professional qualification application process is a multi-step process accomplished by two distinct committees (Vocational Assessment Committee and Vocational Committee), with the shared goal of ensuring objective and transparent competency assessments while fostering professional growth (Figure 3). Today, the Estonian professional assessment system operates on the principle of peer evaluation, often described as "from teacher to teacher" or "from colleague to colleague" or "from practitioner to practitioner". Professional assessors are expert teachers who have achieved the highest qualification standards and are formally trained in assessment procedures.

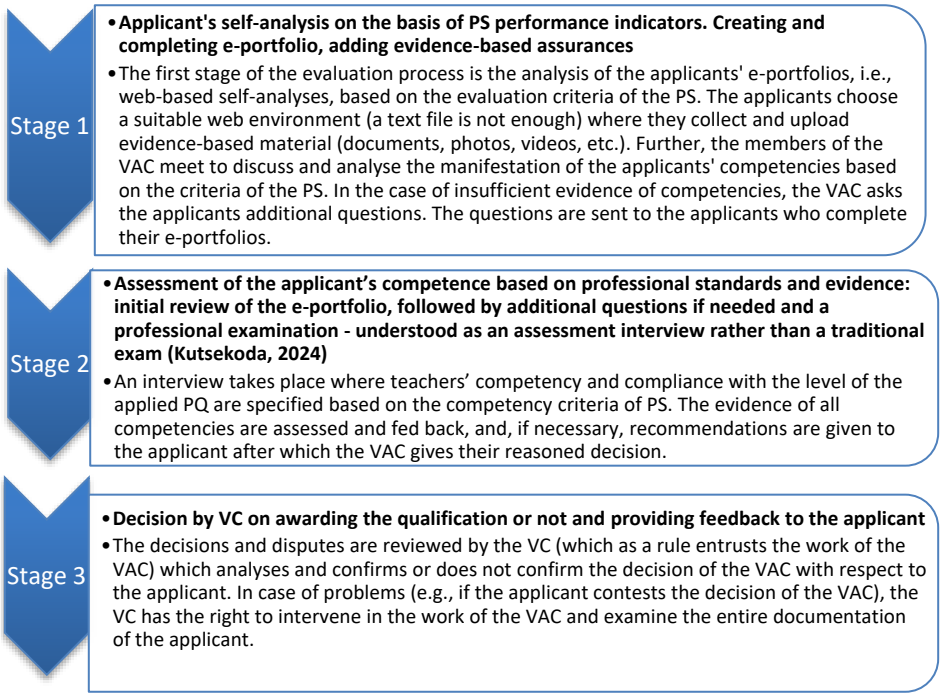

Figure 3. Process of professional qualification application

The professional qualification application process consists of three interrelated steps:

1. Initial assessment: the VAC evaluates applicants based on submitted documentation and an interview. This assessment is conducted in accordance with the PS criteria, ensuring alignment with performance indicators.
2. Committee review: the VC reviews and approves (or rejects) the VAC's reasoned proposal to grant professional qualification.
3. Final decision and certification: upon approval, the teacher is awarded their qualification electronically, accompanied by constructive feedback and targeted recommendations to support ongoing professional development.

The first stage of the evaluation process involves analyzing applicants' e-portfolios, which serve as web-based self-assessment tools aligned with the PS criteria. The core value of the e-portfolio lies in supporting teachers' professional development (Smith & Tillema, 2001). Additionally, the requirement to compile an e-portfolio encourages the development of digital competencies among teachers.

The applicants choose a suitable web-based platform to compile and upload evidence-based materials (documents, photographs, videos, etc.). Further, members of the VAC meet to evaluate the applicants' demonstrated competencies based on the criteria established in the professional standards. If the submitted evidence is found to be insufficient, the VAC requests additional clarification by posing specific questions to the applicants, who must then revise and complete

their e-portfolios accordingly. Next, the applicants participate in an interview, during which their competencies are assessed in relation to the professional qualification level they seek to obtain. The VAC systematically evaluates all submitted evidence, provides constructive feedback, and, if necessary, issues recommendations for further professional development. Upon completing this assessment, the committee delivers a reasoned decision regarding the applicant's qualification status.

The VC reviews the decisions and argumentation presented by the VAC, generally endorsing its evaluations. The VC conducts a final assessment to either approve or reject the recommendation regarding the applicant's qualification. In the event that disputes arise – such as an applicant contesting the VAC's decision – the VC has the authority to intervene, undertaking a comprehensive review of the submitted documentation and reassessing the case as necessary. The outcome of the application process is either an award of a professional qualification or a denial of the application. If granted, the professional certificate is issued electronically together with detailed feedback and recommendations for the applicant's ongoing professional development.

2.3. Learning Analytics

The definition of learning analytics (LA), presented at the 1st International Conference on Learning Analytics and Knowledge, describes LA as "the measurement, collection, analysis, and reporting of data about learners and their contexts to understand and optimize learning and the environments in which it occurs" (Romero & Ventura, 2013, p. 2). This definition highlights three key components of learning analytics: data, analysis, and action (Šereš et al., 2022). Data refers to the systematic collection of information about learners, their learning environments, interactions, and learning outcomes throughout the learning process. Analysis involves processing these data, often using machine learning techniques, to generate actionable insights that can inform educational practice.

Learning analytics is a rapidly evolving field that is increasingly shifting from a technology-centric paradigm toward an education-centric approach. Although technological, pedagogical, and political-economic factors continue to shape its development, the primary goal of LA is to enhance teaching and learning processes. Its importance within technology-enhanced learning lies in its capacity to support educators by optimizing instructional strategies and enabling institutions to make data-driven pedagogical decisions (Ferguson, 2012). In addition, learning analytics provides educators with valuable visual and verbal feedback on their professional competencies, helping to assess their alignment with professional standards and ultimately improving pedagogical effectiveness (Boud & Molloy, 2013).

To guide the design and implementation of learning analytics systems, Chatti and colleagues (2012) proposed a four-dimensional reference model structured around four fundamental questions:

What data are collected and analyzed?

Who is the target audience?

Why is the data analyzed?

How is the analysis performed?

Based on these questions, they developed a high-level conceptual framework for learning analytics system design. Complementing this approach, Greller and Drachsler (2012) introduced a multidimensional framework that strengthens practical implementation by explicitly addressing ethical considerations, data ownership, and pedagogical intervention. Their model identifies six critical dimensions to be considered when developing learning analytics applications: stakeholders, goals, data, resources, external limitations (such as ethical, legal, or institutional constraints), and internal limitations within the learning analytics system (see Figure 4).

<table>
<tr><th colspan="4">Learning Analytics</th></tr>
<tr>
<td>Stakeholders can be data clients and at the same time data subjects who are also providers; in some cases, when LA application provides information, teachers become one of the two stakeholders.</td>
<td rowspan="2">Goals
(1) Reflection
Self-assessment of different participants at all levels of the information flow.
(2) Prediction
And modeling of learners' actions, which is useful in planning and designing pedagogical interventions.
(3) Feedback – all of above measures can be helpful in the intervention.</td>
<td rowspan="2">External limitations
Conventions:
(1) Privacy: the analysis complies with privacy policies, teachers are aware of the data collection and management of their data.
(2) Ethics: What are the risks of data misuse? Teachers are the owners of their data.
(3) Norms: Are there legal data protection or intellectual property rights associated with the use of the data.</td>
<td rowspan="2">Internal limitations
Required competencies:
(1) Interpretation: do data owners have the necessary competencies to interpret and follow up on results and analyze them?
(2) Critical thinking: do teachers/ professional assessors understand what data is missing? Critical analysis is supported by a bank of statements based on performance indicators of PS.</td>
</tr>
<tr>
<td>Educational data
Data sets can be protected or open (in which case they should be anonymized.</td>
</tr>
<tr>
<td colspan="2">Tools
(1) Pedagogical theories
(2) Technologies e.g. educational data mining – statistics, machine learning social network analysis.
(3) Presentation of results, e.g. statistical tables, diagrams etc. This dimension also includes conceptual tools.</td>
<td colspan="2">Instruments
Pedagogical theory
Technology: xAPI, statistic etc.
Presentation: visualization, feedback</td>
</tr>
</table>

Figure 4. Framework of learning analytics (adapted from Greller and Drachsler, 2012)

Overall, learning analytics is undergoing a clear transition from a predominantly technology-driven approach to one that prioritizes educational impact. While technological, pedagogical, and political-economic influences remain important, increasing emphasis is placed on supporting educators in evaluating and refining their competencies and assisting institutions in informed pedagogical decision-making (Šereš et al., 2022).

Therefore, learning analytics is widely understood as a human-centered and multidisciplinary field that examines how learning-related data can be used to improve education. Although it was originally defined in 2011 with a strong focus on data collection and analysis, the field has expanded considerably over the past 15 years. In response to these developments, the Learning Analytics Community (SOLAR) revisited and refined the definition to better reflect contemporary theory and practice.

The updated definition (SOLAR, 2025) defines learning analytics as the collection, analysis, interpretation, and communication of data about learners and their learning to produce theoretically grounded and actionable insights that improve learning and teaching. Central to this definition is the concept of actionable insights: data use must lead to meaningful actions that enhance learning or teaching. Importantly, these insights should be grounded in learning theory rather than focused solely on technical analysis.

In conclusion, the renewed definition reflects a broader shift in learning analytics from an emphasis on data and analytical methods to the responsible, theory-informed, and collaborative use of data to enhance learning and teaching in real educational contexts. Developments between 2011 and 2025 demonstrate that learning analytics is no longer defined primarily by the data it processes, but by how knowledge is generated, communicated, and applied to support human learning – an orientation that aligns directly with the goals of this thesis. Thus, the evolution from 2011 to 2025 reflects a shift from "doing analytics on educational data" to "using data responsibly, theoretically, and collaboratively to improve learning and teaching." (SOLAR, 2025).

2.3.1. Educational Applications of Learning Analytics

Since its emergence in 2011, learning analytics has been utilized in the field of education as a transformative tool that enhances both learning and teaching through immediate feedback and analytical insights (Chatti et al., 2012). LA is recognized as a multidisciplinary domain that integrates machine learning, information retrieval, statistics, and data visualization. Additionally, it encompasses methodologies such as action research, recommender systems, and personalized learning (Chatti et al., 2012; Tannenbaum et al., 2010). More recently, artificial intelligence (AI) has become an essential component of LA, further expanding its capabilities (Luckin et al., 2016).

The World Economic Forum (2024) highlights the increasing role of AI in education, emphasizing the need to support teachers through AI-driven automation. According to the report, AI can automate approximately 20% of teachers'

administrative tasks, allowing educators to devote more time to students' individualized needs and their own professional development. Moreover, AI can provide targeted feedback and recommendations to enhance teaching effectiveness and pinpoint areas that require further training.

The primary objectives of LA models are to improve learning outcomes and examine the learning process through various methodological approaches (Sengupta et al., 2020). Siemens (2013) defines three foundational principles within his theory of Learning Analytics: Big Data – LA relies on the collection and analysis of extensive data sets to derive meaningful insights; Learning Science – the application of LA is grounded in research on human learning, incorporating cognitive and educational psychology theories; Design – LA facilitates the development of intervention strategies and feedback mechanisms to optimize learning experiences.

Research indicates that LA serves multiple purposes, including monitoring learning environments, predicting student performance and behavior, and implementing intelligent educational systems (Gabbi, 2022). Additionally, LA enables automated and personalized feedback, fostering self-assessment and continuous professional development among educators. Through the analysis of teaching practices and student learning outcomes, LA empowers teachers to refine their instructional strategies and engage in targeted professional development (de la Hoz-Ruiz et al., 2024).

Beyond improving student outcomes, LA facilitates the identification of opportunities to enhance teaching methodologies and professional competencies. Siemens and Baker (2012) argue that LA has the potential to revolutionize education by enabling personalized learning experiences, diagnosing areas for professional growth, and providing real-time feedback. The primary objective of LA is to forecast learning behaviors, establish clear pedagogical goals, and assess both the strengths and areas for improvement in educators' practices (Ferguson, 2012).

The integration of learning analytics with AI has strengthened its capacity to analyze and understand learning through machine learning and data-driven techniques. As a result, LA is inherently interdisciplinary, combining elements of computer science, statistics, psychology, and education to develop innovative, data-informed educational strategies.

In summary, learning analytics not only enhances the understanding of learner behavior and educational outcomes but also empowers teachers to reflect on their instructional methodologies. By facilitating effective resource allocation and strategic professional development, LA plays a crucial role in fostering a culture of continuous learning within educational institutions.

2.3.2. Learning Analytics and Teachers' Professional Development

Learning analytics has already demonstrated its potential in supporting professionals in enhancing their performance. An analysis of its application highlights the need to develop systems that facilitate workplace learning through

machine-based analytics. However, the integration of LA systems with human decision-making presents challenges, as professionals must not only identify their learning needs but also modify their behaviour accordingly. Therefore, self-regulation is a critical factor in the successful implementation of LA techniques. The effectiveness of learning analytics in professional development is maximized when it is seamlessly integrated into work-related systems while simultaneously accounting for the human element (Littlejohn, 2022; Omedes, 2021).

The renewed concept of learning analytics (SOLAR, 2025) envisions the implementation of learning analytics-related changes in learning and teaching. What is expressed in strategic planning for learning and teaching, i.e., the consideration and implementation of reliable learning analytics at all stages of strategic planning, including the analysis of change needs, decision-making, implementation, and monitoring, as well as the evaluation of strategic decisions, taking into account the complexity and context of strategic decision-making.

Learning analytics has emerged as a key area within technology-enhanced learning, benefiting both educators and institutions. It supports teachers by enhancing instructional practices and helps educational institutions make data-driven decisions (Ferguson, 2012). LA provides teachers with visual and verbal feedback on their professional competencies, facilitating personalized insights into areas requiring improvement. This targeted approach enables educators to monitor their development over time, leading to continuous professional growth. Moreover, LA plays a crucial role in assessing the alignment of competencies with professional standards, thereby optimizing teaching performance (Boyd & Molloy, 2013).

Using LA fosters self-analysis, a fundamental component of professional development. Several studies have validated the impact of LA on competency assessment. For example, Rayon and colleagues (2014) explored the use of real-time dashboards in competency evaluation, demonstrating their effectiveness in aligning assessments with professional standards and enhancing formative feedback. Similarly, Kleimola and Leppisaari (2022) confirmed that LA contributes to the development of critical competencies, such as reflective practice, self-awareness, and self-management, all of which strengthen teachers' ability to align their professional practice with desired competencies.

Despite its advantages, the adoption of LA in teacher professional development is not without challenges. Key concerns include data privacy, misinterpretation of analytics, and resistance from educators. A balanced implementation approach, which incorporates ethical considerations, human judgment, and data analytics, is essential for ensuring effective and responsible use of LA. Given these challenges, ethics and privacy remain fundamental to the successful implementation of LA. Establishing transparency and trust in data usage fosters a responsible learning analytics ecosystem where teachers feel empowered to make informed decisions about their professional growth. By integrating ethical considerations with LA methodologies, educators can leverage analytics not only to refine teaching practices but also to align them with established pedagogical frameworks, ensuring meaningful and sustainable improvements.

The integration of learning analytics into professional development provides data-driven insights that enhance teaching strategies and learning outcomes. For instance, personalized professional development leverages LA to create customized learning paths based on individual performance analytics. This approach enables teachers to identify areas for growth and systematically monitor their progress. Similarly, data-driven decision-making enables educators to assess the effectiveness of instructional methods and refine their teaching practices (Zangana et al., 2025).

Furthermore, learning analytics encourages reflective teaching practices, enabling teachers to critically analyze their professional expertise and enact meaningful pedagogical changes. From an institutional perspective, aggregated LA data serves broader applications, such as curriculum development and educational policy planning. Learning analytics has been implemented in various educational initiatives to support teacher development and professional growth. For example, Ruiz-Calleja and colleagues (2017) developed a prototype dashboard for self-assessment within non-formal teacher education. Similarly, the eTwinning European teacher community introduced a visual competency framework that incorporates recommendations for addressing training gaps. These applications illustrate how LA can enhance teacher professionalism, foster a culture of continuous improvement, and ultimately advance student learning outcomes.

This research builds upon Greller and Drachsler's (2012) framework, which provides an application model for LA designed to support teacher professionalism. Their model emphasizes the importance of visual feedback and pedagogical intervention, focusing on methods that lead to behavioral changes in teaching practices. Furthermore, LA plays a crucial role in evaluating didactic approaches, providing empirical support for pedagogical theories of learning and knowledge acquisition (Greller & Drachsler, 2012).

Building on this foundation, LA enhances teacher development by offering insights that lead to optimized teaching strategies and evidence-based instructional improvements (Greller & Drachsler, 2012). When integrated with fair and unbiased assessment models, LA enables a more objective evaluation of competencies, helping to eliminate external biases, such as social beliefs (Bjork et al., 2013). By leveraging these insights, educators can refine their instructional approaches, ensuring both individual professional growth and improved teachers' as learners learning outcomes.

From a developmental perspective, LA strengthens professional learning when embedded within authentic work practices. Personalised feedback supports goal setting and progress monitoring, while aggregated data can inform collaborative reflection, curriculum development, and institutional decision-making (Zangana et al., 2025). In this way, teachers function simultaneously as individual learners and contributors to collective professional knowledge.

Conceptually, this understanding aligns with Greller and Drachsler's (2012) learning analytics framework, which emphasises stakeholders, goals, data, and instruments as interrelated components of pedagogically meaningful analytics.

Within this model, the teacher as professional learner occupies a central position as the interpreter and user of analytics for pedagogical action. LA supports behavioural and instructional change only when teachers actively engage in reflective interpretation and purposeful decision-making. Similarly, the learning professional perspective (Simons & Ruijters, 2014) highlights that professional growth involves continuous learning, ethical commitment, and participation in professional communities – all processes that are supported, but not replaced, by analytics.

Overall, LA positions teachers as self-directed, reflective, and data-informed professional learners. Their role is to interpret feedback, regulate learning, make context-sensitive decisions, and translate insights into improved practice. When teachers actively engage in this way, LA becomes a structured and theory-informed mechanism that supports professional development, strengthens teacher agency, and promotes continuous improvement in teaching and learning (Greller & Drachsler, 2012; Simons & Ruijters, 2014; Tammets & Laanpere, 2015).

Its integration into educational systems empowers teachers, promotes continuous professional development, and enhances student learning outcomes, positioning LA as a cornerstone of modern education.

2.4. Integrating Learning Analytics into Teacher Professional Development and Qualification Advancement

The aim of this doctoral thesis is to develop a digital application to support teachers' professional development and qualification advancement. The application focuses on assessing teachers' PD in accordance with the requirements outlined in professional standards, ensuring that competencies are acquired at the required level. To achieve this, the thesis integrates the concepts of the learning professional and learning analytics. More specifically, it conceptualizes the learning professional as a pedagogical construct and learning analytics as a methodological instrument for evaluating professional practice. The implementation of LA in teaching qualification processes is justified by its technological integration and the benefits it offers in facilitating lifelong learning. Both frameworks emphasize the importance of teacher involvement in continuous professional growth, allowing for self-reflection, identification of development opportunities, and feedback on PD based on performance indicators of professional standards. Additionally, innovative solutions and technology-enhanced learning play a crucial role in this approach (Pedaste et al., 2019).

The relationship between LA and the learning professional can be conceptualized as a feedback cycle. First, teaching practices generate data through pedagogical interactions and performance. Next, LA systems capture, process, and visualize this data. The subsequent stage involves analyzing teacher competencies, identifying both the presence and absence of professional skills, and highlighting areas that require further development. This is followed by professional development activities, including reflection, collaboration, and the setting

of developmental goals. Finally, insights are integrated into practice, which in turn produces new data, thereby sustaining the cycle. Within this model, the teacher simultaneously occupies the roles of subject (whose competencies are assessed) and beneficiary (who receives actionable feedback). This dual role reinforces the teacher's identity as a learning professional actively engaged in self-improvement.

Building on the frameworks of Greller and Drachsler (2012) and Simons and Ruijters (2014), the following analysis aligns the six dimensions of the LA model with the characteristics of the learning professional, highlighting their combined implications for teacher PD (Table 2).

Table 2. Connections between LA dimensions and the development of a learning professional

LA dimension (Greller & Drachsler, 2012)	Characteristics of a learning professional (Simons & Ruijters, 2014)	Professional development focus
Stakeholders	Professional frame & identity	Recognize dual role as data subject and data user; negotiate shared goals for competence development.
Objectives	Commitment & integrity	Define explicit and defensible goals; align with professional priorities.
Data	Body of knowledge	Develop data literacy; validity; bias; interpretation limits.
Instruments	Theory-of-action	Connect analytic outputs to pedagogical decisions; evaluate contextual effectiveness.
External limitations	Ethical stewardship	Embed privacy, consent and transparency into everyday practice.
Internal limitations	Collective learning	Foster team-based interpretation, surface tacit assumptions, and challenge biases.

The following outlines the relationship and analysis between dimensions of learning analytics and the characteristics of the learning professional:

Stakeholders and professional identity

Teachers must navigate the dual position of being both data subjects (measured by analytics) and data users (acting upon analytics). This duality extends professional identity beyond pedagogical expertise toward socio-technical negotiation, requiring teachers to mediate between analytics, students, colleagues, and institutional systems.

Objectives and professional integrity

LA demands that professionals articulate explicit goals and success criteria (e.g., risk prediction, formative feedback, equity). Integrity in this context entails addressing the uncertainty inherent in probabilistic and incomplete data, and aligning analytic aims with broader educational commitments to learners and society.

Data and the body of knowledge

Professional expertise increasingly includes data literacy, encompassing knowledge of validity, bias, and interpretive limits of digital traces. Teachers must not only maintain disciplinary knowledge but also understand the epistemic boundaries of measurement data.

Instruments and theories of action

Dashboards, predictive models, and social network analyses embody implicit pedagogical assumptions. Learning professionals must formulate and test explicit theories of action that link analytics to instructional choices and evaluate their effectiveness in specific contexts.

External constraints and ethical stewardship

Ethics in LA extends beyond compliance to an active professional practice. Teachers are required to co-construct norms with learners regarding transparency, informed consent, and the proportional use of data, exercising judgment about when analytics should and should not inform their practice.

Internal limitations and collective learning

Professional growth is increasingly grounded in collaborative interpretation of analytics. By engaging in collective sense-making, teachers can moderate biases, challenge assumptions, and ensure equity in data-informed decision-making. Professionalism is therefore reframed as a shared, evidence-informed practice rather than an individual endeavor.

Taken together, these dimensions position the learning professional as a data-informed, ethically responsible, and collectively reflective practitioner whose professional authority derives from transparent and evidence-based integration of analytics into practice.

Integrating the concept of the learning professional with LA holds significant potential for enhancing teacher professionalism. A data-informed approach enables the refinement of teaching methodologies, the identification of professional developmental needs, and ongoing skill enhancement (Greller & Drachsler, 2012; Simons & Ruijters, 2014; Tammets & Laanpere, 2015). However, from an ethical standpoint, two limitations remain prominent. First, research to date provides

limited evidence on the long-term effects of digital applications on teacher PD. Second, challenges persist regarding the security and ownership of educational data. One possible safeguard is granting teachers greater control over the use of their personal data.

Despite these limitations, combining the two conceptual frameworks enables teachers to monitor their PD continuously, receive targeted feedback, and engage in more objective evaluations of their competencies, thereby reducing the influence of social biases (Bjork et al., 2013). Moreover, LA creates shared artefacts (e.g., dashboards, cohort maps) that facilitate structured professional dialogue, allowing teams to articulate tacit theories, surface potential biases, and align collective actions (Simons & Ruijters, 2014). Nevertheless, a balanced approach remains critical: while LA offers powerful tools for evidence-based reflection, it must be integrated with the human dimensions of teaching to ensure that professional development is both holistic and ethical.

The present study contributes to this discourse by supporting teacher PD through a self-assessment process aligned with professional standards. The digital application, developed as part of this research, enables teachers to conduct structured self-analysis, receive feedback and recommendations, and collect evidence-based documentation (e.g., certificates, photographs) to substantiate their competencies.

The use of LA addresses key challenges related to professional self-analysis and reflection, enabling evidence-based assessment and supporting the entire qualification application process. Specifically, LA provides personalized, supportive, and timely feedback, helping teachers self-assess their competencies (Joksimović et al., 2019; Jovanović et al., 2017). Related studies describe LA as a supportive mechanism that allows teachers to receive data-driven feedback on their instructional practices (e.g., assessment methods and teaching strategies), ultimately enhancing teacher awareness and reflective practice (Vezzoli et al., 2020).

To ensure valuable outcomes from LA-integrated applications, the LA model must include the following elements:

1. Relevant goals – the primary objectives of LA include improving learning and examining the learning process through various instrumental studies (Sengupta et al., 2020). In the context of teacher PD, LA helps educators identify their self-development needs, raising awareness for further in-service training and qualification enhancement.
2. Core components – these are based on the objectives of the LA model and include self-analysis of nationally recognized professional standards (aligned with performance indicators); data collection based on these indicators to evaluate teachers' competencies and professionalism; a teacher module, complemented by a professional assessor module, to enable quick and constructive feedback.
3. Theories and methods – the model follows the learning professional framework, integrating theoretical perspectives to guide implementation (Quadir et al., 2021).

LA models have been extensively studied, particularly in the context of learning (Yang et al., 2016), but also in areas such as administration (Macfadyen & Dawson, 2012), predictive modeling (Al-Tameemi et al., 2020), collaborative learning, and personalized recommendations (Dai et al., 2022). However, few existing LA models specifically support professional development while remaining rooted in theoretical frameworks (Gabbi, 2022). Given its significant potential, LA can effectively support professional development and lifelong learning (de Laat & Schreurs, 2013). It enables educators to monitor their progress as individual learners and within collaborative learning environments, identify areas requiring improvement, and align competencies with desired professional standards. Additionally, it allows educators to evaluate the effectiveness of qualification assessments using data-driven insights and collect evidence-based materials when applying for a qualification. Additionally, LA supports the evaluation of didactic approaches, providing empirical validation for specific pedagogical theories of learning and knowledge acquisition (Greller & Drachsler, 2012). Within the scope of this research, LA serves to assist teachers in meeting professional standards and ensuring their competencies align with established benchmarks for continued PD.

Unlike traditional educational data mining, the goal of LA is to support teachers in making dynamic and diagnostic pedagogical decisions. Based on the theoretical framework of LA, Drachsler & Greller (2012) emphasize that LA enables the evaluation of specific didactic approaches, offering empirical evidence for pedagogical theories of learning and knowledge acquisition (Figure 5).

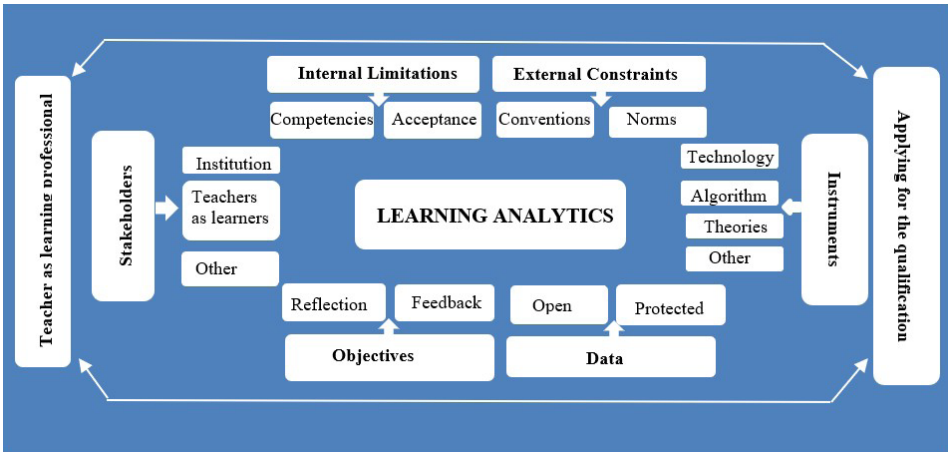

Figure 5. Framework of LA embedded in teacher PD and applying for the qualification (adapted from Greller & Drachsler, 2012)

The digital application model developed in this study (Section 5.1) is based on the framework developed by Drachsler and Greller (2012), which encompasses six key dimensions of LA: stakeholders, objectives, data, tools, external constraints, and internal limitations. These dimensions are systematically outlined in

the accompanying table and further enriched with the application values derived from the digital application *Kutsepeegel* (Table 3), ensuring a comprehensive perspective on the model's integration and functionality.

Table 3. LA framework dimensions (adapted from Greller and Drachsler, 2012, for the digital application *Kutsepeegel)*

Dimension	Application values of ***Kutsepeegel***
Stakeholders	Data subjects: teachers – lifelong learners Data clients: teachers, headmasters, schools, professional assessors
Objective	Reflection: analyse teacher self-analysis, identify teachers' needs for development Prediction: qualification level
Data	Protected dataset: teacher self-reflection, data from protected databases. Interfaces with external digital systems of Estonian education EHIS, JUHAN, eKool/Studium. Interfacing with external systems enables teachers to retrieve evidence of their qualifications and career history from national databases. Interfacing facilitates the transfer of data, for instance, to a professional committee. The aim of developing data exchange options is to ensure the seamless operation of the system in collaboration with other e-government services. Open data: data from open web environments
Instrument	Pedagogical theory: teacher as learning professional (Simons & Ruijters, 2014; Pedaste et al., 2019) is illustrated in Figure 1. Technology: xAPI, statistics. The application is based on Open Source technologies (PHP, MySQL) Presentation: visualization, feedback
External constraints	Privacy: protected data. Logging into the environment is done with an ID-card, mobile-ID, and smart-ID using the universal state-provided TARA service, as well as the HarID service (national educational ID). Norms: based on national professional standards
Internal limitations	Competencies – required competencies for data interpretation Clarity of visualization and interpretation of results. Further use of received information (understanding and interpretation)

Building on the frameworks proposed by Greller and Drachsler (2012) and Simons and Ruijters (2014), the six dimensions of the learning analytics (LA) model – stakeholders, objectives, data, instruments, external constraints, and internal limitations – can be aligned with the characteristics of the learning professional to highlight their implications for teacher development. Teachers navigate the dual role of being both data subjects and data users, extending their professional identity beyond pedagogical expertise to include socio-technical negotiation. They must mediate between analytics, students, colleagues, and institutional systems, translating data into informed educational decisions. Professional integrity requires that teachers define explicit goals and success

criteria while confronting the uncertainty inherent in probabilistic data. This process demands alignment of analytic aims with ethical and societal commitments to learners.

As professional expertise increasingly incorporates data literacy, teachers must understand the validity, bias, and interpretive limits of digital traces alongside their disciplinary knowledge. Analytical instruments, such as dashboards and predictive models, often embed implicit pedagogical assumptions. Consequently, learning professionals are expected to formulate explicit theories of action that link analytics to instructional choices and evaluate their effectiveness within specific contexts. Ethical stewardship extends beyond regulatory compliance to an active professional stance, in which teachers and learners co-construct norms of transparency, informed consent, and proportional use of data. Collaborative interpretation of analytics further promotes collective sense-making, mitigates bias, and strengthens equity in data-informed decision-making. Consequently, professionalism becomes a shared, evidence-based practice rather than an isolated individual pursuit.

Taken together, these dimensions portray the learning professional as a data-informed, ethically responsible, and collectively reflective practitioner whose authority stems from the transparent integration of evidence into practice. Integrating the concepts of LA and the learning professional offers significant potential for enhancing teacher professionalism, enabling refinement of teaching methodologies, identification of developmental needs, and continuous skill enhancement (Greller & Drachsler, 2012; Simons & Ruijters, 2014). Nevertheless, ethical challenges remain. Current research provides limited evidence on the long-term effects of digital applications on teacher professional development, and persistent concerns exist regarding the security and ownership of educational data. Providing teachers with greater control over the use of their personal data represents one potential safeguard. Despite these limitations, the combination of LA and the learning professional framework enables continuous monitoring of professional growth, provides targeted feedback, and facilitates a more objective evaluation of competencies, thereby reducing the influence of social bias (Bjork et al., 2013). Moreover, LA generates shared artefacts such as dashboards and cohort maps that facilitate structured professional dialogue, support collective reflection, and make implicit theories explicit (Simons & Ruijters, 2014). However, a balanced approach is essential: while LA provides powerful tools for evidence-based reflection, it must remain integrated with the human and ethical dimensions of teaching to ensure that professional development remains holistic and comprehensive.

To ensure meaningful outcomes, the LA model integrates three essential components: relevant goals, core components, and theoretical grounding. The primary goals of LA include improving learning and examining learning processes through evidence-based analysis (Sengupta et al., 2020). In the context of teacher professional development, LA helps educators identify self-development needs, increase awareness, and guide further in-service training and qualification enhancement. Core components are based on self-analysis of nationally

recognized professional standards, data collection aligned with performance indicators, and the inclusion of both teacher and assessor modules to facilitate constructive feedback. The model also follows the framework of the learning professional, incorporating theoretical perspectives that inform its implementation (Quadir et al., 2021).

Although LA has been widely applied in learning (Yang et al., 2016), administration (Macfadyen & Dawson, 2012), predictive modeling (Al-Tameemi et al., 2020), and collaborative learning (Lowent et al., 2018), few existing models directly address teacher professional development while maintaining a solid theoretical foundation (Gabbi, 2022). LA holds substantial potential to support professional growth and lifelong learning (de Laat & Schreurs, 2013). It enables teachers to monitor their progress as individual learners and as members of professional learning communities, to identify areas requiring improvement, and to align their competencies with national and institutional standards. Furthermore, LA facilitates data-driven evaluation of qualification processes and the collection of evidence-based materials for qualification applications.

In addition to supporting individual reflection, LA provides empirical validation for pedagogical theories by enabling evaluation of didactic approaches and models of learning and knowledge acquisition (Greller & Drachsler, 2012). Unlike traditional educational data mining, the goal of LA is to support teachers in making dynamic, diagnostic, and adaptive pedagogical decisions. Within this research, LA functions as both a diagnostic and developmental tool, helping teachers meet professional standards and align their competencies with established benchmarks for continued professional growth. Ultimately, the integration of LA with the learning professional framework provides the foundation for a reflective, ethical, and evidence-based approach to professional development – one that positions teachers as active agents in their lifelong learning and qualification advancement (de Laat & Schreurs, 2013; Siemens, 2013).

2.4.1. Critical and ethical aspects of using LA in research

While LA has the potential to enhance teachers' PD, several critical challenges, such as privacy concerns and the risk of data misinterpretation, must be addressed. A balanced approach that integrates ethical considerations and human judgment with data analytics is essential for successful implementation.

The application of LA in research on teacher PD highlights several key considerations. Foremost among them is the need to ensure data privacy and ethical practices. LA involves the collection and analysis of extensive data from educators, raising concerns about privacy and the ethical use of information. It is imperative that data collection and analysis adhere to relevant data protection regulations, safeguarding teachers' rights throughout the process (Hoel & Chen, 2018). In this context, privacy refers to control over data – its accessibility and usage. However, addressing privacy concerns is a complex legal challenge, as different countries and institutions impose varying regulations. To mitigate this issue, the framework developed in this study incorporates user-driven data

control, rather than institutional oversight. The digital application aggregates information from multiple sources, allowing users to determine which data they wish to share.

Furthermore, the interpretation of LA-generated data must be approached with caution. Improper analysis can result in erroneous conclusions, leading to ineffective or even detrimental decisions in teacher PD. Thus, it is crucial that data interpretation is carried out by qualified experts and that findings are assessed critically (Silm et al., 2023).

Over-reliance on technological solutions poses another challenge, potentially rendering teacher PD disproportionately dependent on digital tools. Maintaining a balance between technological advancements and interpersonal communication is essential. LA may not always account for contextual variables such as specific learning environments, cultural differences, or individual learner needs – all of which influence data interpretation and subsequent decision-making. Therefore, it is necessary to supplement LA-generated insights with qualitative data to provide a more nuanced understanding of the context. Addressing all these critical considerations ensures that the use of LA in teacher PD research is ethical, balanced, and effective, ultimately fostering teachers' continuous professional growth.

3. RESEARCH METHODOLOGY

This chapter outlines the rationale behind the methodological choices made in planning this doctoral thesis, as well as the approaches employed in the research process. It provides a comprehensive overview of the data collection methods and analytical techniques used, aligning them with the research objectives and questions. Given that the field of supporting teacher professionalism and the qualification application process remains underdeveloped, and that the primary outcome of this study is a modern digital application, the research is conducted within the framework of the pragmatic paradigm (Weaver, 2018).

Pragmatism is rooted in the interpretation of experience and seeks to investigate emerging challenges, in this case, the development of teacher professionalism and the resolution of related issues, such as the creation of a digital application. The pragmatic paradigm does not aim to establish absolute truths but rather generates knowledge that informs the development of new practices, thereby fostering change (Legg & Hookway, 2019). Consequently, the experience acquired through this research is significant, as participants are not merely subjects of study but rather informed contributors and experts in the field (Metcalfe, 2008).

The methodological limitations of this doctoral research must be understood in relation to the pragmatic paradigm that underpins the study and the practice-oriented objectives guiding the research design. As outlined in the methodology chapter, the primary aim of this study is not to establish universal or generalizable truths but to generate contextually grounded knowledge that informs the development of new practices, particularly in the domain of supporting teacher professionalism and the qualification application process through a digital application. Within this pragmatic framework, limitations are not solely methodological constraints but also reflect the deliberate trade-offs inherent in practice-driven research.

First, the study is characterized by a selective and relatively small sample. Recruiting participants who met the defined criteria proved challenging across all phases of the research, resulting in purposive samples consisting mainly of teachers who had already applied for, or were actively engaged in, professional qualification processes. While this sampling strategy aligns with the pragmatic emphasis on engaging knowledgeable practitioners as informed contributors rather than passive research subjects (Metcalfe, 2008), it also introduces selection bias. The perspectives of senior teachers, non-professional teachers, and those who have not pursued formal qualifications are underrepresented. Consequently, the findings cannot be generalized across the teaching profession and should instead be interpreted as context-specific insights derived from a particular group of experienced stakeholders.

Second, the focus on applicants for higher professional qualifications further narrows the study's scope. Teachers' professional development is a multifaceted and evolving process shaped by institutional contexts, career trajectories, and

individual motivations. Given this complexity, the study does not provide a basis for making normative claims about professional standards, qualification frameworks, or professional development pathways. In line with the pragmatic paradigm, the findings contribute to understanding "what works" within a specific context rather than offering prescriptive or universally applicable solutions (Legg & Hookway, 2019).

Third, the study relies primarily on qualitative data collection methods, including semi-structured interviews. These methods are consistent with the study's emphasis on experience-based knowledge and participants' interpretations of practice. However, they also introduce subjectivity. Participants' responses may be influenced by professional self-positioning, reflective capacity, or social desirability, particularly given the evaluative nature of professional qualification processes. Similarly, the interpretation of qualitative data is shaped by the researcher's analytical perspective, limiting replicability in a positivist sense.

A further methodological limitation concerns the use of the currently used e-portfolios, or the self-analysis of the *Kutsepeegel,* as the main data source. Although e-portfolios/self-assessments provide insights into teachers' reflective practices and self-assessed professional development, they do not provide a comprehensive or objective picture of professional competence. However, the quality and depth of their content are strongly influenced by teachers' writing skills and self-expression. Therefore, the study cannot claim that e-portfolios/ self-assessments accurately reflect professional practice or performance, which raises questions about the validity and equity of portfolio-based assessment.

In addition, the scope of the empirical investigation was constrained by the developmental stage of the digital application, which constitutes the primary outcome of the study. Due to limited time and resources, the application was not fully developed at the time of evaluation. Key functionalities, such as xAPI-based data collection, assessor modules, artificial intelligence–supported feedback, multilingual support, and integration with external professional environments, were not implemented. Consequently, the study focuses on participants' perceptions of functionality and anticipated benefits rather than empirically measured impacts on professional development or qualification outcomes. This limitation is consistent with the pragmatic orientation of the research but limits claims about the application's effectiveness.

Finally, from both methodological and ethical perspectives, the study lacks a longitudinal component. While the research captures participants' experiences and expectations at specific moments in the qualification process, it does not examine the long-term impact of the digital application on teachers' professional development. Without longitudinal data, it remains unclear whether the perceived benefits identified in the study translate into sustained changes in professional practice.

In summary, the limitations of this study arise from its pragmatic orientation, purposive sampling strategy, reliance on qualitative self-reported data, and the partial development of the digital artefact. These limitations constrain generalizability and causal inference but are consistent with the exploratory, practice-

focused aims of the research. Importantly, they also highlight directions for future research, including longitudinal investigation, broader participant inclusion, and the evaluation of a fully developed digital application within diverse professional contexts.

3.1. Research design

This study employs a design-based research (DBR) approach, which integrates the systematic design, implementation, and evaluation of an educational intervention within a real-world context. Although the study comprises a single iterative cycle, it includes key phases characteristic of DBR – problem analysis, intervention design, prototype development, empirical testing, and reflective analysis based on user feedback. The research aligns with DBR principles through its theoretical grounding, responsiveness to contextual needs, and aim to generate design knowledge that can inform both practice and further development (Reeves, 2006; McKenney & Reeves, 2018; Design-Based Research Collective, 2003).

Design-based research is inherently pragmatic, as it seeks to address complex, real-world educational challenges by developing and implementing interventions while simultaneously refining theoretical frameworks and design principles (Creswell, 2013). Hoadley and Campos (2022) further affirm DBR's pragmatic nature, asserting that it fosters transformation in both human and organizational capacities to achieve design objectives.

To structure this research, the general DBR model proposed by McKenney and Reeves (2014) was adopted. This model ensures alignment with the research questions, as the study explores multiple dimensions, including teachers' perceptions of the qualification process, identified challenges in self-analysis and professional assessment, and expectations for qualification applications facilitated through a digital platform.

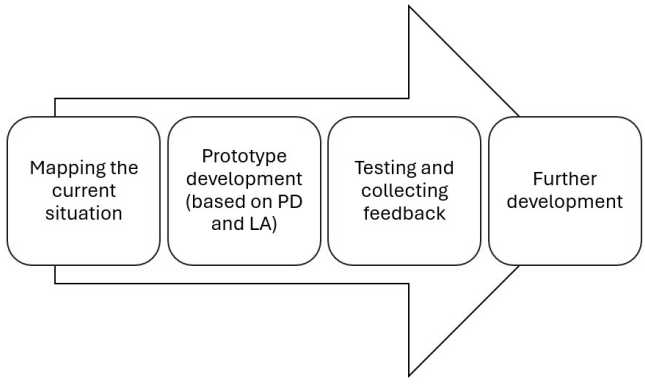

Figure 6. Design-based research plan (based on McKenney & Reeves, 2014)

DBR is characterized by three core, interrelated phases (Figure 6): (1) mapping the current situation through analysis and exploration, (2) developing a prototype via design and construction, and (3) testing and collecting feedback through evaluation and reflection, which collectively serve to reinforce the integration of theory and practice within authentic learning environments.

3.2. Study I

To map the current situation (Figure 7), qualitative research was conducted to investigate how the target groups – teachers and assessors – perceive the existing qualification application process and what expectations they hold regarding its capacity to support their professional growth. Purposive strategic sampling was applied to ensure representation across all relevant subgroups, including qualified teachers, professional assessors involved in the qualification compliance assessments, and one developer of the PS system. A phenomenological approach was chosen to gain a holistic understanding of participants' lived experiences related to the qualification process and to interpret the underlying commonalities among them (van Manen, 1990).

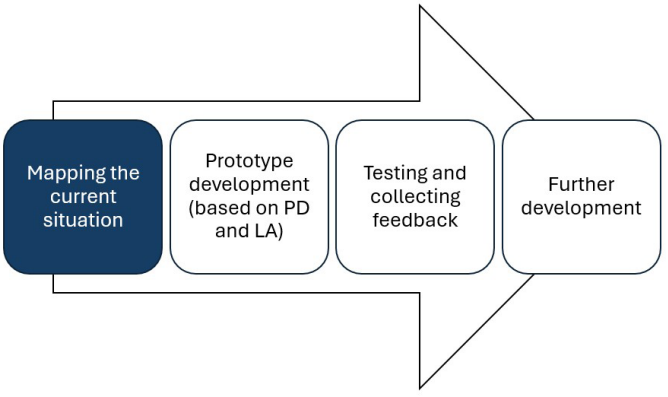

Figure 7. The first phase of the DBR study (based on McKenney & Reeves, 2014)

Qualitative analysis was deemed most appropriate for capturing and interpreting participants' views, particularly their opinions and suggestions concerning the system's effectiveness (Robson, 2002). Semi-structured, open-ended interviews provide the depth and flexibility necessary for eliciting detailed responses (Turner, 2010). The use of open-ended questions in individual discussions also ensures that participants can elaborate on perceived shortcomings of the PS and offer constructive suggestions for its improvement.

3.2.1. Participants

Based on the study's aim to explore teachers' and assessors' perceptions of the current qualification application process and their expectations for its role in supporting professional development, a purposive sampling strategy was employed. The sample included seven practicing teachers who met the following inclusion criteria: (1) active engagement in the teaching profession, (2) direct involvement in the qualification application process (either as applicants, assessors, or developers), and (3) possession of a professional qualification. Participants represented three key subgroups: teachers who had been awarded the qualification, professional assessors, and individuals involved in developing professional standards.

The sample consisted of seven participants, including teachers (n = 3), assessors (n = 3), and a PS developer (n = 1). Of these, one was male and five were female. The participants' professional experience ranged from 13 to 45 years, with an average of 31.8 years.

3.2.2. Data Collection

Data collection was conducted through individual semi-structured interviews, focusing on the criteria outlined in the professional standards and the qualification application process. Interviews were carried out face-to-face at times and locations convenient for the participants. The semi-structured format provided the flexibility to explore participants' perceptions in greater depth.

Interview questions were adapted for each target group, reflecting their specific roles in the qualification application process (Appendix A). The first section of the interview (Questions 1–5) addressed perceptions of the current professional standards and related application procedures, with an emphasis on identifying potential shortcomings. The second section (Questions 6–9) examined participants' expectations and professional needs concerning both the PS and the qualification process. Before each interview, participants were informed about the confidentiality of their responses and asked to provide their consent for the audio recording of the session.

3.2.3. Data Analysis

To analyse the collected data, qualitative inductive content analysis was applied. This method was chosen because it aligned with the overall aim of the study: to support the development of a conceptual model and a digital application that reflect the expectations and needs of key stakeholder groups – unqualified teachers seeking certification, qualified teachers, professional assessors, and professional standards developers. Particular emphasis was placed on aspects related to professional standards and the qualification improvement process (Thomas, 2006). This method was chosen for its effectiveness in identifying recurring

patterns in participant responses, allowing for the extraction of in-depth insights and offering participants the opportunity to justify their perspectives.

To ensure participant confidentiality, segments of the audio recordings that could potentially reveal the identities of the interviewees were excluded from the transcription. Data were analysed using QCAmap, a qualitative data analysis software that facilitates systematic coding, storage, and organisation of the data, including code reuse. In response to Research Question 1, the coding process yielded ten initial codes, which were subsequently grouped into seven subcategories and synthesised into five overarching categories. For Research Question 2, eleven codes were identified and organised into four main categories.

3.3. Study II

Building upon the findings of the first study, which identified shortcomings in the early stages of the qualification application process and highlighted teachers' expectations for its improvement, the second study aimed to support the development of a prototype for the learning-analytics application *Kutsepeegel* (see Section 5.1), designed to address the identified needs and expectations of teachers and assessors regarding their professional development (Figure 8). Purposive strategic sampling was adopted to ensure the inclusion of all relevant target groups. The sample comprised teachers currently applying for a qualification, qualified teachers, professional assessors, and PS developers.

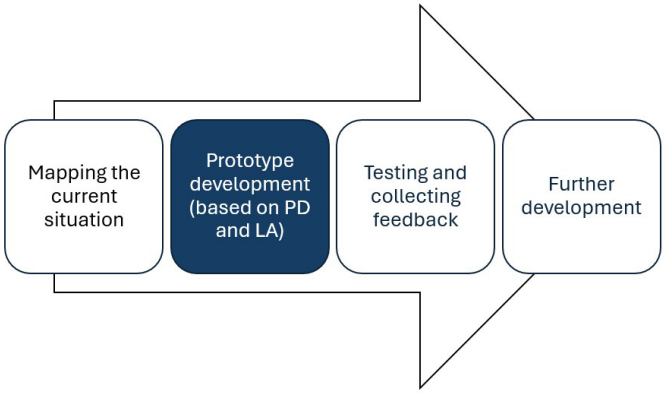

Figure 8. The second phase of the DBR study (based on McKenney & Reeves, 2014)

A qualitative approach was employed to explore stakeholders' expectations regarding the LA application and the qualification process. Semi-structured focus group interviews were conducted to encourage collaborative dialogue and elicit in-depth insights (Patton, 2002). This interactive format enabled participants to express complementary perspectives and formulate shared expectations for a prospective digital application aimed at supporting both PD and the qualification process more broadly. Particular attention was paid to key areas, including self-

analysis, self-assessment, and evidence-based documentation. In addition, the anticipated benefits of implementing such a digital application were examined.

The foundation for the competence-based digital tool rested on the professional standards for teachers, which encompass six key domains: (1) planning of teaching and learning activities, (2) designing the learning environment, (3) supporting learning and development, (4) reflection and professional self-development, (5) consulting and guidance, and (6) development, creation, and research activities. In the long term, the envisioned application aims to provide continuous support and feedback throughout the qualification process, thereby promoting teachers' engagement with lifelong professional learning.

Finally, the study explored how teachers understand the concept of professionalism, focusing on their expectations for support in enhancing professional development and navigating the qualification application process. This included reflection on broader elements that shape professional identity, such as adherence to professional standards, professional autonomy, foundational knowledge, and evolving expectations both within and beyond the profession.

3.3.1. Participants

The second study employed a purposive strategic sampling method to include all target groups aligned with the study's objectives. A total of 12 participants were recruited and randomly assigned to four focus groups. The sample included teachers applying for professional qualification (n = 3), qualified teachers (n = 3), professional assessors (n = 3), and developers of professional standards (n = 3). Participants were contacted through the Teachers' Union, with the primary inclusion criterion being their active involvement in the qualification application process. More detailed participant background information is provided in Article II.

3.3.2. Data Collection

Data were collected through semi-structured focus group interviews. Due to COVID-19 restrictions, all sessions were conducted virtually using the Zoom platform. An interview protocol was developed, with questions tailored to each target group based on their roles in the qualification application process (Appendix B). The protocol comprised 12 questions for qualification applicants and qualified teachers, and 13 questions for professional assessors and PS developers.

The primary aim of the open-ended questions was to explore participants' expectations concerning the proposed digital application, with particular emphasis on its functionality in supporting both professional development and the qualification application process. This focus corresponded to the first research question (interview questions 1–10). The second research question (interview questions 11–13) examined how the digital solution could further enhance and facilitate these processes.

3.3.3. Data Analysis

The focus group interviews were analysed using the inductive content analysis procedure described by Braun and Clarke (2006), which involves deriving codes directly from the data rather than applying a pre-existing coding framework. To ensure participant confidentiality, segments of the audio recordings that could potentially reveal the identities of the interviewees were excluded from the transcription. NVivo qualitative data analysis software was employed to facilitate systematic coding, categorisation, and data organisation.

In response to Research Question 1, the analysis yielded nine codes, which were consolidated into two overarching categories. A similar structure emerged for Research Question 2, with nine codes likewise grouped into two primary categories. The results were described in detail. Notably, overlapping thematic patterns were observed across both research questions, reflecting commonalities in participants' expectations and experiences.

3.4. Study III

The third study was carried out following the development of the *Kutsepeegel* digital application prototype (see Section 5.1), which incorporated a learning analytics module informed by the findings of the second study. The focus of this study was on examining the user experience of three key target groups – unqualified teachers, qualified teachers, and professional assessors – as they interacted with the *Kutsepeegel* application. The primary objective was to evaluate the application's functionalities and intended purpose while eliciting reflections on user experience (Figure 9).

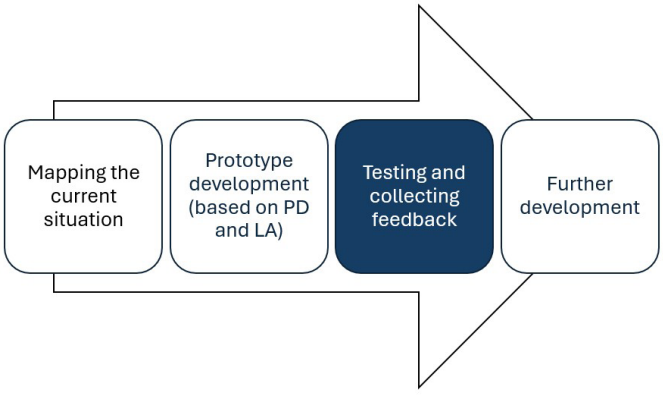

Figure 9. The third and fourth phases of the DBR study (based on McKenney & Reeves, 2014)

A participatory user experience (UX) research design was adopted (Vermeeren et al., 2015), enabling the collection of feedback from users with diverse backgrounds and experiences related to the qualification process. This included unqualified teachers in the process of applying, qualified teachers, and professional assessors. The UX approach facilitates an in-depth exploration of how users interact with the application in practical terms and whether it effectively supports professional development and goal attainment as perceived by the users themselves.

Prior to interviews, participants had registered for a user account in *Kutsepeegel*, completed the self-analysis and competence verification process, and received feedback on their PD status and areas for further development. During the interviews, they assessed the overall UX, the system's usability, and the perceived effectiveness of the application.

Data were collected via semi-structured interviews to investigate participants' attitudes, experiences, and the practical applicability of the digital solution. Additionally, the interviews aimed to identify usability issues or functionality gaps that could inform future improvements (Rohrer, 2014).

3.4.1. Participants

The study employed purposive sampling, selecting participants capable of contributing meaningfully to the understanding of the research problem and core phenomenon (Creswell & Poth, 2018). Teachers who held a professional qualification – i.e., those who had completed the qualification application process – and professional assessors, who were certified as master teachers and had completed assessor training, were invited to participate. Teachers who had not yet applied for a qualification were also included in the study to gain insight into their assessments of the created application.

The sample consisted of 20 individuals: unqualified teachers (n = 4), qualified teachers with prior experience in the application process (n = 7), and professional assessors (n = 9) involved in qualification compliance assessments. More detailed participant background information is available in Article III.

3.4.2. Data Collection

Based on the research questions, an interview protocol was developed, and the questions were formulated accordingly (Appendix C). The interview questions were tailored to the two main target groups (different focus): 12 questions for qualified teachers and 12 for professional assessors. The first set of questions (Questions 1–6) focused on whether *Kutsepeegel* enables teachers to identify their professional developmental needs. The second set (Questions 7–12) examined how *Kutsepeegel* supports teachers' PD and the qualification application process.

3.4.3. Data Analysis

The interview data were analysed using an inductive content analysis approach. To ensure participant confidentiality, segments of the audio recordings that could potentially reveal the identities of the interviewees were excluded from the transcription. The analysis was conducted using NVivo, a qualitative data analysis software that facilitated the systematic coding and organisation of the data.

The analytical process generated 11 codes, which were grouped into nine subcategories and further synthesised into two main categories: (1) the efficiency and usefulness of *Kutsepeegel's* functions, and (2) the identification of teachers' professional developmental needs.

3.4.4. Data Storage and Protection

To ensure confidentiality and anonymity, all participant data were coded. Within the *Kutsepeegel* application, self-assessment based on professional standards, performance indicators, and any accompanying evidence was accessible only to the individual participants; third parties had no access to this information. The application's data collection functionality ensured that personal data retrieved from professional environments was available exclusively to the respective teachers.

All data collected during the study were used solely for the purpose of achieving the study's objectives. Participants could access their own data at any time if they chose to do so. Once all planned functionalities were implemented, participants received immediate feedback on their data within the secure *Kutsepeegel* environment, accessible only through user authentication via password, ID card, Smart-ID, Mobile-ID, or eID. The collected data was used strictly for scientific purposes and was published in a manner that ensured the confidentiality of the participants.

3.5. Ethical Considerations

Ethical considerations are especially critical in qualitative research, as such studies often involve personal, sensitive, or socially nuanced topics and require close interaction with participants. The primary purpose of research ethics is to safeguard participants' rights, foster the integrity of researchers, and uphold the overall trustworthiness of the research process.

In the present doctoral research, careful attention was paid to key ethical principles, including informed consent, confidentiality, and data protection (Beauchamp & Childress, 2019). All studies adhered to ethical standards designed to ensure the autonomy, privacy, and fair treatment of participants (Creswell, 2007). In accordance with Good Research Practice (Estonian Research Council, 2021), the purpose of each study was clearly explained to participants at the

outset. An overview was provided regarding the types of data collected, their intended use, and data processing and storage procedures. Participants were assured of the confidentiality and security of their data (Kaiser, 2009).

Participation in the studies was voluntary, and interviewees were informed of their right to withdraw at any time without any negative consequences (Orb et al., 2001). It was emphasized that all data would be used solely for scientific purposes, and results would be reported in a generalized form, ensuring participant anonymity. Written informed consent was obtained from all participants. For the third study, approval was granted by the Human Research Ethics Committee of the University of Tartu.

Given that some interviews were conducted via Zoom, participants were explicitly asked for permission to record the sessions. They were assured that all personal identifiers and sensitive information would be removed during transcription and securely coded to preserve anonymity.

While ethical principles for qualitative research have been well established, the integration of learning analytics into educational contexts presents new ethical and privacy challenges (Drachsler et al., 2012). Maximizing the potential of LA requires the integration of existing institutional data sets; however, this raises ethical, legal, and social concerns. In addition to these, organizational, managerial, and process-related constraints must also be considered (Greller & Drachsler, 2012).

3.6. Further development

To advance the field of learning analytics, future research must examine longitudinal patterns by following teacher cohorts across repeated assessment cycles. This would enable a deeper understanding of the relationships between the quality of self-assessment, competence development, assessor ratings, and downstream outcomes such as mentoring contributions and student-directed innovations. Further empirical work is needed to validate assessor judgments on statement-based portfolios and visual feedback, including analyses of bias and fairness across diverse contexts and teacher profiles. In parallel, the development of explanatory microfeedback, such as prompts for missing evidence or deeper reflection, should be explored, ensuring that such features remain transparent and respect privacy constraints.

Organizational dimensions also warrant attention, particularly leadership practices and school cultures that can transform individual reflection into collective professional learning without reducing the process to compliance. Additionally, the portability of the proposed model should be tested by mapping various standards frameworks into a shared assertion–visualization–feedback loop, identifying which components require localization and which are generalizable across systems.

Scientifically, the thesis contributes a theory-anchored, standards-aligned learning analytics model that renders the learning professional empirically

measurable and evaluable, while clarifying issues of validity, reliability, and socio-technical integration in qualification contexts. Practically, it offers a transferable blueprint comprising tools, workflows, and ethical guardrails for implementing learning analytics to support teacher self-reflection, streamline qualification processes, and inform system-level professional development decisions, all while upholding privacy, fairness, and teacher agency.

In conclusion, *Kutsepeegel* demonstrates that when standards are made interpretable, evidence is curated purposefully, and feedback is embedded within a secure and collaborative workflow, qualification evolves into a meaningful vehicle for professional learning. The resulting implication is both practical and actionable: education systems must invest not only in the content of standards, but also in the infrastructure of professionalism – tools, processes, and ethical safeguards that empower teachers to recognize their growth, articulate their professional narrative, and take informed next steps in their development.

4. FINDINGS

4.1. Study I

RQ1: What shortcomings do different target groups perceive in the current professional standards and application process?

The first research question examined the perceived deficiencies among various target groups within the context of current professional standards and the application process. Inductive content analysis yielded five primary categories: (1) Perceptions of deficiencies while interpreting the PS; (2) Shortcomings in the first stage of application (e-portfolio and self-analysis); (3) Evidence-related shortcomings; (4) Shortcomings in the second stage of application (discussion/ interview); (5) Shortcomings in the third stage of application Professional Qualification (Professional Committee) (Appendix D).

An overview of the results of Study I, with illustrated quotes from participants, can be found in Appendix E.

4.1.1. Perceptions of Deficiencies while Interpreting the PS

The perception of deficiencies in interpreting the professional standards revealed several critical problem areas: limited understanding of the PS content, complex and bureaucratic language, ambiguously defined performance indicators, and challenges in self-assessing individual competencies. Interview data indicated a consensus among assessors and applicants that many teachers struggle to comprehend the PS, particularly its terminology and structure. The performance criteria were often described as either unintelligible or insufficiently clear. Teachers consistently acknowledged their inability to decode the PS, while qualification assessors attributed this issue largely to the use of overly formal or clerical language.

All three stakeholder groups – teachers, assessors, and PS developers – agreed that the complex phrasing and repetition of performance indicators rendered the standards difficult to interpret. Moreover, teachers faced significant challenges in internalizing and articulating the required competencies during the qualification process, resulting in deficits in self-assessment. Although many educators may meet the PS criteria in practice, they often lack awareness of their own professional capacity.

Leadership competence was identified by all groups as one of the most conceptually challenging criteria. Teachers commonly associated it with administrative roles, failing to recognize that classroom management also constitutes an aspect of leadership. This misinterpretation suggests a broader disconnect between teaching practice and the conceptual language of the PS.

Applicants and evaluators additionally pointed to shortcomings in meeting the criterion of cooperation with universities, which is required at the master teacher

level (Level 8). Barriers include limited institutional partnerships, geographic constraints, and the difficulty of evidencing collaboration. Assessment, as another key criterion, emerged as problematic due to diverse interpretation practices across Estonian schools. The variability between numerical and formative assessment methods complicates how this standard is understood and applied.

One of the most complex criteria identified was reflection on teaching and learning activities. This includes both content delivery and methodological implementation. Teachers often fail to critically analyze their chosen methods, particularly from the learner's perspective, and rarely interrogate the reasons underlying ineffective instructional approaches. Assessors provided examples of reflective deficits, such as teachers' failure to evaluate poor student performance beyond assigning a grade, indicating minimal consideration of pedagogical adjustments.

Supporting student development through the selection of appropriate methodologies and flexibility was also viewed as insufficiently demonstrated. However, assessors and PS developers emphasized that teaching experience plays a pivotal role in cultivating the analytical capacity necessary for reflective practice and professional growth.

The criterion concerning the development of educational materials – required at Level 8 – was considered especially demanding. While Estonian teachers frequently create teaching resources, they seldom publish or share them beyond internal school platforms. Factors contributing to this reluctance include low digital literacy, concerns about quality, time constraints, and the perceived pressure of perfectionism associated with preparing materials for public dissemination.

A major concern raised by all stakeholder groups was the tendency of applicants to select an inappropriate qualification level. Despite having the autonomy to choose, many lack the evaluative skills required for accurate self-assessment against PS criteria. This often results in a misalignment between the candidate's actual competence and the level for which they are applying. Teachers often appear uncertain and self-critical, which affects their ability to confidently assess and present their qualifications.

Finally, both assessors and the PS developer highlighted systemic implications within the Estonian qualification framework. The option to apply for the lifelong Teacher Level 7 qualification may lead to a sense of professional complacency. Given the complexity and workload involved in compiling activity descriptions and validation documents over recent years, teachers may be inclined to avoid the renewal process required every five years for senior (Level 7) and master teacher (Level 8) qualifications. In fact, assessors observed instances where teachers who could qualify for Level 8 opted instead for Level 7, either due to unfamiliarity with the system or preference for a non-renewable qualification route.

4.1.2. Shortcomings in the First Stage of the Application Process (e-Portfolio and Self-Analysis)

The second major area of concern pertains to the initial stage of the qualification process – primarily the compilation of e-portfolios and the demonstration of self-analytic competence. Applicants are required to provide a comprehensive overview of their professional competencies aligned with the performance indicators of the PS, supported by evidence-based documentation. These portfolios serve as the primary source through which assessors form an initial impression of an applicant's qualifications.

However, both assessors and the PS developer concur that e-portfolios are an insufficient basis for drawing definitive conclusions about applicants' competencies. The quality and clarity of written expression vary significantly among teachers; some struggle with articulating their experiences, while others produce lengthy texts that lack substantive content. This variability complicates the assessment process and undermines the reliability of portfolio-based evaluation. Assessors further noted that the essay format commonly used in self-analyses – often characterized by weak structure and inconsistent technical and expressive skills – poses additional challenges. These inconsistencies hinder the accurate interpretation of the applicant's professional growth and alignment with the PS criteria.

All three stakeholder groups emphasized the need to strengthen teachers' self-analysis capabilities. The task of pedagogical self-reflection is cognitively demanding and time-intensive, often exceeding teachers' initial expectations regarding workload. Despite its complexity, this reflective practice holds significant developmental value, enabling teachers to identify underlying issues, clarify learning outcomes, and link instructional decisions to desired results. Consequently, applicants are expected to provide documented evidence of reflective practice across a five-year period and analyze their contributions across diverse educational domains.

Candidates also reported difficulties in recognizing and articulating the impact and value of their professional actions. Self-analysis was frequently misinterpreted as a form of self-validation, leading to superficial or ineffective reflective outputs. A particularly challenging area was identifying activities that have contributed to school or community development – an aspect that many teachers struggled to evaluate meaningfully.

In certain Estonian schools, annual professional development interviews based on the PS framework have helped strengthen teachers' self-reflection skills. Teachers who participated in such structured reflective processes expressed greater confidence and ease when undertaking the qualification application. Nonetheless, all stakeholder groups agreed that complete alignment between individual competencies and the PS is aspirational and rarely achievable in practice. It is critical for teachers to understand that absolute conformity is not the expectation; rather, developmental potential and trajectory are key evaluative dimensions.

At the national level, several structural issues further inhibit the qualification process. Estonia currently lacks standardized professional development requirements for teachers – there are no mandated training hours or obligations related to continuing education. Decisions concerning professional growth are left entirely to individual teachers. Moreover, the salary system does not systematically reward higher qualification levels. Even teachers who attain Level 8 may not receive increased compensation, as salary decisions are largely dependent on individual school principals' evaluations of qualifications and the available budget. This creates a disconnect between professional advancement and tangible incentives.

The absence of a harmonized national framework for teacher development contributes to fragmented and inconsistent professional trajectories. While autonomy may foster intrinsic motivation and personalized growth, it also risks organizational incoherence, as development priorities remain undefined and uncoordinated.

4.1.3. Evidence-Related Shortcomings

The third critical area identified in the analysis concerns the insufficiency of evidence submitted during the qualification process. Several shortcomings emerged, notably the absence of documented assessments, limited availability of video material, and inadequate digital competencies among applicants.

Evidence-based self-assessment constitutes a key component of the qualification system, which relies on professional trust and peer feedback to evaluate the relevance and impact of teachers' pedagogical activities. However, both applicants and assessors observed that the absence of school-mandated assessments signals a broader lack of institutional engagement and support. Without standardized school-level input, teachers may struggle to effectively validate their professional contributions. Similarly, the lack of requirements for video recordings or formal lesson observations was highlighted as a limitation. While many teachers expressed a desire to showcase their instructional practices, several obstacles hinder this approach. Filming may disrupt classroom dynamics and may not be suitable for inclusive settings that involve students with special needs. Additionally, many teachers encounter technical barriers, including a lack of skills in video editing and publishing. Concerns regarding data protection and GDPR compliance further complicate the process, as parental consent is required for recording and sharing footage involving minors.

Lesson observations were frequently mentioned as a preferred method for evidencing pedagogical competence; however, the availability of qualified observers remains limited, thereby undermining the feasibility of this practice. This shortage hinders efforts to establish a comprehensive understanding of professional expertise.

All stakeholder groups also identified systemic difficulties in supervising student internships and collaborating with universities. While supervising secondary-level research projects can facilitate academic cooperation, primary

school teachers face greater challenges due to limited institutional connections. Such collaboration is often restricted to specific projects or research initiatives, with few opportunities for ongoing engagement.

A major concern articulated across all groups was the general inability among teachers to demonstrate competence against the performance indicators outlined in the professional standards. Assessors and the PS developer noted that applicants frequently failed to provide sufficient evidence, including photos, screenshots, and external references, to substantiate the claims made within their e-portfolios. The lack of such documentation impairs the evaluators' ability to form an objective and comprehensive assessment.

The e-portfolio, intended as the central artifact for showcasing professional achievements, was consistently identified as lacking in evidentiary depth. Although designed to illustrate competencies and qualifications, many e-portfolios lacked adequate materials to support evaluative conclusions. This evidentiary gap underscores the need for clearer guidelines and support mechanisms to assist teachers in collecting and presenting valid evidence of practice.

4.1.4. Shortcomings in the Second Stage of the Application Process (Discussion/Interview)

The second stage of the teacher qualification process involves a formal interview, conducted by the Vocational Assessment Committee, based on the applicant's pre-submitted documentation – primarily their self-analysis presented through the e-portfolio. This stage is intended to clarify and deepen the applicant's understanding of their competencies; however, multiple structural and procedural shortcomings were identified.

Applicants consistently reported uncertainty regarding the expectations of the assessment committee during the interview. The lack of a clearly defined interview format leaves applicants unsure whether to adopt an academic, evidence-based approach or to rely on personal narrative and professional intuition. This ambiguity hampers their ability to present their competencies effectively and undermines confidence in the evaluative process.

Similarly, assessors expressed confusion about the intended content and purpose of the interview. While they anticipate that the discussion will enrich and expand upon the applicant's written self-analysis, the absence of a standardized structure complicates efforts to maintain consistency across assessments. The PS developer also acknowledged the lack of coordinated dialogue and joint training among assessors, citing limited time and the competing demands of their primary roles as full-time teachers.

Assessors typically document their observations independently during the interview, but these notes are seldom consolidated and discussed collectively due to scheduling constraints. This fragmented evaluation approach hinders opportunities for post-interview collaboration and obstructs efforts to develop targeted follow-up questions related to unaddressed or unclear competencies.

A further significant limitation identified by the PS developer concerns the quality of feedback provided to applicants. Feedback should serve not only as an evaluative tool but also as a developmental resource that supports teacher self-efficacy, identifies areas of strength, and encourages ongoing professional growth. However, feedback often lacks sufficient specificity, constructive tone, or motivational value, thereby failing to fulfill its formative role in the qualification process.

4.1.5. Shortcomings in the Third Stage of the Application Process (Decision by Vocational Assessment Committee)

The third and final stage of the teacher qualification process involves deliberation by a Vocational Assessment Committee, comprising approximately ten members representing diverse professional backgrounds across the education sector. The primary function of this committee is to either approve or reject the qualification recommendations forwarded by the assessment panels, based on their evaluation of applicants' submitted documentation and interview outcomes.

While this stage is intended to serve as a final quality assurance checkpoint, the analysis revealed a notable and recurring limitation: the lack of sufficient time allocated for committee deliberations. According to the developer of the professional standards, time constraints are a persistent challenge that compromises the thoroughness and depth of the VAC's review process. Meetings are often scheduled under pressure, with limited opportunity for extended dialogue, detailed analysis of individual cases, or resolution of disagreements.

The committee typically relies heavily on the prior assessments and recommendations of evaluators, assuming their judgments to be accurate and comprehensive. While this delegation may be necessary due to practical constraints, it raises concerns about the independence and rigor of the final decision-making process. The absence of a structured mechanism for questioning or validating evaluator judgments further reinforces a procedural gap, particularly in complex or borderline cases.

In addition, the VAC's workload is exacerbated by the voluntary or part-time nature of committee participation. Most members maintain full-time professional responsibilities, which restricts their availability and preparedness for in-depth review. Although individual notes and reflections are made during meetings, limited time and coordination often prevent a systematic synthesis of feedback or discussion of emerging patterns and concerns.

As a result, one of the most pressing challenges identified at this stage is the constrained temporal framework within which decisions must be made. This limitation may hinder the committee's ability to holistically consider applicants' professional competencies and to ensure equitable and transparent qualification outcomes. Addressing this issue may require revised procedural policies, expanded meeting formats, or formalized follow-up mechanisms to facilitate more reflective and collaborative deliberation.

RQ2: What are the expectations and needs of different target groups for professional standards and professional application procedures?

The inductive content analysis revealed two main categories: (1) expectations and needs for the first stage application process, and (2) expectations for the second stage of the application process (Appendix D).

The findings of the second research question, illustrated with quotes from participants, can be found in Appendix F.

4.1.6. Expectations and Needs for the First Stage of the Application Process (E-portfolio and Self-analysis)

Within the category corresponding to the expectations and needs for the initial stage of the teacher qualification application process, five principal areas of focus were identified: professional standards, performance indicators, the e-portfolio, self-analysis, and professional collaboration.

To apply for the qualification, teachers must create an e-portfolio, which serves as a platform for teacher self-assessment, and the self-assessment must be conducted based on national professional standards. The target groups expressed concern about the complexity and abstract phrasing of these standards. This linguistic ambiguity hinders comprehension of the performance indicators and impedes the self-assessment process. Consequently, all applicant groups advocated for the professional standards to be operationalized more clearly, preferably through explicit performance statements, to facilitate meaningful self-evaluation. Furthermore, both assessors and applicants emphasized the need to eliminate redundant phrasing and to provide more concrete descriptions of performance indicators within the standards. For example, clearer guidance is needed regarding the expected scope of competencies (e.g., the number of published teaching resources and the scale of management activities).

All three stakeholder groups agreed that constructing an e-portfolio is a demanding, time-consuming endeavor that requires personal commitment and reflective capacity. Teachers must independently organize the portfolio's structure and base their self-analysis on both professional experience and perceived competency levels. Assessors, in turn, expect applicants to draw primarily on their practical experience, with theoretical knowledge serving a supplementary role.

There was a shared recognition across all groups that teachers' self-analysis skills require further development. Teachers reported a need for structured support, such as predefined templates or frameworks, to help guide the reflective writing process. Additionally, they identified the importance of a secure digital environment for compiling and storing the e-portfolio, emphasizing concerns around privacy and the public accessibility of professional development documentation. To address these challenges, respondents called for detailed guidance and targeted training on both e-portfolio creation and self-assessment practices in accordance with professional standards.

The integration of video-based evidence, such as recorded lessons or classroom observations, was proposed as a valuable addition to the qualification process. These methods enable assessors to gain insight into applicants' instructional practices while also providing a tool for teachers to enhance their self-reflective abilities. All target groups supported the idea of allowing teachers to upload annotated video clips that highlight both successful and challenging moments in their practice. Such artifacts would not only strengthen analytical and digital competencies but also serve as robust evidence of pedagogical proficiency. The use of video recordings, while beneficial in terms of self-assessment and digital skill development, also facilitates a clearer understanding of the applicant's teaching competencies by the evaluator. This contributes to a more effective and streamlined assessment process for professional committees. Moreover, annual teacher development interviews, currently practiced in some Estonian schools under the framework of professional standards, were recognized as helpful mechanisms for cultivating self-analysis skills. Teachers familiar with this process demonstrated greater confidence and competence during the qualification application.

All stakeholder groups agreed that teaching is inherently collaborative and not solely an individual endeavor. Thus, school leadership and peer support play a crucial role in the qualification process. The involvement of school principals or school management members in providing recommendations or evaluations was deemed essential in endorsing the professionalism of applicants. Furthermore, teachers expressed the expectation that student feedback should also be incorporated into the evaluation process, as it can offer valuable insights for self-analysis and portfolio documentation.

In summary, these measures aim to deliver a comprehensive and objective representation of the teacher's professional profile. To enhance this portrayal, applicants are encouraged to incorporate a variety of evidence types, including videos, images, and endorsements from institutional leaders and professional networks, into their application materials.

4.1.7. Expectations and Needs for the Second Stage of the Application Process (Discussion/Interview)

Within the expectations and needs for the second stage category, four principal codes were identified: relevance, necessity, feedback, and expectations regarding the interview. Central to this stage is the opportunity for direct communication between the applicant and the assessment committee. Prior to the interview, assessors have reviewed the applicant's written self-analysis; however, the interview serves as a vital moment for personal engagement, allowing assessors to gain a more nuanced understanding of the applicant's competencies, professional disposition, and reflective capacity.

In addition to confirming the competencies presented in the self-analysis, the interview provides assessors with the opportunity to address gaps or ambiguities

in the applicant's documentation. When necessary, supplementary questions are sent in advance to elicit clarification regarding specific performance indicators. Oral reflection during the interview provides applicants with the opportunity to elaborate on unexpressed competencies and contextualize their professional experience.

Notably, the interview can uncover well-articulated professionalism in applicants whose written submissions may appear limited or understated. This process fosters meaningful interaction not only between applicants and assessors but also among assessors themselves, thereby contributing to shared learning and professional development across stakeholders. All target groups consistently emphasized the value of face-to-face dialogue, identifying it as an essential and often most rewarding element of the application procedure.

Candidates reported that the supportive attitude and constructive feedback provided by the Vocational Assessment Committee had a positive impact on their self-confidence and overall perception of the qualification process. It was noted that many teachers found it easier to express themselves verbally than in writing, especially in light of the technical challenges associated with compiling online self-assessments. Consequently, both assessors and standard developers underscored the importance of interviews being affirming and developmentally oriented, highlighting applicants' strengths while offering guidance for further growth.

Concerns were raised regarding the lack of standardization in interview procedures. Teachers expressed a desire for clearer expectations and greater transparency regarding the format and focal areas of the interview, which is occasionally perceived as a form of professional examination. Assessors similarly recognized the need for a more structured framework, as current practices vary significantly between committees. While basic questions are commonly used, their content and delivery often differ, creating inconsistencies that may affect the applicant experience.

Although training on interview techniques has been provided for assessors, stakeholders suggested that additional, more uniform training is necessary to ensure coherence across committees. Assessors also advocated for the development of a shared bank of interview questions to promote consistency and facilitate equitable assessment practices.

In conclusion, the interview is a critical and trust-based component of the teacher qualification process. It serves not only as an evaluative measure but also as a platform for feedback, affirmation, and guidance. Applicants expect the evaluation committee to thoroughly engage with their materials, recognize exemplary competencies, and provide thoughtful recommendations for continued professional development. A more standardized and transparent interview process would strengthen the reliability and developmental impact of this stage.

4.2. Study II

RQ3: What are the needs and expectations of different target groups regarding the digital application Kutsepeegel in supporting teachers' professional development and application for the qualification? The findings of the study II, illustrated with quotes from participants, can be found in Appendix G.

The results of the data analysis are presented in alignment with the research questions and are organized into main and subcategories (Appendix D). For both RQ3 and RQ4, the coding process yielded nine distinct codes, which were organized into two overarching categories. Notably, the same categorical framework emerged for both research questions, indicating a consistent pattern across the data.

Study II, RQ3 examines the needs and expectations of various target groups in supporting teachers' professional development and their application for the qualification via the digital platform *Kutsepeegel*. The findings are presented based on a set of analytical codes derived from the data.

4.2.1. Core functions

4.2.1.1. Security and access

Before engaging in self-assessment, teachers are required to select a web-based platform for creating an e-portfolio, where they can systematically store and organize all relevant documentation. Given that most free online environments are publicly accessible, all target groups emphasized the importance of a secure and protected system for managing teacher documentation and self-assessment materials.

There was a shared understanding across target groups that the analysis of a teacher's work does not need to be publicly available. Teachers should have full autonomy in determining both the recipients and the extent of access to their professional development records. Both educators and evaluators agreed that sensitive information, such as personal data and work-related analysis, should only be accessible using a personal identification number. This highlights the collective need for a secure and user-controlled digital infrastructure that ensures confidentiality while fostering professional growth.

4.2.1.2. Self-analysis

Self-analysis is a crucial component of professional development, enabling teachers to reflect on their work from an external perspective. This metacognitive ability is regarded as a key indicator of professional growth, offering an opportunity to critically examine one's practices, identify strengths, and recognize areas for improvement. While self-analysis is inherently complex and time-

intensive, it plays a significant role in fostering professional awareness and interpretation.

Teachers reported that although they regularly interpret and evaluate their activities, this process often remains unconscious and undocumented. Both applicants and experienced teachers highlighted the initial ambiguity surrounding self-analysis, particularly concerning what should be written, to what extent, and in which format. There is a recognized need to establish clarity regarding the structure and content of self-analytical writing, as concrete examples and models are currently lacking.

Professional assessors observed a common misconception among teachers that self-analysis should focus solely on highlighting positive experiences. In contrast, reflecting on unsuccessful methods and identifying underlying causes is equally important and contributes meaningfully to methodological refinement. Accordingly, *Kutsepeegel* is expected to offer a well-structured questionnaire format that is accessible to all users and facilitates the self-analysis process through clarity and comprehensibility.

It was further acknowledged that individuals vary in their capacity for written self-expression. For some, composing a self-analysis is a straightforward task, while for others, it requires considerable thought and effort. The motivation behind seeking qualification and how it is expressed in the self-analysis is also viewed as essential, likely influencing the relevance and thematic focus of the content. All target groups emphasized that the application should accommodate differing levels of self-expression and writing ability, ensuring precision and clarity in the formulation of self-analytical texts.

Compliance with PS performance indicators. Self-analysis is grounded in the professional standard, which is organized into performance indicators based on competencies. Teachers are expected to reflect on their professional activities in accordance with specific performance indicators outlined in the PS. However, many teachers report uncertainty regarding what exactly should be included in the self-analysis.

Professional assessors have noted a tendency among applicant teachers to simply list the performance indicators from the PS within their texts. While this may demonstrate awareness of the standards, it does not effectively convey their actual competencies or the depth of their practice.

To address this gap, all target groups expressed the need for a consistent and structured format to guide self-analysis and competency evaluation. Specifically, there is a shared expectation that *Kutsepeegel* will offer a standardized framework, whether in the form of a questionnaire or predefined statements, that supports teachers in articulating their professional development in a clear and meaningful way.

Structure. All target groups emphasized the importance of maintaining a consistent structure in self-analysis carried out within *Kutsepeegel*, specifically aligned with the performance indicators outlined in the professional standards. This structured approach was considered essential for simplifying both the writing and evaluation of self-assessments.

When a performance indicator instructs the applicant to "describe" or "give an example," they can provide a relevant response in the designated self-assessment field. To ensure clarity and usability, it was suggested that the self-assessment should retain a fixed format, preferably presented in a tabular layout, making it suitable for submission to the Vocational Assessment Committee.

The unified structure of self-analysis within *Kutsepeegel* is regarded as beneficial in two key ways: it enhances teachers' understanding of the self-reflection process and clarifies the description of their activities, while also streamlining the evaluation of competencies for assessors. A breakdown aligned with performance indicators would support evidence-based self-assessment and contribute to the overall reliability of the evaluation process.

Length. All target groups positively evaluated the fact that *Kutsepeegel* limits the scope of self-analysis. The emphasis was placed not on the length of writing, but on the relevance and specificity of the analysis in capturing one's professional development. The standardized structure and volume of the writing space provided in the application were considered beneficial in supporting teachers through the self-assessment process.

According to the PS developer, the purpose is not writing for its own sake but ensuring that (1) teachers have conducted a thorough self-assessment, (2) the documentation serves as evidence of their professional competencies, and (3) the self-analysis is directly linked to performance indicators. Furthermore, all target groups considered it appropriate that the existing narrative-style e-portfolio could be replaced with a performance indicator–based self-assessment form within *Kutsepeegel*. This transition would increase the relevance and precision of the content while reducing anxiety among teachers with less-developed writing or self-expression skills. A structured format would eliminate the need for blog-like reflections, which may not be suitable for all individuals, particularly those who struggle with sentence construction.

In conclusion, the self-analysis feature within *Kutsepeegel* is seen as a valuable tool for illustrating a teacher's current professional development level and identifying areas for growth. It would offer a transparent overview of where the teacher stands, what is lacking, and where further development is needed. While feedback from assessors may sometimes be difficult to accept, objective insight offered by the *Kutsepeegel* environment could foster constructive engagement. Although teachers currently determine the scope of their self-analysis independently, resulting in highly variable texts ranging from lengthy narratives to brief outlines, target groups have suggested introducing parameters (e.g., word count limits, standard writing area dimensions). Currently, there is no clear guideline regarding the required length of a self-assessment.

4.2.1.3. Data collection

All target groups emphasized the importance of data collection, viewing it as a means to gather teachers' personal and professional information from both secure national databases and open web sources. The PS developer emphasized that data

collection provides analytical support for teacher self-assessment. Professional assessors considered it essential that embedded links in the supported analysis function reliably, as this would significantly facilitate their evaluation process. They also noted that automatic data gathering via the application should allow teachers to selectively choose which evidence-based materials to include.

Self-analysis is expected to be accompanied by supporting evidence, such as documents, photographs, and external website links, which validate the teacher's activities and demonstrate their competencies. However, the undefined scope of such evidence has caused confusion among teachers. Consequently, both teachers and vocational assessors called for clear guidelines, specifying minimum and maximum requirements for the inclusion of evidence, which would enhance both the credibility and confidence in the self-assessment process.

To address these challenges, all target groups proposed that *Kutsepeegel* could incorporate recommendations aligned with PS performance indicators and data collection practices. A shared expectation emerged that *Kutsepeegel* should offer a feature for storing evidence, enabling teachers to compile snapshots of relevant materials for development reviews or job interviews, and to create excerpts or share selected items as needed.

Furthermore, evidence-based self-analysis could be adapted to diverse professional contexts, such as development discussions or qualification procedures. To strengthen this functionality, it was proposed that *Kutsepeegel* incorporate features for uploading supporting materials, such as documents, recommendation letters, and endorsements, enabling school leadership to gain a holistic view of a teacher's progress and streamline formal evaluation processes. Overall, target groups emphasized that a structured, integrated self-assessment tool grounded in evidence would play a pivotal role in validating professional growth and competencies.

4.2.1.4. Feedback

All four target groups emphasized the critical role of feedback throughout the self-assessment and application process. Feedback is expected at multiple stages: following the completion of the self-assessment, from school leadership, during document submission, and from the VAC.

Assessors noted that applicants, especially first-time candidates, require consistent, encouraging, and guiding feedback to navigate the process with confidence. Given the complexity of the tasks involved, feedback helps mitigate uncertainty and supports teachers at every phase. Both PS developers and assessors highlighted that applicants value immediate and concrete feedback, preferably supplemented by clarifying questions, to deepen understanding and promote improvement.

Following the submission of the self-assessment and supporting evidence, all target groups suggested that digital feedback mechanisms could begin with quantified metrics (e.g., percentage scores based on task performance criteria) or

visual representations (e.g., diagrams), followed by verbal recommendations for refinement.

Once the self-assessment file is submitted to the VAC, applicants are expected to receive constructive verbal feedback and development-oriented suggestions. Each stage of the process should include evaluation against the relevant PS performance indicators, culminating in either approval or guidance for further revision. Additionally, assessors proposed that the application (*Kutsepeegel*) should enable targeted follow-up questions if competencies require clarification or are missing, thereby improving the quality of evaluations and streamlining the revision process.

Document sharing via *Kutsepeegel* was also regarded as essential. The ability to exchange materials digitally would reduce administrative burden and eliminate the need for paper-based submissions. Sharing self-assessment documentation directly with the VAC would enable assessors to provide feedback promptly and register questions within the application. In turn, this could minimize the number of separate assessment documents produced by the committee. Finally, all target groups recommended that the *Kutsepeegel* self-assessment form include designated sections where both school leadership and the VAC can offer formal, supportive feedback, contributing to a comprehensive and transparent development overview.

4.2.2. Supportive functions

In addition to the previously outlined expectations, target groups identified several additional application features that could significantly reduce the administrative burden for teachers and enhance both professional development support and the overall efficiency of the application process. Specifically, the implementation of a dashboard and a progress bar was highlighted as essential.

A dashboard would provide teachers with a centralized overview of their self-assessment status, submitted materials, received feedback, and upcoming tasks, streamlining navigation and enabling users to monitor their progress with ease. Meanwhile, a visual progress bar would provide real-time feedback on the completion status of various stages in the application process, helping teachers to stay organized and better manage deadlines.

Together, these features are expected to foster a more intuitive and user-friendly experience, reducing uncertainty and allowing teachers to focus on the substance of their professional development journey.

4.2.2.1. Dashboard

All target groups expressed a clear expectation for the implementation of a visual dashboard within the *Kutsepeegel* environment, recognizing its value in providing a comprehensive overview of teachers' professional development. Such a dashboard would serve as a visual summary of the self-assessment process, presenting teachers' competencies in an accessible and personalized format.

Applicants could receive individual competency diagrams, enabling them to construct a tailored profile based on their self-assessment outcomes. This visualization is anticipated to support both self-reflection and planning for further development. Moreover, the dashboard would facilitate a clearer understanding of each teacher's current level of PD, helping educators and evaluators identify strengths, gaps, and future learning needs.

4.2.2.2 Progress bar

All target groups emphasized the importance of integrating a progress bar into the *Kutsepeegel* application, recognizing its potential to support teachers in navigating various stages of the application process more effectively. Teachers expect the progress bar to visually indicate the proportion of performance indicators that have already been analyzed and verified, as well as those that remain to be analyzed and verified. The green segment would symbolize completed tasks, while the red segment would reflect pending activities.

This feature is especially valuable for first-time applicants, who seek assurance that they are proceeding correctly and appreciate a clear summary of their progress in the self-analysis process. Moreover, having a structured activity overview, rather than confronting a blank page, can alleviate stress and provide practical guidance. Displaying the amount completed and what remains to be done provides a necessary visual summary of the documentation required for a successful application. In this way, the progress bar functions not only as a tracking tool but also as a motivational and organizational aid, making the application process more accessible and user-friendly.

RQ4: What should be the design and functionalities of Kutsepeegel to support teachers' professional development and the application process?

4.2.3. Core functions

4.2.3.1. Security and access

All target groups emphasized the importance of a secure, protected web-based environment as part of the *Kutsepeegel* environment. Such an environment would assure teachers that their self-analysis documentation is safeguarded from public access and search engine indexing, thereby minimizing risks related to privacy breaches and plagiarism. A centralized documentation repository was also considered vital, offering teachers the ability to quickly retrieve personal self-assessments and other professional records. This feature would support efficient material management and, when needed, simplify the process of sharing relevant documents.

The *Kutsepeegel* application would allow for long-term storage of PD self-assessments and feedback, helping teachers organize and reflect on their professional growth over time. Professional assessors and PS developers emphasized

that recurring applications, such as those for Senior Teacher or Master Teacher qualifications, which are granted for five-year terms, require access to prior submissions. Retaining this documentation, including self-assessment responses, VAC-related questions, and feedback within the *Kutsepeegel* environment, would provide educators with a comprehensive view of their career development and in-service training history.

Furthermore, the issue of e-portfolio complexity and time intensity could be mitigated through the implementation of a login-secured platform. This would give teachers confidence in the privacy and protection of their materials, fostering greater comfort and engagement in the application process.

4.2.3.2. Self-analysis

The TAPP's strongest contribution to teachers' professional development lies in its support for self-analysis. Across target groups, self-analysis was recognized as an impartial reflection process – one in which educators describe and evaluate their professional activities and analyze their own competencies. This introspective practice fosters greater self-awareness, allowing teachers to identify both strengths and areas in need of improvement.

The in-app self-analysis tool was widely recognized for encouraging meaningful self-reflection. Qualified teachers, in particular, valued it as a method to gain a structured overview of their PD journey. Furthermore, all groups affirmed that conducting self-analysis within the *Kutsepeegel* environment enhances professional development by highlighting strengths and drawing attention to competencies that require further growth. Importantly, self-analysis was seen as the core element of the application process. *Kutsepeegel* provides targeted support for composing self-analytical narratives aligned with Professional Standard performance indicators, thus guiding teachers to articulate their PD progress effectively and with precision.

Compliance with PS performance indicators. All interviewees highlighted that the *Kutsepeegel* system effectively prevents the omission of PS performance indicators by requiring teachers to provide corresponding self-analyses or descriptions of their professional activities for each indicator. The ability to complement self-assessment with detailed reflections or descriptions of specific tasks was highly appreciated by all target groups, underscoring the system's role in supporting thorough, indicator-based analysis.

Additionally, the embedded instructional guidance, including notes on how to describe the indicator, assess compliance, and relevant references for further reading, was deemed essential to the self-assessment process. These prompts help clarify expectations and provide a structured pathway for teachers to engage meaningfully with each competency area.

The inclusion of questionnaires and structured statements further enhances the system's functionality. These tools help teachers navigate the thematic blocks of the PS and ensure comprehensive coverage, eliminating the risk of unintentionally skipping indicators.

Participants agreed that the self-assessment form implemented within *Kutsepeegel* reinforces the framework and integrity of the professional standards, thus supporting the qualification application process. Overall, the system's design encourages systematic reflection, safeguards continuity, and empowers teachers to monitor and articulate their professional growth with precision and confidence.

Structure. All target groups emphasized the importance of maintaining a unified structure for self-analysis within the *Kutsepeegel* environment, grounded in the framework of the PS. Such consistency enables teachers to navigate the self-assessment process and analyze their professional activities in relation to specific performance indicators. A well-defined structure not only enhances teachers' understanding of how to reflect on their competencies but also streamlines the assessment process for professional assessors. It provides a clear and coherent basis for evaluating the applicant's competence analysis, ensuring that both educators and evaluators engage with a common format that supports fairness, clarity, and accuracy in interpreting the self-assessment outcomes.

Length. All target groups responded positively to *Kutsepeegel'*s implementation of length constraints for self-analysis, emphasizing that clarity and relevance outweigh verbosity. Rather than focusing on the extent of the written content, teachers and assessors alike recognized the value of concise, targeted analyses aligned with performance indicators, which allow for a clearer overview of the teacher's professional development.

Additionally, the inclusion of a unified in-app self-analysis form was seen as a major advantage, offering a consistent and structured writing space for all users. Target groups advocated for the replacement of narrative-style e-portfolios with streamlined self-assessment forms guided by development indicators, ensuring the relevance and focus of each reflection. This approach also alleviates anxiety for teachers who may lack confidence in written expression, making self-assessment more accessible and equitable. By guiding users toward focused reflections, the system helps teachers articulate their current level of professional development and identify areas for further growth with greater ease and precision.

4.2.3.3. Data collection

All target groups emphasized the importance of application-based automatic data collection within the *Kutsepeegel* system. This functionality would enable the collection of materials from both secure internal databases and the open web, gathering links and evidence-based content related to the applicant's professional activities. Teachers could then select the most relevant materials and easily integrate them into their self-analysis before submitting it to the VAC.

This approach was appreciated for its efficiency and user autonomy – saving applicants considerable time while allowing them to curate data that best represents their competencies and development. The system's design ensures that teachers maintain control over the information included, while also streamlining the documentation process and enhancing the overall accessibility of professional self-assessment.

The degree of evidence. The target groups underscored the value of *Kutsepeegel*'s support for evidence-based documentation, recognizing it as a critical feature for validating teachers' professional activities. The application's ability to collect materials automatically, from both secure databases and public sources, was viewed as a major efficiency booster, allowing teachers to select relevant links and supporting documents to incorporate into their self-analysis submissions for professional assessment.

This functionality addresses a frequent concern raised by professional assessors and PS developers: while teachers often claim to have completed certain tasks, they may lack proper documentation to confirm those actions. By enabling direct uploads in various file formats and accepting even descriptive narratives as valid evidence, *Kutsepeegel* ensures that teachers can demonstrate their competencies with precision and confidence.

Additionally, target groups emphasized the importance of integrating letters of recommendation and community-based endorsements into the system. The ability for school leaders, colleagues, or assessors to affirm a teacher's contributions within the protected environment supports a multidimensional view of collaboration and professional engagement.

Crucially, all four target groups highlighted the need for a secure, updatable system that not only protects self-assessment content but also enables teachers to track their development over time. *Kutsepeegel*'s capacity to store and version self-assessments supports ongoing reflection and the construction of a personalized professional development pathway.

4.2.3.4. Feedback

All target groups recognized feedback as an essential and supportive component of the *Kutsepeegel* environment. Feedback is understood not only as an assessment but also as a source of recommendations for further professional growth. *Kutsepeegel* would offer both automated responses and personalized verbal assessments, fostering continuous improvement. The timely delivery of feedback across different stages of the application process, particularly during self-analysis and evidence submission, was highlighted as crucial. Feedback from various stakeholders, including school management, professional communities, and assessors, was seen as vital for reinforcing teacher confidence and ensuring they are on the right track.

By providing constructive and affirming evaluations, *Kutsepeegel* helps teachers recognize their strengths and accomplishments, which in turn supports self-esteem and motivation for further development.

4.2.4. Supportive Functions

All four target groups recognized the value of *Kutsepeegel* in offering a versatile and reusable self-analysis format that can be applied beyond the qualification process – specifically in development interviews, job applications, and for

monitoring ongoing professional growth. This flexibility ensures that teachers derive continuous benefits from their documented self-assessment, using it as a dynamic tool across various professional contexts.

Professional assessors and those involved in developing the PS further emphasized the importance of *Kutsepeegel* in the re-application process for senior and master teacher qualifications, which must be renewed every five years. By consolidating the required documentation within a single, protected environment, *Kutsepeegel* streamlines the administrative process and enables teachers to revisit and reflect on how their competencies have evolved over time. Through these functionalities, *Kutsepeegel* supports the construction of a long-term development trajectory, empowering teachers to trace their growth, identify milestones, and prepare confidently for future career advancements.

4.2.4.1. Dashboard

The visual dashboard was widely acknowledged by target groups as an essential tool for providing a graphical summary of teachers' competencies. This feature provides a clear and accessible diagrammatic overview that illustrates both strengths and developmental needs, enabling teachers to reflect on their professional progress in a structured and meaningful way.

Importantly, the dashboard helps teachers identify competencies they may not consciously recognize amidst their daily responsibilities. By transforming self-assessment data into a personalized competence profile, the dashboard supports greater awareness and facilitates interpretation of professional development over time.

As a result, the visual dashboard serves not only as an informational resource but also as a strategic tool for guiding reflection, planning future growth, and supporting career development.

4.2.4.2. Progress bar

The progress bar was especially valued by the teacher target group as a vital tool for tracking the stages of the qualification application process. Its function provides a clear visual overview of progress, making it particularly beneficial for first-time applicants, who may find the process unfamiliar and complex.

Integrated within the *Kutsepeegel* environment, the progress bar reflects the effectiveness and completion of activities – from initial self-assessment and reflection to uploading evidence-based materials and submitting the full application to the peer review panel. This step-by-step visual guidance helps teachers comprehend the logical flow of the qualification process, reinforcing their confidence and sense of direction throughout.

Ultimately, the progress bar serves not only as a monitoring tool but also as a motivational and organizational aid, ensuring that educators stay informed and supported during every stage of their professional development journey.

4.3. Study III

RQ5: How do teachers and professional assessors evaluate the usefulness and effectiveness of the digital application in supporting their professional development and identifying their professional developmental needs when applying for a qualification? The findings of the fifth research question, illustrated with quotes from participants, can be found in Appendix H.

The results of the data analysis are presented in alignment with the two components of the research question: (1) supporting professional development and (2) identifying developmental needs. These aspects are addressed separately and organized according to the eight categories that emerged through the inductive content analysis.

4.3.1. Supporting professional development

During the *Kutsepeegel* application process, both qualified and unqualified teachers, as well as professional assessors, evaluated the digital tool's functionality in relation to its capacity to support professional development. This evaluation led to the identification of five key categories: a protected environment, support for teacher self-analysis, enhanced data collection and efficiency, and the effectiveness of feedback (Appendix D).

4.3.1.1. Protected environment

Both target groups emphasized the importance of a secure digital environment that is linked to the teacher's educational institution and requires personal authentication for access. Such a system was considered supportive, as it alleviates concerns about the public visibility of portfolios or self-analyses and ensures the protection of personal data.

Interviewees particularly valued the ability to store all self-analyses conducted throughout their professional careers, along with the corresponding feedback. This feature was seen as a significant contributor to professional growth, enabling teachers to reflect on past achievements and set progressively higher goals for future development.

Building on the shortcomings identified in Study I (Article I), namely, the lack of managerial support during the qualification application process, this study underscored a key opportunity for improvement: the provision of recommendations and feedback directly within the *Kutsepeegel* environment, offered by school leaders, colleagues, and professional assessors.

All target groups emphasized the value of the functionality enabling teachers to share their self-analysis directly with assessors via the digital platform. This feature was widely appreciated for its capacity to simplify and enhance the efficiency of the evaluation process for both applicants and evaluators. Overall, *Kutsepeegel* consistently received positive assessments from both qualified and

unqualified teachers, as well as professional evaluators, particularly regarding its secure support for self-evaluation, the confidentiality of stakeholder feedback, and the dependable storage of professional development records.

4.3.1.2. Supported teacher self-analysis process

Teachers unanimously valued the opportunity for self-analysis within the secure environment of *Kutsepeegel*. The platform enables the preservation of professional reflections accumulated over years of practice, facilitates the reuse of previous self-analyses when progressing to the next qualification level, and supports the monitoring of individual professional development trajectories.

Respondents collectively emphasized that the ability to archive self-analyses over time, effectively documenting a teacher's professional growth, is a critical feature in supporting continuous in-service training. Given that self-analysis is often perceived as the most challenging component of the qualification application process, all target groups underscored the importance of *Kutsepeegel's* functionalities in enabling both professional self-monitoring and structured development tracking.

From a broader organizational standpoint, teachers and professional assessors recognized self-analysis as a valuable tool for mapping internal school development and identifying institutional needs. *Kutsepeegel* was seen as particularly effective in facilitating internal assessments, allowing teachers to evaluate their competencies across defined competence blocks. This enables schools to focus on specific areas, identify strengths, and foster peer learning by encouraging experienced teachers to share their expertise and support the development of colleagues. Overall, the findings confirm that Kutsepeegel was intentionally designed to support teachers' professional development and is perceived by users as successfully fulfilling this objective.

Supporting compliance with professional standards performance indicators. Professional assessors acknowledged that the process of reflection remains challenging for many teachers. However, they emphasized that engaging in reflective practice enables teachers to identify their strengths and weaknesses – recognizing which competencies are demonstrated and which are underdeveloped – and fosters an awareness of the role of self-reflection in professional growth.

Teachers similarly reported that self-analysis provides valuable insights into their competence-based strengths. The structured statements aligned with the performance indicators of the professional standard were found to support teachers in both conducting self-analysis and gaining a clearer understanding of their professional competencies.

The application was noted to offer a meaningful opportunity for teachers to assess themselves professionally, formulate development goals, and prepare for progression to higher qualification levels. Given *Kutsepeegel's* capacity to record self-analyses over time, teachers appreciated the ability to base future development goals on previously identified areas for improvement.

All three target groups emphasized that presenting performance indicators within competence blocks, accompanied by guiding statements and instructions, makes the self-analysis process more accessible and comprehensible. This clarity was valued regardless of whether the self-analysis was conducted for qualification purposes or for personal growth and development.

Kutsepeegel was commended for its clear articulation of competencies, enabling users to understand what is expected in demonstrating specific professional standards. Overall, the use of performance-based statements aligned with professional standards was found to have a positive and supportive impact on the self-analysis process. Importantly, all target groups noted that engaging in self-analysis contributed to a significant increase in teacher self-esteem.

The effectiveness of the self-analysis structure. Another functionality highly valued by both target groups was the structured approach to self-assessment. The process of self-assessment, particularly in terms of meeting required criteria and demonstrating competence, was perceived as complex and demanding. Teachers emphasized that the structure provided by the digital application, which distinguishes between core and optional competencies, offers substantial support in navigating this process. Consequently, the presence of a clear and organized framework was regarded as both essential and facilitative.

Respondents noted that self-assessment is a meaningful process for teachers as reflective practitioners, allowing them to engage in introspection while simultaneously observing their own professional actions from a more objective standpoint. All target groups agreed that the inclusion of specific instructions, ensuring comprehensive coverage of all competencies, provides valuable guidance throughout the self-assessment process. The structured format not only helps teachers maintain focus and direction during self-assessment but also significantly eases the task of assessors by providing a coherent and transparent basis for evaluation.

Effectiveness of guidelines for self-assessment and qualification application. The instructional materials, designed to guide teachers through relevant methodological content and offer tips for substantiating specific performance indicators, were highly appreciated by both teachers and assessors. Given the inherent complexity of the self-assessment process, all respondents agreed that such guidance is indispensable for supporting teachers in their reflective practice.

Across all target groups, the guidelines were consistently rated as one of the most essential analytical tools. Assessors particularly emphasized the varying levels of reflective competence among teachers: while some are accustomed to regular self-analysis and critical reflection, others struggle to understand the expectations and requirements of the process.

As a recommendation for future development, all target groups proposed the inclusion of additional instructional Resources, such as reflection models, theoretical frameworks, and methodological guidance. These enhancements were viewed as crucial to enhancing the effectiveness of the self-assessment process and further simplifying the task of self-analysis.

Supporting the self-assessment and qualification application process with a progress bar. All interviewees agreed that the progress bar significantly facilitates the teacher's self-analysis process. Given that self-analysis is a time-consuming and extensive undertaking, the progress bar serves as a valuable visual tool for tracking progress. The use of colour coding enhances its functionality: green indicates competencies that have been successfully completed through self-analysis, while red highlights those that remain unaddressed.

As part of the proposed future developments, teachers recommended introducing a yellow indicator to signify competencies that are currently in progress. This addition would offer a more refined depiction of self-assessment status and more accurately capture the evolving nature of professional growth. In conclusion, all target groups acknowledged the progress bar as a valuable tool that supports teachers in tracking their development throughout the self-analysis process, thereby fostering a more organized and motivating experience.

4.3.1.3. Data collection support and efficiency

Within *Kutsepeegel*, both the automatic data collection functionality and the option to upload relevant files were highly valued by all target groups. Respondents particularly appreciated the autonomy afforded by these features, allowing teachers to make informed decisions about which materials to include as evidence and which to omit. However, assessors identified certain challenges related to file uploading, especially among teachers with limited digital literacy. These shortcomings, revealed during the submission of evidence-based materials, highlight the need to strengthen digital competencies, which are recognized as a transversal skill in professional standards. To address these issues, assessors recommended the development of a comprehensive file upload guide, which could be integrated into the *Kutsepeegel* environment.

The data collection functionality within *Kutsepeegel* also serves a diagnostic purpose by identifying gaps in the demonstration of competencies, such as missing documents, images, or other required materials. These deficiencies can be systematically mapped and addressed through targeted support measures. Overall, the feature was regarded as highly beneficial, as it facilitates the qualification application process while granting teachers autonomy in selecting relevant evidence. In doing so, it not only optimizes workflow efficiency but also strengthens teachers' agency in articulating their professional expertise.

4.3.1.4. Feedback effectiveness through Kutsepeegel

The *Kutsepeegel* dashboard, which offers a visual overview of a teacher's competencies, was positively received by both teachers and assessors. In the current qualification application process, teachers often struggle to gain a clear and comprehensive understanding of their competency levels. While self-analysis is possible, it does not always provide an accurate picture of the manifestation and depth of professional competencies.

All target groups emphasized the importance of feedback in this context, describing it as both essential and highly supportive. Teachers expressed particular satisfaction with the visual feedback provided by *Kutsepeegel*, noting that the rose diagram – a graphical representation of competencies – offers clear and inspiring insights into their professional development. This visual metaphor was described as motivational, with one comparison likening a teacher's growth to a blooming rose: gradually becoming fuller and more vibrant as competencies develop.

Teachers also proposed enhancements to the dashboard, suggesting the addition of percentage-based feedback alongside the existing visual indicators. They recommended that both visual and numerical feedback be integrated directly into competency blocks, rather than being limited to performance indicators. This would allow for a more precise and accessible understanding of competency manifestation. Furthermore, feedback from professional assessors was considered the most valuable, serving as a key indicator for future development. Teachers also highlighted the importance of supportive feedback from colleagues, school leaders, and assessors during the qualification process. Such feedback was seen as instrumental in boosting self-esteem and reinforcing professional identity.

In summary, the feedback mechanisms within *Kutsepeegel* were highly appreciated for their clarity, motivational value, and developmental support. The proposed improvements reflect a desire for even more nuanced and actionable feedback, underscoring the central role of reflective and external input in teacher growth.

4.3.2. Identifying developmental needs

In response to the second part of the research question – how the qualification application process contributes to identifying teachers' professional developmental needs – three key categories emerged: needs identification, effectiveness of self-assessment, and data use (Appendix D).

4.3.2.1. Needs identification

The *Kutsepeegel* functionality plays a central role in identifying both the strengths and developmental needs of teachers. All target groups emphasized that the self-analysis process effectively reveals competencies requiring further improvement. Teachers noted that they often become aware of specific areas for development only after receiving visual feedback, which clearly highlights underdeveloped competencies. This functionality not only supports teachers in their reflective practice but also enhances the efficiency of the professional assessor's evaluation, providing a structured overview of the applicant's competency profile. The visual representation facilitates targeted feedback and streamlines the assessment process.

Furthermore, all target groups unanimously affirmed the importance of constructive feedback from professional assessors, emphasizing its role in guiding teachers toward meaningful professional growth. This type of feedback provides

clear insights into existing competency gaps and suggests concrete directions for development, making it a critical component of the qualification process. When combined with visual feedback mechanisms, this integrated feedback system was regarded as a powerful tool for supporting teachers' ongoing professional development and fostering a deeper understanding of their individual growth trajectories.

4.3.3. Effectiveness of self-assessment

All interviewees agreed that the functionalities of *Kutsepeegel* effectively support teachers in assessing their professional developmental needs. The guided self-analysis process enables teachers to reflect on and evaluate their professional activities to date, providing a clearer understanding of their current development status and identifying areas that require further growth.

A central feature of this process is the visualization of competencies through a rose diagram. In this diagram, the length of each beam represents the level of competence, with longer beams indicating higher proficiency and shorter beams reflecting lower competency ratings. From a developmental perspective, this visual representation was found to enhance teachers' understanding of their current qualification level and to facilitate the setting of specific, targeted goals for future improvement.

Both teachers and professional assessors consistently described *Kutsepeegel* as a highly effective self-assessment tool. Teachers particularly appreciated the visual feedback provided for each individual activity indicator. However, they recommended further development of the application to include an aggregated overview of entire competence blocks, which would offer a more holistic understanding of their professional profile.

4.3.4. Data Use

The *Kutsepeegel* platform enables the use of diverse, verified data in teacher self-assessment, including information collected through integrated data collection tools. This functionality supports a comprehensive evaluation of a teacher's professional development.

In both self-assessment and qualification application processes, teachers are required to upload relevant professional documentation to *Kutsepeegel* in order to demonstrate their competencies. All target groups highly valued the autonomy afforded to teachers in selecting which data to include as evidence. Importantly, this data remains under the teacher's control – managed, shared, and accessed solely by the individual – thereby ensuring data privacy.

Participants also appreciated the ability to attach files and links that substantiate performance indicators, as well as the automatic integration of data from professional databases and open web sources. These features were viewed as valuable tools for identifying competencies that require further development and for enhancing the overall transparency and efficiency of the assessment process.

In conclusion, the *Kutsepeegel* platform was consistently recognized by all target groups as a robust and secure environment for teacher self-assessment, offering flexible and autonomous data management. By enabling the integration of diverse, verified sources, including user-uploaded documentation, linked evidence, and automatically retrieved data from professional databases, the platform supports a comprehensive and transparent evaluation of professional competencies. Its emphasis on teacher agency and data privacy, combined with diagnostic tools for identifying developmental needs, contributes meaningfully to both formative self-reflection and formal qualification processes.

5. DISCUSSION

This doctoral thesis aimed to develop and test the learning analytics application *Kutsepeegel* and to evaluate the perceptions of teachers and qualification experts regarding its functionalities in supporting their evidence-based self-reflection and professional development. At the same time, it also supported teachers in identifying the most suitable qualifications and competencies that need to be developed.

The first study of the doctoral thesis examined both the shortcomings of professional standards and the qualification application process as perceived by various target groups involved in the process (three qualified teachers who have completed the professional application process, three professional assessors and one teacher who developed professional standards), as well as the expectations and needs of the same target groups regarding these standards and procedures.

The findings of this study highlight several critical challenges and needs in the current teacher professional qualification system in Estonia. In particular, the professional standards and the qualification application process were scrutinized through the perspectives of three key stakeholder groups: experienced teachers who have completed the qualification process, professional assessors, and a teacher involved in developing the standards. By examining these perspectives, the study identified common shortcomings, explored teachers' self-assessment practices, and gathered proposals for improving the system.

Participants across all groups pointed out three main shortcomings in the qualification process: (1) difficulty in selecting the appropriate level of professional qualification, (2) inconsistent understanding and interpretation of the professional standards, and (3) challenges in providing evidence for certain performance indicators (such as those related to supervision of colleagues or collaboration with universities). These issues suggest that teachers often struggle to determine which qualification tier best matches their experience, that there may not be a shared, clear understanding of what the standards entail, and that some criteria (e.g., demonstrating mentorship or university cooperation) are difficult to verify in practice. Given that Estonia initiated its teacher professional certification system in 2014, the first cycle of five-year certifications, i.e., Senior Teacher at levels 7.1 and 8, has led to a wave of renewal applications. This new situation has brought these issues to the forefront, indicating the need to review and possibly revise the standards and application procedures to better support repeat applicants.

A prominent theme in the findings is that, similar to earlier research (e.g., Goldman & Grimbeek, 2015), many teachers have underdeveloped skills in self-analysis and self-reflection. All three stakeholder groups observed that teachers often struggle to critically evaluate and describe their own practice. Several reasons were noted for this shortcoming. First, teachers may feel constrained by time, focusing on day-to-day teaching tasks while neglecting to document or reflect on them, assuming their "meaningful activities" are self-evident and not

in need of articulation. Second, there is evidence that some teachers misunderstand the purpose of self-analysis, treating it as an exercise in self-promotion rather than a balanced appraisal of strengths and weaknesses (Kotuľáková et al., 2022). This was evident in cases where self-evaluations primarily consisted of self-praise, lacking critical insight. Third, even when teachers do recognize their weaknesses, they often do not know how to address or overcome them (Purnama et al., 2025). As a consequence, many teachers approach the qualification application, lacking confidence in their self-assessment. Therefore, a teacher should have a clear vision of both teaching and content, both pedagogical knowledge and content teaching, as well as knowledge of pedagogical content (Shulman, 1987), and the ability and willingness to reflect on their teaching activities (Pedaste et al., 2019). In fact, respondents across all groups noted that teachers tend to be overly self-critical and uncertain about their competence. This low self-confidence was attributed in part to a lack of recognition and support from school management, which leaves teachers feeling undervalued. The net effect is a cycle where teachers are hesitant to present themselves positively (for fear of seeming boastful) yet also harsh on their own shortcomings, leading to self-analyses that are neither fully candid nor constructive (Bantwini, 2012).

To address the issues in self-analysis, the study underscores the need for better support mechanisms – most notably, a digital e-portfolio application for teachers. An e-portfolio is envisioned as a structured online environment where teachers can document their professional activities, reflect on their practices, and map evidence to the professional standards (Younghusband, 2021). Such a tool would guide teachers in interpreting the standards and prompt them to provide concrete evidence for each competency area. While an e-portfolio alone may not capture every aspect of a teacher's competence (especially since the PS framework describes an *ideal* teacher that few, if any, can perfectly embody) (Admiraal et al., 2014), it would significantly support both applicants and assessors. For applicants, it provides a clear format and prompts for thorough self-analysis. For evaluators, it offers an initial comprehensive overview of each teacher's profile and can serve as a basis for focused follow-up questions during the assessment. Notably, teachers who had gone through the application process themselves expressed that developing an e-portfolio would also be beneficial for improving their digital competencies. Preparing the required documentation and evidence in a digital format inherently builds skills in using technology for professional growth (Muharom et al., 2023). At the time of this study, participants pointed out a gap: there was no sample or template e-portfolio provided by the Teachers' Union or relevant authorities to illustrate how performance indicators in the standards could be effectively documented. The clear message, therefore, is that a well-designed digital application for self-analysis is needed to support teachers – one that provides guidance in interpreting standards, offers examples of evidence, and provides a user-friendly way to record reflections.

In addition to diagnosing problems, the study gathered constructive proposals from stakeholder groups on how to improve professional standards and the application process. One of the most significant recommendations is the integration of

video-based analysis of teaching practice into the application. Specifically, teachers applying for higher qualifications could be encouraged (or required) to submit a video recording of a lesson or teaching activity, accompanied by the teacher's own analysis of that footage. This approach offers multiple benefits. On the one hand, it allows teachers to demonstrate and analyze their work in an evidence-based manner: rather than merely writing about their teaching, candidates can show actual classroom interactions, then reflect on what went well and what could be improved (Fadde et al., 2009). This makes the self-analysis more concrete and anchored in real practice. On the other hand, creating and analyzing a teaching video helps teachers develop their digital and reflective skills (Bruce et al., 2015). Learning to film a lesson, possibly edit it, and critically assess it is a valuable professional development activity in itself. From the evaluators' perspective, reviewing a concise video of a lesson can provide a richer understanding of a teacher's instructional methods, classroom management, and interaction with students than written portfolios alone. It can also save time and make the evaluation more efficient by focusing on key segments of teaching that the teacher has identified as representative of their practice. Of course, implementing video submissions requires careful attention to ethical and privacy considerations. All groups emphasized that any use of classroom videos must comply with data protection regulations (i.e., GDPR), which means obtaining informed consent from parents/guardians before recording students in a classroom. Despite these concerns, the consensus was that a video component could substantially strengthen the application process by adding a direct, observable dimension to teacher self-analysis and evidence of competencies.

Another important proposal that emerged is the need for stronger support and acknowledgement from school leadership in the qualification process. All three stakeholder groups agreed that the involvement of school management can be a valuable addition. For example, a formal letter of recommendation or endorsement from the school principal could be included in the application. Such a letter would attest to the teacher's contributions and effectiveness from the perspective of someone in a supervisory role. This measure would not only provide external validation of the teacher's achievements (addressing, in part, the teachers' lack of confidence and recognition) but also encourage principals and school leaders to take an active role in teachers' professional growth (Brown & Militello, 2016). In essence, the qualification process should be seen as a collaborative effort, where teachers are supported by their peers (through the peer-review assessment committees) and by their employers, i.e., as a professional community that contributes to professional learning (Pedaste et al., 2019).

The discussion of results must also be situated in the evolving context of Estonia's professional qualification system. The professional standards are not static; they undergo periodic revisions aimed at improving the clarity of the standards and the efficiency of the application process. Since the introduction of teacher certification in 2014, the number of teachers interested in pursuing higher professional qualifications has increased annually. Initially, the state only regulated the basic teaching qualification required to enter the profession, while

higher-level certifications (such as *Senior Teacher* or *Master Teacher*) were voluntary and had no direct policy mandate. In this unregulated scenario, those who chose to apply for higher qualifications tended to be highly motivated, self-driven individuals. The study confirms that teachers who embark on the qualification application are typically those with strong internal motivation – they are often passionate about teaching, eager to develop themselves, and open to adopting educational innovations. In other words, they could be described as "patriots" of their profession or activist educators who constantly seek to better their practice. Their decision to pursue advanced certification stems from intrinsic motivation and a personal commitment to continuous self-improvement. This finding aligns with Sachs's (2005) observations, which noted that teachers with high internal drive are most likely to engage in voluntary professional advancement.

However, by the time of writing the thesis (2023–2024), there are signs (evidenced by the different research conducted over the years and the author's experience as a VAC member) that the landscape is shifting and extrinsic motivators are becoming more influential in teachers' decisions to seek higher qualifications. In practice, this means that what was once largely a voluntary, intrinsically motivated endeavor is increasingly influenced by external pressure or requirements. This recent development suggests a tension between internal and external motivations in professional development: while many teachers still apply out of personal desire to grow, others may do so to meet new job expectations or policy changes. The study's initial data (2020–2021) captured a time when applications were mostly driven by personal initiative, and it observed that the overall demand for higher qualifications was relatively limited at that time. The growing numbers and external push factors indicate a broader institutionalization of the professional qualification process.

It is encouraging that the teachers who went through the qualification application in 2020–2021 reported general satisfaction with the procedure. They found the process fair and worthwhile, which bodes well for the legitimacy of the system. Moreover, these teacher applicants themselves had suggestions for enhancing the process, notably by expanding the scope of the self-analysis component. They felt that a more extensive self-analysis section would allow them to better demonstrate their competencies and growth. From the assessors' viewpoint, a more detailed self-analysis (especially if guided by a digital template as mentioned earlier) could make it easier to evaluate candidates in depth. In summary, both applicants and assessors recognize the value of rich, evidence-based self-reflection as part of the application process. Increasing the "volume" (depth and detail) of self-analysis can support the development of various competencies by prompting teachers to reflect on a wider range of their professional activities. This provides assessors with more substantial material to review, thereby potentially improving the reliability and fairness of their judgments (Valentine et al., 2022).

The study's findings also shed light on the nature of the professional qualification framework in Estonia, characterizing it as a trust-based peer-review

system. A unique aspect of the Estonian model is that teacher applicants have the autonomy to choose the qualification level they believe is appropriate for themselves, based on their self-evaluation against the standards. In other words, a teacher initially decides whether to apply, for example, for *Senior Teacher* (Level 7) or *Master Teacher* (Level 8) after reflecting on their own experience and meeting the criteria. This approach places significant trust in the teacher's professional judgment and honesty. The role of the professional assessment committee of peers (experienced educators and other experts) is then to review the evidence submitted – portfolio, self-analysis, possibly video, etc. – and to provide an independent evaluation and feedback. The system works effectively on a peer-to-peer principle: the assessors are not distant bureaucrats but colleagues from the educational field, which helps create an atmosphere of collegial review rather than adversarial judgment (Gosling, 2013). A crucial outcome of this process, as highlighted by the study, is the constructive feedback that applicants receive. Regardless of whether the teacher's application is successful (i.e., whether they are awarded the qualification level sought), the feedback from the committee serves as meaningful guidance for further growth. Teachers reported that this feedback supported their self-esteem, validated the things they were doing well, and also offered direction for future professional development by pinpointing areas for improvement. Such a feedback-rich, trust-based approach turns the qualification application into a formative experience, not just a summative one. It underscores that the goal is not only to certify teachers but also to support their professional growth.

One of the clearest messages from the study is the call for a dedicated digital application to facilitate teacher self-analysis. The difficulties teachers faced in interpreting the professional standards and articulating their achievements indicate that many would benefit from a guided online system. Such a system could translate the broad competencies of the PS into user-friendly prompts or checklists, provide examples of evidence for each standard, and essentially function as an interactive coach through the reflection process. The absence of a standardized e-portfolio template or example (e.g., one officially provided by the Estonian Teachers' Union) was noted as a gap. Filling this gap would likely improve consistency and clarity in applications (Hizli Alkan et al., 2024). If teachers had access to a model e-portfolio demonstrating how to document each performance indicator, they could better understand what is expected and how to showcase their work. The development of a digital application aligns well with the earlier point about enhancing digital competencies: it would not only make the application process more efficient but also encourage teachers to engage with technology in a professional context, thereby improving their digital literacy.

Hence, the research affirms that teachers are indeed interested in continuous professional development and are willing to invest effort in improving their practice. This is true for those driven by intrinsic motivation and increasingly also for those responding to extrinsic pressures (such as institutional requirements). Simons and Ruijters (2014) similarly note that teachers' engagement in professional learning can be fueled by both personal ambition and external stimuli.

Importantly, the findings reveal that many teachers are somewhat uncertain about the value they create for their organizations or how their individual development aligns with school or national goals. This indicates a need for clearer communication and alignment between teacher professional development activities and organizational improvement targets. A well-implemented professional assessment and qualification system can bridge this gap by explicitly linking teacher competencies to student outcomes and school development (Peklaj, 2015).

The study demonstrates that a structured professional assessment system, when effectively implemented, provides a valuable opportunity to identify teachers' strengths and weaknesses. It serves a dual purpose: it is a means of certifying competence and also a structured occasion for self-reflection. Teachers going through the process are prompted to take stock of their practice, celebrate their achievements, and pinpoint areas for growth. Such a process can be transformative for practitioners, especially when coupled with constructive feedback, as was the case in the Estonian model. At the same time, sustaining a high-quality assessment system requires ongoing effort and faces challenges (Colbert et al., 2012). Developers of the professional standards and the assessors must continuously refine the criteria and procedures. As teaching practices evolve and new educational innovations emerge, the standards need regular updates to remain relevant. Assessors must be trained to understand any new criteria and to handle novel situations fairly. The process must adapt to ensure that evidence of teaching competence can come in modern forms (e.g., digital artefacts like videos or learning analytics data, in addition to traditional portfolios).

Professional standards, in essence, serve as benchmarks or measurement tools throughout this process. They define what proficient or distinguished teaching looks like, and the application process measures candidates against these benchmarks by examining the alignment between a teacher's self-analysis (and supporting evidence) and the competencies outlined in the current standards. The study identified a particularly interesting connection between established professional standards and the concept of the teacher as a "learning professional." A close relationship was noted between the competencies defined in the PS (essentially the qualities of a competent teacher) and the objectives that characterize a *learning professional* – that is, a teacher who continuously learns and improves (Simons & Ruijters, 2014). Recognizing this alignment, the research integrated these objectives of lifelong learning into a teacher professionalism model. In other words, the model of teacher professionalism that emerged from the study explicitly includes the goals of self-directed learning and continuous improvement, alongside meeting the formal standards. This approach reinforces the idea that achieving a professional qualification is not a one-time accomplishment but part of an ongoing journey of growth (Zhgenti et al., 2018). If the goals of professional standards are achieved and the qualities of professional learners are developed, then only when teachers are committed (Simons & Ruijters, 2014; Sachs, 2003). If the goals of professional standards are achieved and the qualities of professional learners are implemented, then, as a result, teachers increase their autonomy and authority (Pedaste et al., 2019).

However, it should not be forgotten that teacher professional development is inherently broader and more multifaceted than the way it is captured through professional standards or through structured self-assessment in *Kutsepeegel*. Professional development emerges through a dynamic interaction of personal experience, reflective practice, collaboration, organisational culture, context-sensitive decision-making, and often informal and situational learning processes. Therefore, professional standards and the digital tools that operationalise them cannot provide a comprehensive representation of teacher professional development; rather, they address it through a necessarily normative and structured framework.

Overall, the need for emphasizing self-determination and self-improvement in teacher professional qualifications became clear. The most effective professional development and qualification processes are those that empower teachers to take charge of their own growth (Hargreaves et al., 2013). When teachers approach certification not just as a compliance exercise but as a personal development journey, the outcomes are more meaningful for both the individual and the educational system (Visković & Višnjić Jevtić, 2018). The study's results underscore that the system should continue to nurture teachers' intrinsic motivation – encouraging reflection, innovation, and pride in one's professional progress – while also smartly integrating the external structures (standards, digital tools, feedback mechanisms) that guide and support that journey. In conclusion, by addressing the identified shortcomings, leveraging digital solutions such as e-portfolios, and fostering a supportive, trust-based culture, the teacher qualification framework in Estonia can better achieve its dual goals: ensuring high standards of teaching and promoting the continuous professional growth of educators. This aligns with broader research on professional learning, which shows that teachers thrive in developmental environments that recognize their autonomy, encourage self-assessment, and provide constructive feedback (Simons & Ruijters, 2014; Sachs, 2005). The present study's discussion contributes to understanding how these principles can be applied in practice and highlights areas for further improvement in policy and implementation.

In addition to these findings, the role of learning analytics in supporting standards-informed professional learning warrants critical consideration. While learning analytics is presented as a mechanism for aligning teachers' reflective practice with formally defined professional expectations, its contribution must be evaluated with attention to both its potential and its limitations. But it is the interpretive and reflexive involvement of the teacher that transforms analytics into professional learning. In this sense, learning analytics acts as a mediating structure that supports, but does not determine, professional growth.

The conceptual framing of learning analytics as a mediating tool between professional standards and teachers' reflective practice is theoretically compelling. By making professional competencies more visible through structured data, analytics can support evidence-based reflection, longitudinal tracking of development, and more systematic engagement with professional benchmarks. In this sense, learning analytics may help transform professional standards from static compliance requirements into developmental reference points that guide

professional growth. However, much of this potential remains normative. The extent to which teachers actually engage with learning analytics in the reflective and critical ways envisioned depends heavily on contextual conditions, including data literacy, institutional culture, time availability, and system design. Without sufficient empirical evidence demonstrating consistent and meaningful use, claims regarding the transformative impact of learning analytics should be interpreted with caution.

A further issue concerns the dual role of learning analytics in supporting both professional development and professional accountability. While these functions are often presented as complementary, they may also generate tension. Systems that produce measurable indicators of competence can shift from supporting reflection to reinforcing performative monitoring. When professional standards are operationalised through quantifiable data, teachers' engagement may become oriented toward demonstrating compliance rather than deep professional learning. Organisational expectations, evaluation practices, and policy pressures may further shape how analytics is used, potentially limiting teachers' interpretive autonomy. Thus, the developmental value of learning analytics cannot be assumed independently of the institutional contexts in which it operates.

The effectiveness of LA also depends on teachers' capacity to interpret and contextualise data. The discussion assumes that teachers can engage critically with analytics outputs, relate them to their specific teaching contexts, and integrate them into professional judgment. In practice, however, teachers' data literacy and confidence in using analytic information vary considerably. Without adequate professional learning opportunities, collaborative interpretation structures, and time for reflective engagement, analytics may reduce complex pedagogical work to simplified indicators rather than supporting nuanced understanding. The translation of professional standards into measurable indicators also raises the risk of reductionism, where aspects of teaching that are difficult to quantify – such as relational work, ethical sensitivity, or context-responsive decision-making – may be underrepresented.

Ethical and sociotechnical considerations further complicate the integration of learning analytics into professional development. The teacher's role is also ethical and critical. The use of LA requires professionals to engage with issues of data interpretation, privacy, and responsible use. Trust, transparency, and informed participation are therefore essential conditions for meaningful engagement with analytics. Thus, analytics systems are not neutral tools; they are shaped by design assumptions, institutional priorities, and underlying models of professional competence. Questions related to data governance, privacy, algorithmic interpretation, and transparency are particularly relevant when analytics is used to represent or evaluate professional practice. These factors influence not only what counts as evidence but also whose interpretations are recognised as legitimate within professional frameworks.

At the same time, an important strength of the learning analytics perspective lies in its recognition that engagement with professional standards remains interpretive and context-sensitive. Analytics does not determine professional action but mediates the relationship between generalised expectations and situated

professional judgment. This emphasis on mediation acknowledges the continuing importance of teacher agency and contextual responsiveness. However, it also highlights the need to consider how different institutional and cultural environments shape the meanings and uses of analytic evidence in practice.

Overall, learning analytics offers a promising but conditional contribution to standards-informed professional learning. It provides structures that may support the interpretation of expectations, the monitoring of professional growth, and evidence-based reflection. Yet its effectiveness depends on organisational conditions, professional capacities, ethical safeguards, and the broader purposes for which analytic systems are implemented. Consequently, the value of learning analytics should be understood not as inherent to the technology itself, but as emerging from how teachers, institutions, and professional communities engage with data within specific educational contexts.

5.1. Overview of the development of *Kutsepeegel*

The second study focused on identifying teachers' expectations and needs related to a technological application designed to support self-analysis and the qualification application process. The target groups included (1) teachers currently applying for qualifications, (2) teachers who had already obtained qualifications, (3) teachers functioning as professional assessors, and (4) teachers involved in developing professional standards. Findings from this study complement the results of the first study, which explored challenges in the qualification application process. Together, these insights informed the development of the *Kutsepeegel* application, ensuring its alignment with user needs and the structure of Estonia's national professional standards.

The *Kutsepeegel* application is grounded in the learning professional model (Simons & Ruijters, 2014; Pedaste et al., 2019), which emphasizes reflective practice, evidence-informed decision-making, and continuous professional learning. The application also integrates learning analytics theory (Greller & Daschler, 2012), which advocates for using data to support personalized learning and inform teaching practices. These frameworks ensure that *Kutsepeegel* not only supports teachers' professional development but also provides actionable insights based on data visualizations and evidence-based self-reflection. *Kutsepeegel* is based on Greller and Daschler's (2012) learning analytics model, which consists of 6 dimensions. The learning professional model is integrated into the application as an instrument that provides important input to support teacher professionalism.

Kutsepeegel was developed based on four core functionalities:

1. Monitoring the self-assessment process: teachers engage in reflective practice to determine their professional competence. LA techniques track progress and visualize learning pathways, supporting metacognitive engagement (Ebner et al., 2015).

2. Identifying areas for improvement: the system uses LA to highlight competencies requiring further development, thereby facilitating personalized professional learning (Ferguson, 2012).
3. Assessing compliance with qualification standards: the application aligns with national professional standards and assists teachers in evaluating their professional level based on performance indicators.
4. Collecting evidence-based documentation: teachers upload or link materials that substantiate their competencies. This aligns with the learning professional model's emphasis on evidence-informed practice.

A key innovation of *Kutsepeegel* is its dashboard-based feedback system, particularly the rose diagram (Figure 11), which visualizes the extent to which professional competencies are met. Unlike some LA dashboards criticized for limited metacognitive support (e.g., Matcha et al., 2020), *Kutsepeegel* is explicitly designed to enhance teachers' self-regulation by helping them plan, monitor, and evaluate their professional development (Zimmerman, 2002).

The application is structured according to six dimensions of professional standards: (1) planning learning and teaching, (2) shaping the learning environment, (3) supporting learning and development, (4) reflection and professional development, (5) counseling and mentoring, and (6) research and creative activity. These are mapped across professional levels (EQF Levels 7 and 8), and performance indicators are presented in simplified statements, adapted from qualification application reports, to facilitate a clearer understanding (van den Beemt et al., 2020).

The application supports learning professionals offering the following features:

- Self-monitoring tools: teachers can track their development over time using a timeline where green and red dots signify fulfilled and unfulfilled competencies.
- Evidence collection: the system allows the integration of uploaded files and external digital data, streamlining the portfolio development process.
- Peer and supervisor involvement: teachers can invite principals or colleagues to provide feedback, reinforcing collaborative learning and professional dialogue (Simons & Ruijters, 2014; Timperley et al., 2007).
- Stakeholder interaction: assessors can leave comments and follow-up questions directly within the application, facilitating formative feedback loops.

Kutsepeegel significantly contributes to professional learning ecosystems by reducing administrative burdens through automated data collection and enhancing teacher agency and motivation through personalized, formative feedback (Bandura, 1997). In addition, it supports vocational assessment committees by streamlining qualification verification and promotes a culture of self-directed professional development aligned with national goals (OECD, 2019).

5.2. Overview of functionalities and supportive functions of *Kutsepeegel*

Kutsepeegel was developed with four fundamental criteria in mind: (1) monitoring the self-assessment process – determining professional competence through self-reflection (LA is used to track teachers' progress in achieving the desired competencies), (2) identifying areas for improvement (in this case, competencies requiring enhancement), (3) assessing compliance with qualification standards, and (4) collecting evidence-based materials for qualification applications (Figure 10). Therefore, this study utilizes LA data collection and visualization functionalities (Figure 9) that facilitate personalized adaptive learning. These four criteria are based on national teacher professional standards.

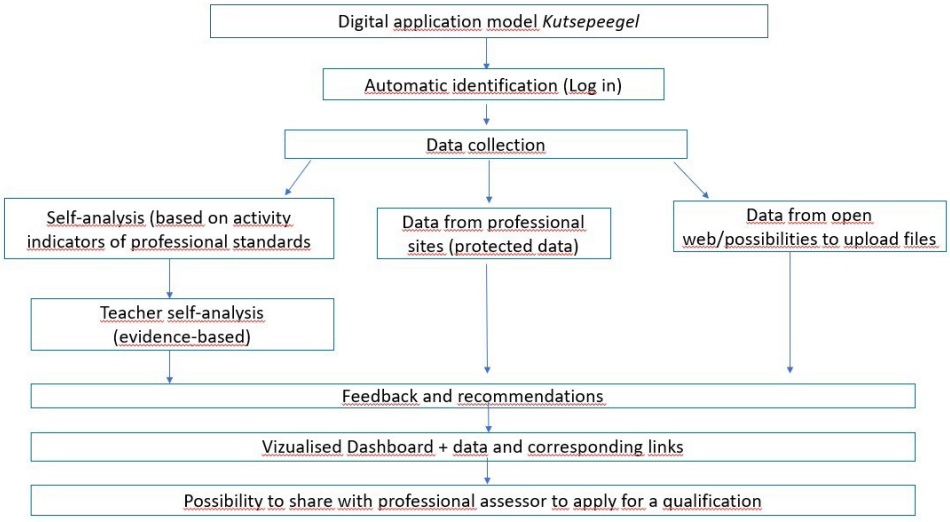

Figure 10. The workflow of the digital application *Kutsepeegel*

The workflow shows the concept and step-by-step process of how *Kutsepeegel* works:

When entering the *Kutsepeegel*, the teacher must enter the environment through automatic identification (login). Only teachers with a HaridID account can enter the *Kutsepeegel*, i.e., only people working as teachers can enter the environment (Figure 13). This is a professionally secure professional environment.

After entering the *Kutsepeegel*, data collection begins:

1. a self-analysis is carried out based on the performance indicators of professional standards
2. The system collects data from educational/professional sites (i.e. protected data), the list of these databases includes Ehis, e-school/studio, and eTwinning environment.
3. The system collects data from the open web, and the teacher can also upload data/files from their computer.

Based on this data, the *Kutsepeegel* provides feedback on the manifestation of competencies in a visual form (rose diagram).

When applying for a professional qualification, a teacher can share their self-analysis and evidence-based data with professional assessors, who can add their questions and explanations directly to the *Kutsepeegel*'s environment. The teacher designates and invites the person with whom they wish to share their data (the data belongs to the teacher).

A visual dashboard (rose diagram) provides an overview of the extent to which these criteria have been achieved or remain unfulfilled.

The result of the teacher's self-analysis and the attached evidence base are displayed as feedback on a rose diagram (Figure 11), where the length of the ray of the rose diagram corresponds to the qualification level, i.e., the longer the ray, the more competent the teacher. The peak of the ray helps to assess the level, with the lowest being level A and the highest being level D (by default, level D corresponds to an aspiring master teacher). By clicking on the ray, the competence block opens, and the corresponding competence level is shown (four levels: A–D).

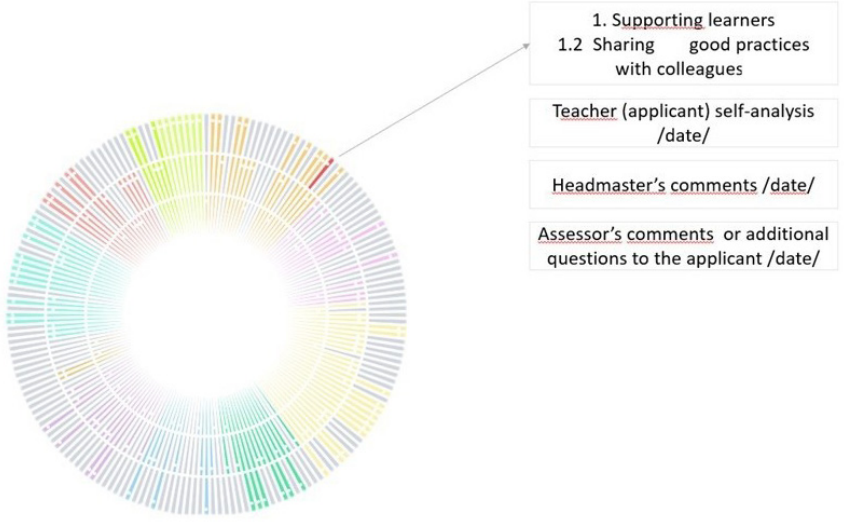

Figure 11. Visual feedback on teacher competencies through performance indicators (rose diagram)

The different colours of the ray blocks correspond to certain competences, which in turn can be highlighted as individual rays, i.e., separate action indicators. The competence and action indicator is displayed in the right corner, where the text contains the teacher's self-analysis and the comments or feedback from the headmaster/colleague/professional assessor. *Kutsepeegel* gives the teacher a visual overview of the result of their self-analysis process in a way that is as understandable to them as possible.

5.3. The operating principle of the application

The front page of the application's homepage (Figure 12) explains the working principles of *Kutsepeegel*.

When you enter the address of Kutsepeegel (https://kutsepeegel.ee), a window opens in the browser, which provides an overview of the application:

What is *Kutsepeegel*?
Kutsepeegel is a digital tool that allows you to look deep into yourself and analyze your various competencies, based on national professional standards. The Kutsepeegel also provides visual feedback and allows you to add a school principal's assessment and share the results of the self-analysis with the VAC.

How does *Kutsepeegel* work?
1. Create a self-assessment report.
The self-assessment is based on national professional standards. Add an analysis of your work and evidence-based materials. As a result of the self-analysis, you will get a visual overview of your professional development and development needs.
2. Involve the school principal in providing an assessment.
3. Plan and set goals for your further professional development.
4. Submit your self-assessment report to apply for a professional qualification.

Figure 12. *Kutsepeegel's* official homepage

Only a person working as a teacher in an Estonian state, municipal, or private school can log in to *Kutsepeegel* using an ID card, Mobile-ID, Smart-ID, or the universal state-provided TARA service, as well as the HarID service (national educational ID) (Figure 13).

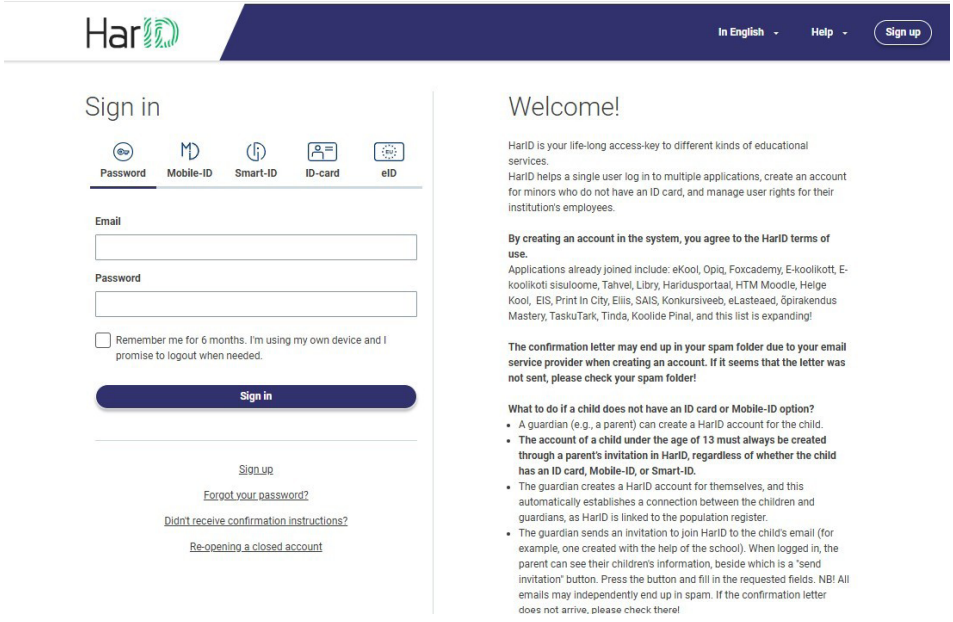

Figure 13. Log-in page

This functionality eliminates the possibility of unauthorized individuals logging in and simplifies the work of professional assessors when verifying the professional background of an applicant for a teaching profession.

The first stage of self-analysis in *Kutsepeegel* is conducted using the operational performance indicators of six valid professional standards. These standards are divided based on professional levels: teacher level 7, senior teacher level 7, and master teacher level 8 (EstQF, 2024). Self-analysis performance indicators differ in terms of their difficulty and content (according to professional levels). To alleviate teachers' concerns about a uniform interpretation and understanding of professional standards, the author of the doctoral thesis developed statements based on performance indicators (n = 182) that support a teacher's firm understanding of the content of professional standards. These statements are based on the qualification application reports of the professional assessment committee, which have been in use for the past six years, and are presented in a simplified version.

The teacher can gain an overview of their self-assessment process using a progress bar (Figure 14). When the competencies have been written down and verified by the applicant, the point on the progress bar turns green; if the competencies have not yet been assessed, it remains red. The process can be left unfinished and saved, allowing you to continue the self-assessment from the same point next time.

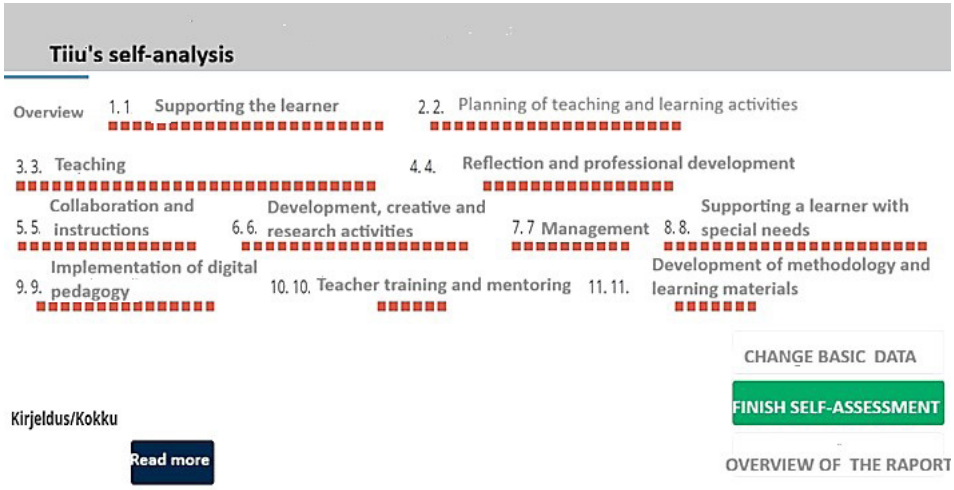

Figure 14. Overview of teacher self-assessment process using a progress bar

The *Kutsepeegel* application exemplifies the integration of learning professional theory and learning analytics into a cohesive tool for teacher development. It enables reflective practice, supports evidence-based qualification processes, and facilitates ongoing professional growth. By aligning with national standards and incorporating user needs, it positions itself as a transformative instrument in the Estonian education system.

The third study investigated the user experience of the *Kutsepeegel* digital application in supporting teachers throughout the qualification application process and in identifying their professional developmental needs. Participants included three key user groups: teachers without qualifications, qualified teachers, and professional assessors. Their feedback and experiences were systematically analyzed to evaluate the application's utility, usability, and pedagogical effectiveness.

The findings indicate that *Kutsepeegel* provides significant support for teacher self-analysis, reflective practice, and application of professional qualifications. Participants particularly appreciated features such as feedback by competency domains, performance indicators aligned with professional standards, and the provision of a percentage-based visual overview. These functionalities enhanced users' ability to critically assess their own competencies and identify areas for growth, thereby aligning with the core dimensions of the learning professional model (Simons & Ruijters, 2014), which emphasizes commitment, reflection, analytical practice, and continuous self-improvement.

Teachers reported that the application's secure environment, contrasting with earlier, public e-portfolio systems, fostered a sense of psychological safety and encouraged deeper engagement in the self-assessment process. Key functionalities that supported this process included:

1. Clear instructional guidance;
2. Statement-based self-analysis aligned with professional standards;
3. The ability to attach evidence in various formats (documents, images, videos);
4. Visual progress indicators;
5. Differentiated self-analysis across mandatory and optional competencies (totaling 182 indicators);
6. Involvement of colleagues or school leaders upon request;
7. Rose diagram-based visual feedback highlighting strengths and development areas;
8. Direct integration with the qualification submission process;
9. Opportunities for assessors to comment and engage within the system;
10. Accumulated self-analyses serving as evidence of longitudinal PD.

These design elements demonstrate the system's capacity to facilitate evidence-based reflection and professional goal-setting, thereby promoting deeper professional agency and autonomy – an essential characteristic of teachers as learning professionals (Simons & Ruijters, 2014; Pedaste et al., 2019).

From a theoretical perspective, *Kutsepeegel* effectively embodies the learning analytics framework (Greller & Drachsler, 2012), which outlines how data can be used to inform, support, and personalize the learning process. Specifically, the application facilitates evidence-based decision-making by collecting, analyzing, and visualizing teacher input (Wilcox et al., 2021); provides formative feedback loops, allowing users to track their progress, adjust their professional goals, and improve instructional practices (Cavaleri et al., 2019); supports data-informed dialogue between teachers and assessors; and enables continuous self-monitoring and longitudinal tracking of professional competence (Chatti et al., 2012).

The integration of LA and the learning professional theory within *Kutsepeegel* contributes to a holistic framework that not only facilitates administrative processes, such as qualification applications, but also strengthens pedagogical development, i.e., the continuous development of the teacher as a learning professional. Teachers gain structured insights into their competencies (learning professional goal), can set professional goals based on real-time analytics (supported aims of the theoretical model – ongoing professional learning), and submit qualifications within a single, coherent platform.

Moreover, the feedback provided by the application, particularly the rose diagram, proved especially effective in enabling teachers to visualize their strengths and developmental needs (qualities of a professional learner). This visual representation fostered increased self-awareness, improved confidence in self-assessment accuracy, and helped teachers prioritize PD efforts. Such alignment between self-perception and objective performance data reflects a maturity in professional reflection, supporting lifelong learning practices central to modern professional development models (Simons & Ruijters, 2014; Pedaste et al., 2019).

Beyond the individual teacher level, *Kutsepeegel* supports institutional practices. It enables schools to monitor and discuss professional growth more systematically and supports Vocational Assessment Committees in tracking and verifying teachers' qualification readiness. This reinforces the application's role not only as a personal reflection tool but also as a systemic component of quality assurance in education.

Importantly, the application was found to be time- and resource-efficient for both applicants and assessors. Despite its benefits, the study identified areas for further improvement, including enhanced user interface design, more personalized recommendations, and improved support for formative peer review processes.

In conclusion, Study III confirms that *Kutsepeegel* effectively bridges learning analytics and the learning professional model, offering a digital environment where teachers can engage in authentic, data-informed, and personalized professional development. It enhances teachers' self-efficacy, supports reflective practice, and strengthens professional identity. Moreover, it offers a replicable model for similar systems internationally, adaptable to national professional standards and contextual requirements.

The study highlights the optimal benefits of the qualification application process and supports the teacher's professional development through it. The teacher feels more confident and trusts the accuracy of their self-analysis, has an overview of how far and which competencies have already been assessed, receives a visual overview of their competencies, on the basis of which goals can be set for further professional development, and can submit an application for a qualification directly from the *Kutsepeegel* environment. *Kutsepeegel* significantly simplifies the qualification application process, saving time and resources (both the applicant's and the assessors'). The digital application requires further improvement and development to enhance efficiency and maximize its usefulness.

The application incorporates the Estonian Qualifications Framework and the teacher standards, which are valid until September 2025 (Teacher level 7, Senior Teacher level 7, and Master Teacher level 8). It is designed to authenticate users via ID-card, Mobile-ID, Smart-ID, and the state TARA service, with HarID serving as the education identity. This alignment enhances trust, reduces the workload of assessors (e.g., background verification), and facilitates national scale-up across both general and vocational education. Notably, Estonia updated teacher standards in 2025; Kutsepeegel's architecture can track and reflect those changes without disrupting teachers' evidence records (EstQF, 2025).

Kutsepeegel delivers four high-impact affordances: (1) a visual dashboard (rose diagram) that renders performance indicators as interpretable progress; (2) guided self-assessment using I-form statements derived from Estonia's qualification standards; (3) secure evidence management with both uploads and links (plus options to integrate protected/public sources); and (4) collaborative review (principal/colleague co-feedback and in-app assessor comments). Evidence-based decision-making is supported by transparent indicators and structured

artefacts; users reported better calibration of self-judgments and clearer goal-setting for professional development. These findings align with research indicating that targeted, dialogic feedback and analytics-informed views can enhance reflective practice and inform subsequent steps (Cavaleri et al., 2019).

5.4. Limitations and future research

Although data collection through interviews enabled a detailed analysis of respondents' perceptions, assessments, and expectations, recruiting a sufficient number of interviewees proved challenging. The first study focused on applicants for higher professional qualifications; therefore, the findings may not fully reflect the views of applicants for level 7 professional qualifications or non-professional teachers. Given the complexity of teachers' professional development, the opinions and suggestions of the target groups do not allow for broad generalizations about professional standards or qualification practices. Moreover, the sample consisted of individuals who had already applied for a qualification and possessed a relatively high level of professional certification. Despite these limitations, the study provided an overview of different target groups' perspectives on the current professional qualification system and the application process. Another limitation is that neither e-portfolios nor evidence-based self-assessment (in *Kutsepeege*l) fully demonstrate teacher competence, while in the case of the written approach, self-assessment still depends on the teacher's good self-expression and literacy skills.

The second study examined teachers who were already in the process of applying for a professional qualification, which may limit the generalizability of the results to senior teachers or non-professional teachers. Nevertheless, it offers insight into the expected benefits of the *Kutsepeegel* application in supporting in-service training and professional qualification processes across different target groups. Future research should include both practicing teachers and those at earlier stages of qualification, in order to clarify expectations regarding *Kutsepeegel's* role in supporting in-service training and professional qualifications, as well as its perceived benefits in these contexts.

In the third study, recruiting interviewees who met the selection criteria was again difficult. However, individual interviews with representatives of different target groups enabled a detailed analysis of their assessments. At the same time, participating teachers tended to focus primarily on evaluating the user interface rather than providing feedback related to professional development and the qualification process, which limited the conclusions that could be drawn. Nevertheless, the study provided useful insights into the perceived usability and potential value of *Kutsepeegel*.

Several broader limitations should also be noted. The studies relied on small, criterion-based samples and short-term use of the digital application, and therefore do not provide evidence of long-term impacts on teachers' professional development or school-level outcomes. In addition, the application remains a

prototype that has not yet been fully developed due to resource constraints. Key functionalities – such as xAPI capability, the assessor module, and integration with external professional environments – have not been fully implemented. The *Kutsepeegel* interface also requires further development, including language-selection options and improved interoperability.

Another limitation concerns the absence of artificial intelligence functionality. AI could potentially support users by providing formative feedback and mentor-like guidance to qualification applicants. However, due to limited resources, this functionality has not yet been implemented. This gap represents an important direction for further development, alongside the design and testing of the assessor module and system integrations.

From a research perspective, future development should include longitudinal, mixed-methods studies examining the impact of the application on professional development and qualification outcomes. In addition, the responsible integration of artificial intelligence – ensuring transparency, bias awareness, and explainability – should be explored to enable automated micro-feedback and recommendations for subsequent developmental steps during self-assessment (Sailer et al., 2023).

One limitation of this study and of the *Kutsepeegel* application is that professional development is examined primarily through the lens of standards-based self-assessment and evidence-based qualification processes. While this approach supports the articulation of development goals, structures reflection, and makes competencies more visible, it does not fully capture the informal, relational, emotional, and context-dependent dimensions of professional learning, nor the broader dynamics of professional identity formation. The findings should therefore be interpreted with the understanding that *Kutsepeegel* supports certain, primarily formalised and standards-related, aspects of professional development, but does not represent the full complexity or holistic nature of teachers' professional growth.

Despite these limitations, the studies provide valuable insights into how different target groups perceive the functionality and potential benefits of the *Kutsepeegel* in identifying teachers' professional development needs and supporting the qualification application process.

6. CONCLUSIONS AND IMPLICATIONS

6.1. Conclusions

This thesis examines how standards-informed professional self-assessment, supported by the learning analytics application *Kutsepeegel*, contributes to teacher professionalism and professional development. The study is grounded in the premise that teachers are central to educational quality, yet their professional growth is often difficult to sustain and demonstrate under contemporary pressures such as accountability demands, teacher shortages, evolving pedagogies, and rapid technological change. In response, the research aimed to design and evaluate a digital tool that supports systematic self-assessment, evidence collection, and qualification processes aligned with professional standards, including the Estonian and European Qualification Frameworks.

The theoretical foundation of the dissertation conceptualises teacher professionalism as a historically contingent, multi-layered, and continuously negotiated construct (Hargreaves, 2000; Evans, 2008; Wermke & Höstfält, 2014). Professional development is understood as the central mechanism through which professionalism is enacted and renewed (European Council, 2009; Snoek, 2011). Professional standards can provide coherence and shared reference points for development (Ingvarson, 2010), but their effectiveness depends on formative and context-sensitive use that supports professional judgment rather than compliance (Sachs, 2005; OECD, 2020). The "teacher as learning professional" perspective further emphasises reflective practice, ethical commitment, and collaborative learning within professional communities (Simons & Ruijters, 2014; Hargreaves & O'Connor, 2018).

Empirically, the thesis reports three studies that guided the design and evaluation of Kutsepeegel. Together, they demonstrate that existing qualification processes were perceived as fragmented, difficult to interpret, and administratively demanding. The first study identified structural and interpretive challenges in qualification standards and processes, highlighting the need for a secure and guided standards-based environment.

The second study translated stakeholder needs into functional design requirements, including structured self-assessment, evidence management, progress tracking, and visual competence feedback. The third study confirmed that the resulting application improves the quality of self-analysis, supports the identification of developmental needs, reduces administrative burden, and enhances dialogue between teachers and assessors. These findings align with research showing that learning analytics tools are most effective when they provide actionable feedback and support professional workflows rather than merely descriptive data visualisations (Susnjak, 2022).

Across the three studies, several key empirical findings emerged. First, qualification processes require stronger structural and interpretive support: teachers and assessors experienced standards as difficult to interpret consistently and

documentation procedures as fragmented, creating demand for a secure, standards-aligned digital environment that supports structured self-analysis and evidence collection. Second, guided standards-based self-assessment improves professional reflection: Kutsepeegel enhanced the clarity and consistency of standards interpretation and supported deeper, more systematic self-analysis, enabling teachers to identify competence gaps and developmental priorities more effectively. Third, learning analytics strengthens evidence-based professional development: visualised competence feedback and structured progress tracking helped teachers translate reflection into actionable development planning. Fourth, administrative and procedural efficiency improved: the application reduced administrative workload, consolidated documentation, and streamlined qualification workflows, making evidence management more systematic and transparent. Fifth, professional dialogue was enhanced: digital collaboration features improved communication between teachers and assessors, supporting more constructive, feedback-oriented interactions. Finally, the findings indicate that learning analytics can support professional learning rather than surveillance when implemented in a formative and ethically grounded manner that strengthens teacher agency.

The design of Kutsepeegel integrates learning analytics frameworks (Greller & Drachsler, 2012; Chatti et al., 2012) with the learning professional perspective (Simons & Ruijters, 2014 and Pedaste et.al., 2019). By combining structured self-assessment, visualised feedback, and collaborative interaction, the application consolidates evidence, clarifies expectations, and makes professional reflection more understandable and dialogical. As a result, teachers and assessors can move from fragmented documentation toward sustained, reflective professional development anchored in professional standards but responsive to individual learning trajectories.

Overall, the findings demonstrate that standards-informed digital self-assessment supported by learning analytics strengthens teacher professionalism by improving standards interpretation, enhancing reflective self-analysis, supporting evidence-based professional development planning, reducing administrative workload, and strengthening professional dialogue. Importantly, the study shows that when ethically designed and organisationally supported, learning analytics can function as a tool for professional learning rather than surveillance (OECD, 2022).

At the same time, the research identifies important conditions for wider implementation. Realising the full potential of such systems requires not only technical refinement and interoperability but also organisational commitments to time, trust, privacy, and teacher agency. The current prototype lacks full system integrations, AI-supported formative feedback, and long-term evaluation. Future research should therefore include longitudinal studies of professional growth, further development of system functionality, and the responsible integration of explainable and bias-aware artificial intelligence to support formative feedback (Sailer et al., 2023).

In conclusion, the thesis demonstrates that standards-informed professional self-assessment supported by learning analytics can meaningfully strengthen teacher development by making professional reflection structured, evidence-based, and dialogical. Kutsepeegel provides a research-based, stakeholder-validated digital application that supports self-monitoring, competence feedback, and evidence-based qualification processes. As a nationally contextualised proof of concept, it offers a transferable model for responsibly linking learning analytics with professional standards to support reflective and evidence-based teacher professionalism at scale (Greller & Drachsler, 2012).

Therefore, this thesis makes an original contribution to knowledge by demonstrating, both conceptually and empirically, how professional standards, learning analytics, and reflective practice can be systematically integrated into a coherent digital infrastructure that supports teachers as self-directed professional learners. It develops and validates a novel model of standards-informed, analytics-supported professional learning, showing how professional standards can be transformed from static regulatory frameworks into dynamic learning resources through structured self-assessment, evidence integration, and actionable feedback.

The research extends the theoretical and practical boundaries of learning analytics by establishing its applicability beyond student learning to workplace-embedded professional development, and by showing that analytics systems can enhance professional agency, reflection, and developmental decision-making when designed for formative use. Through the design, implementation, and evaluation of Kutsepeegel in an authentic qualification context, the study provides the first empirically grounded demonstration of how learning analytics can operationalise professional standards in ways that simultaneously improve interpretive clarity, reflective depth, and procedural coherence.

By producing a validated digital model that links standards, evidence, feedback, and professional dialogue within real qualification processes, the thesis offers a transferable framework for re-designing professional development systems as learning-centred rather than compliance-centred environments. In doing so, it establishes a new conceptual and applied foundation for understanding how digital technologies can mediate and strengthen teacher professionalism at scale.

The thesis achieves its goal: it delivers a research-based, standards-aligned, and stakeholder-approved digital application that strengthens teachers' self-analysis and self-monitoring, provides visual, interpretable feedback on competencies, streamlines evidence-based qualification applications, and helps teachers plan their professional development with clarity. As a nationally contextualized proof-of-concept, *Kutsepeegel* also offers a transferable blueprint for other systems seeking to connect learning analytics with professional standards to responsibly enhance teacher professionalism at scale (Greller & Drachsler, 2012).

The LA applied in this thesis is primarily descriptive and diagnostic. The *Kutsepeegel* collects and structures teachers' self-assessments, evidence, and feedback from collaborators and links them to performance indicators of professional standards. Data processing is not based on complex predictive models or

machine learning, but on rule-based relationships between standards, self-assessment statements, and visual feedback. The focus is on meaningful data presentation and decision-making support, not on automated prediction or risk profiling.

6.2. Implications

Anchored in a pragmatic paradigm and enacted through a single-cycle design-based research programme, this thesis yields implications at five levels: theory, methodology, design, practice (teachers, schools, and assessors), and policy/system. Together, they articulate how a standards-aligned, learning analytics–enabled application (*Kutsepeegel*) can strengthen teacher professionalism and streamline qualification processes in Estonia, and by adaptation, elsewhere.

6.2.1. Implications for theory and method

Taken together, the findings advance a conception of teacher professionalism that integrates reflective judgement with evidence stewardship, and they demonstrate how such professionalism can be both theoretically grounded and methodologically operationalised. By translating professional standards into interpretable statements and formative visual feedback, the study shows how standards can function as learning-oriented instruments that guide judgement, reflection, and growth, rather than merely as summative tools for performance auditing. This elaborates "teacher as learning professional" models by specifying the mediating role of artefacts, curated evidence portfolios, and analytics, iterative feedback loops, in everyday professional learning practices.

The synthesis of learning analytics dimensions (stakeholders, objectives, data, and instruments) with national professional standards yields a workable theory of professional learning analytics: analytics designed explicitly to scaffold self-assessment, surface competence gaps, and support dialogic feedback among teachers, peers, leaders, and assessors. In contrast to critiques that dashboards often lack metacognitive affordances, the present design demonstrates how visualisations can be productively coupled with process scaffolds and collaborative commentary to support sense-making, reflection, and professional dialogue. Importantly, the observed shift from primarily intrinsic motivations toward a hybrid motivational ecology, where extrinsic drivers such as employer expectations gain salience, reframes standards-based advancement as neither purely self-directed nor purely compliance-driven. Qualification systems must therefore balance the protection of reflective space and professional agency with process designs that reduce friction for externally prompted applicants.

Methodologically, the study shows that even a single, tightly scoped design-based research iteration can generate actionable design knowledge when structured around early phenomenological inquiry into lived tensions, co-specification of requirements across stakeholder groups, and participatory user experience evaluation of a functional prototype. This sequencing is particularly appropriate

for public-sector innovation contexts, where ethical, legal, and organisational constraints, such as data protection, procurement rules, and workload pressures, are non-negotiable and must be addressed from the outset rather than retrofitted.

Inductive content analysis proved effective in deriving concrete design requirements from standards-related discourse, demonstrating how abstract professional language can be translated into system features and interactional supports. Future research can extend this approach by integrating trace data, such as usage logs or longitudinal portfolio development, to create mixed-methods designs that connect subjective experience, artefact quality, and analytic indicators of professional growth. Finally, the findings underscore the importance of treating privacy, consent, and role-based access as core functional requirements. Architecting ethical safeguards, such as teacher-controlled sharing and authenticated access, into the system design not only ensures legal compliance but also fosters trust and uptake, reinforcing the viability of analytics-supported professional learning in regulated educational environments.

6.2.2. Design implications for *Kutsepeegel* and similar tools

Translating performance indicators into clear "I-form statements" reduce interpretive load and supports consistent self-assessment. Maintaining a versioned, provenance-tracked statement bank will be essential as standards evolve. A rose diagram (or comparable competency map) is most useful when it is directly traceable to standards, paired with textual rationales and exemplar evidence, and connected to next-step recommendations (e.g., suggested artefacts, micro-goals, peer review prompts).

Evidence upload must be coupled with lightweight templating (i.e., why this artifact, which indicator, and what impact) and support for links to authentic digital traces. This yields portfolios that are evaluable and learning-oriented. Built-in roles for colleagues, leaders, and assessors (commenting, questions, endorsements) transform a traditionally solitary task into a structured professional dialogue without compromising the teacher's narrative control.

The capacity to accumulate self-analyses and evidence across years supports re-application cycles, reduces administrative burden, and enables teachers to see growth trajectories, not just snapshots. Clear instructions, progressive disclosure of complexity, and the ability to pause and resume are not conveniences; they are prerequisites for adoption in high-workload contexts.

6.2.3. Practical, Policy, and System implications

At the level of professional practice, the findings indicate that statement-guided reflection combined with visual feedback meaningfully enhances teachers' self-assessment processes. By reducing ambiguity in standards interpretation and supporting more accurate calibration of professional judgement, these mechanisms enable teachers to prepare stronger, more coherent qualification dossiers.

Beyond immediate qualification outcomes, the process contributes to the development of a strengthened professional identity: the mapping, discussion, and endorsement of competencies by peers and assessors foster self-efficacy and render professional growth visible and recognisable. Sustained engagement with evidence curation further cultivates portfolio literacy as a digital professional competence, equipping teachers with transferable skills in documenting, interpreting, and communicating their practice across contexts. Thus, the *Kutsepeegel* acts as a professional development tool that supports reflective practice and informed career planning.

For school leaders, the approach supports development-oriented leadership practices by providing access to aggregated, teacher-controlled views that can inform professional dialogue, mentoring arrangements, and continuing professional development (CPD) planning without reducing analytics to instruments of surveillance. The availability of structured endorsements and narrative feedback also establishes a recognition infrastructure that addresses widely reported experiences of insufficient organisational acknowledgement among teachers, thereby reinforcing motivation and professional commitment.

For assessors and assessment committees, the integration of standards-aligned evidence, teacher-authored rationales, and targeted visualisations improves evaluative efficiency by shifting attention away from time-intensive evidence discovery toward professional judgement and deliberation. Shared interpretive scaffolds promote consistency and fairness by reducing subjective variation in the application of criteria and supporting the harmonisation of expectations across panels, particularly in distributed or multi-institutional assessment settings.

At the policy and system level, the study suggests that national teacher standards gain practical legitimacy when they are enacted through supportive digital tools that facilitate interpretation, reduce administrative burden, and embed feedback within the qualification process itself. In the Estonian context, systems such as Kutsepeegel can be positioned as an optional yet institutionally endorsed pathway for reflective, evidence-based professional qualification. Secure and scalable implementation requires formal integration with national e-identification infrastructure, alongside clearly defined data retention policies, guarantees of artefact portability under teacher ownership, and institutional agreements governing role-based access.

System-level CPD provision can be further strengthened by aligning offerings with competency gaps identified through learning analytics, enabling targeted, just-in-time learning opportunities and addressing the limitations of uniform, supply-driven training models. At the same time, policy frameworks must ensure protected time for portfolio development, establish safeguards against high-stakes or punitive uses of analytics, and provide targeted support for schools with limited digital capacity to avoid the amplification of existing inequalities. Finally, sustained investment in open technical standards, such as shared metadata schemas for professional artefacts and API connections to CPD systems, will reduce integration costs and enhance the transferability of the approach across educational sectors, including both general and vocational education.

I confirm that I have prepared this thesis myself and have correctly cited the contributions of other authors and supporters. The thesis has been prepared based on the requirements for the thesis of the Department of Educational Sciences of the University of Tartu and is in accordance with good academic practices.

Applications of generative AI have been used for language proofreading.

Tiiu Leibur / digitally signed /
26.03.2026

APPENDICES

Appendix A
Interview questions (Study I)

RQ		Interview questions	
	Applicant for the profession	Professional assessor	Developer of professional standards
1. How do target groups perceive shortcomings in current PS and professional application procedures?	1. Where did you get the previous information about applying for the invitation? 2. How do you rate the overview of the evaluation criteria (excessive, lacking)? 3. Did you have any disagreements during the appraisal interview? 4. How do you evaluate the process, do you have any suggestions? 5. Are you satisfied/unsatisfied with the application process?	1. How do you assess a teacher's ability/skill to choose a suitable professional standard? 2. What do you think were the most difficult criteria for teacher self-evaluation? Why? 3. Was the overview of the teacher's qualification level sufficient? 4. What were the shortcomings of E-portfolio analysis? What could be the solution? 5. Were there any shortcomings in the interview i.e. professional exam? Solution? 6. Were there any disagreements between the committee members during the evaluation? Solutions?	1. Is a self-assessment overview of the teacher's level sufficient? 2. How does the (initial evaluations) work? 3. Were there any shortcomings in the application? 4. Were there any shortcomings in the work of the selection committee and what were they? 5. How does the work? Initial assessments of documents? 6. Were there any disagreements during the assessment (what were the solutions)?
2. What are the expectations and needs of the target groups for the current professional standards and the procedure for applying for the profession	6. How do you rate the documentation and fulfillment of the interview objectives? 7. How do you assess the professional standards and professional application process? 8. How did you perceive the purpose of the interview, was it based on assessment criteria and documentation? 9. How do you assess the application process?	7. How do you assess the overlap between the goals of documentation and conversation? 8. How did you perceive the purpose of the interview, was it based on assessment criteria and documentation? 9. How do you assess the standards of the profession and the application process?	7. How do you assess the prerequisites for applying to become a teacher? 8. How and on what documentation does the Vocational Committee work (final stage)?

Appendix B
Interview questions (Study II)

RQ 1. What are the needs and expectations of different target groups for the *Kutsepeegel* supporting the PD of teachers and applying for the profession?			
Interview questions			
Teachers currently applying for the profession	Teachers who have the profession	Professional assessors	Teachers who are involved in
1. Are the choice of professional level and criteria understandable? On what basis do you plan to choose the professional level? 2. Is compiling documentation and carrying out self-analysis difficult and time consuming? What would be the options for simplifying the process? 3. How do you gather the evidence? (you search the web, your computer, etc.) 4. How do you assess the evidence-gathering process? (any problems, what?) 5. Do you lack supportive material / technical aids while collecting documentation and writing a self-assessment? What specific support would you need? 6. Would a digital application that helps determine your compliance with PS competencies as an applicant and provide feedback help with self-assessment? 7. Would a digital application that could also collect various	1.Was the choice of professional level easy and the criteria easy to understand? What was the basis for choosing your professional level? 2. Was compiling the documentation and doing the self-analysis difficult and time consuming? What opportunities could be found to simplify this process? 3. How did you gather the evidence? (you searched the web, your computer, etc.) 4. How do you assess the evidence-gathering process? (problems?) 5. In which parts of the application process (excluding the interview) did you lack supportive material / application (help)? What specific support needs emerged? 6. Would a digital application that helps determine your compliance with PS competencies as an applicant and provide	1. Does the applicant always meet the requirements of the chosen level? 2. How content are you with the documentation provided by the applicants? 3. How much evidence must be provided? 4. Did the applicants provide sufficient and correct evidence-based material (links, files, photos, etc.)? 5. In which parts of the application process (excluding the interview) did you lack supportive material / application (help)? What specific support needs emerged? 6. Would a digital application to help determine the applicant's compliance with KS competencies and provide feedback be necessary? Why? 7. Would a digital application that could also collect various evidence-based data (from the web, Ehis, Juhan, e-school – maybe somewhere	1. Does the applicant always meet the requirements of the chosen level? 2. How satisfied are you with the documentation provided by the applicants? 3. How much evidence must be provided? 4. Did the applicants provide sufficient and correct evidence-based material (links, files, photos, etc.)? 5. In which parts of the application process (excluding the interview) did you lack supportive material/application (help)? What specific support needs emerged? 6. Would a digital application to help determine the applicant's compliance with PS competencies and provide feedback be necessary? Why? 7. Would a digital application that could also collect various evidence-based data (from the web, Ehis, Juhan, e-school – maybe somewhere else) be helpful to you as a developer PS? 8. What features should this digital application include? Why?

evidence-based data (from the web, Ehis, Juhan, e-school – maybe somewhere else) be helpful to you as an applicant? 8. What features should this digital application include? Why? 9. What kind of environment for self-analysis would you prefer? Public / Protected. Why? 10. What are your expectations for the digital application (features, how it works, data collection, feedback, etc.)	feedback help with self-assessment? 7. Would a digital application that could also collect various evidence-based data (from the web, Ehis, Juhan, e-school – maybe somewhere else) be helpful to you as an applicant? 8. What features should this digital application include? Why? 9. What kind of environment for self-analysis would you prefer? Public / Protected. Why? 10. What are your expectations for the digital application (features, how it works, data collection, feedback, etc.)	else) be helpful to... 1.you as an applicant? 2. you as an assessor? 8. What features should this digital application include? Why? 9. What kind of environment for self-analysis would you prefer? Public / Protected. Why? 10. What are your expectations for the digital application (features, how it works, data collection, feedback, etc.)?	9. What kind of environment for self-analysis would you prefer? Public /Protected. Why? 10. What are your expectations for the digital application (features, how it works, data collection, feedback, etc.)?
RQ2. Which should be the design and functionalities of the *Kutsepeegel* support the PD of the teacher and the application process?			
Interview questions			
11. What could you benefit from the digital application as a teacher about to apply for the profession? 12. How would the application support the PD of the teacher?	11. What could you benefit from the digital application as an applicant? 12. How would the application support the PD of the teacher?	11. Could the application also support the evaluation process? What information would the assessor need? 12. What could be the benefits of the application? (1st assessor, 2nd applicant)? 13. How would the application support the PD of the teacher?	11. Could the application also support the PS development process? What information would be needed? 12. What could be the benefits of the application for PS developers? 13. How would the application support the PD of the teacher?

Appendix C
Interview questions (Study III)

RQ1. How do different target groups (teachers and professional assessors) evaluate the effectiveness of the created digital application (*Kutsepeegel*) to get an overview of their professional developmental needs?

Interview questions		
Unqualified teachers	Qualified teachers	Professional assessors
1. How do you assess the protection/security of your self-assessment in the *Kutsepeegel* you offer?	1. How do you assess the protection/security of your self-assessment in the *Kutsepeegel* you offer?	1. As a professional assessor, how do you assess the possibility of teacher self-analysis in a protected/safe environment?
2. Whether and how did the structure given by the application support the process of self-analysis?	2. Whether and how did the structure given by the application support the process of self-analysis?	2. Whether and how did the structure given by the application support the process of self-analysis?
3. How do you evaluate the evidence-based inclusion capabilities (file inclusion/automatic data collection)?	3. How do you evaluate the evidence-based inclusion capabilities (file inclusion / automatic data collection)?	3. As a professional assessor, how do you assess the possibilities of evidence-based inclusion (file inclusion / automatic data collection)?
4. How do you evaluate the support provided to teachers during self-assessment (guidelines, additional reading, statements based on professional standards, feedback, progress bar)?	4. How do you evaluate the support provided by the application to the teacher during the self-assessment process (instructions, supplementary reading, statements based on professional standards, feedback, progress bar)?	4. How do you rate the support provided by the application to the teacher during the self-assessment process (instructions, supplementary reading, statements based on professional standards, feedback, progress bar)?
5. How do you evaluate the visual desktop provided by the application? Were your developmental needs identified?	5. How do you evaluate the visual desktop provided by the application? Were your developmental needs identified?	5. How do you assess the usefulness of the visual desktop? Did you get an overview of the developmental needs of the candidates who applied for the qualification?
6. How do you evaluate the feedback, to what extent did it clearly express areas of competence that need self-improvement?	6. How do you evaluate the feedback, to what extent did it clearly express areas of competence that need self-improvement?	6. How do you evaluate the feedback, how clearly did the applicants' qualifications reflect the areas of competence that require self-improvement?
7. How do you evaluate the support provided by the application during the self-assessment process (instructions, additional reading, statements based on professional standards, feedback, etc.)?	7. How do you evaluate the support provided by the application during the self-assessment process (instructions, additional reading, statements based on professional standards, feedback, etc.)?	7. How do you evaluate the support offered by the application to the teacher during the self-assessment process (instructions, supplementary reading, statements based on professional standards, feedback, etc.)?
8. How do you evaluate the opportunity to share your self-assessment with an employer/colleague/professional assessor?	8. How do you evaluate the opportunity to share your self-assessment with an	

9. How do you evaluate the ability to store your self-analysis in the app? Does and how does it support your professional development? 10. How would you characterize the time factor, use, understandability, and outcome when conducting a self-analysis and applying for a qualification? 12. How do you evaluate the support provided by the digital application to your further professional development? 10. Did and how did the application support you in the application process?	employer/colleague/professional assessor? 9. How do you evaluate the ability to store your self-analysis in the app? Does and how does it support your professional development? 10. How do you characterize the time factor, usage, comprehensibility and result compared to the previously completed invitation application process? 11. Did and how did the application support you in the application process? 12. How do you evaluate the support provided by the digital application to your further professional development?	8. How do you evaluate the opportunity to share the self-analysis with the colleague/employer/ professional assessor? 9. How do you assess the possibility of storing teachers' self-analysis in the *Kutsepeegel* application? Does and how does it support their professional develop-ment? 10. How do you characterize the time factor, usage, comprehensibility, and outcome compared to the evaluation process of the invitation application that took place previously? 11. How did the application support applicant's in the invitation application process? 12. How do you assess the support provided by the digital application for the further professional development of applicants?

Appendix D
The code trees of the data analysis

Study	Research question	Categories	Codes
Study I	*RQ1. What shortcomings do different target groups perceive in the current professional standards and application process?*	1. Perceptions of deficiencies while interpreting the PS	comprehending PS, complex wording of the PS, complex performance indicators, complexity of assessing one's competencies
		2. Shortcomings in the first stage of the application process (e-portfolio and self-analysis)	shortcomings in creating an e-portfolio low self-analysis skills
		3. Evidence-related shortcomings	lack of IT skills and video material
		4. Shortcomings in the second stage of the application process (discussion/interview)	shortcomings in interview content feedback
		5. Shortcomings in the third stage of the application process (decision by the Vocational Assessment Committee)	time limit
	RQ2. What are the expectations and needs of different target groups regarding professional standards and application procedures?	1. Expectations and needs for the first stage of the application process (e-portfolio and self-analysis)	professional standards performance indicators e-portfolio, self-analysis, collaboration
		2. Expectations and needs for the second stage of the application process	relevance necessity feedback expectation for the interview
Study II	*RQ3. What are the needs and expectations of different target groups regarding the digital application Kutsepeegel in supporting teachers' professional development and application for the qualification?* *RQ4: Which should be the design and functionalities of the TAPP support the PD of the teacher and the application process?*	1. Core functions	security and access self-analysis /compliance PS; structure; length/ data collection /degree of evidence/ feedback
		2. Supportive functions	dashboard progress bar

Study	Research question	Categories	Codes
Study III	*RQ5: How do teachers and professional assessors evaluate the usefulness and effectiveness of the digital application in supporting their professional development and identifying their professional developmental needs when applying for a qualification?*	1. protected environment	
		2. supported self-analysis process	supporting compliance with PS performance indicators effectiveness of the self-analysis structure effectiveness of guidelines for self-assessment supporting self-assessment and qualification application process with a progress bar
		3. supported data collection	
		4. data collection support and efficiency	
		5. feedback effectiveness	
		6. developmental needs	identifying needs effectiveness of self-assessment data use

Appendix E
Study I findings (1) illustrated with quotes from participants

Findings of the first research question – How do target groups perceive shortcomings in current PS and professional application procedures? of Study I illustrated with quotes from participants

Study 1 finding	**Target group**	**Illustrative quotes**
Shortcomings		
A lack and unambiguous interpretation of PS	All target groups	*"And when I first applied, I realized that I still couldn't read the document. Look, here's the tricky bit that teachers stumble on. They cannot understand what the document actually says..."* *"To be honest, it doesn't make it easy for a teacher – the language contains too much jargon"* *"PS difficult to understand due to the complex wording (A, C) and the large number of repetitions"*
Difficulties choosing the level of professional qualification	All target groups	"*I started to write a self-analysis based on the professional standard for Senior teacher 7. It seemed that level 6 was too low for me, there was no point in applying for it, maybe for a young teacher – it didn't appeal to me at all. I thought about choosing level 7, but it seemed that I deserved a higher level. At the same time, it seemed that I didn't have enough competencies to apply for the Senior teacher level."*
The evidence-based nature of performance indicators is difficult to prove	Assessors and teachers	*"Proving my activities was a real challenge: how to prove it? Is it necessary to include photos or evidence, and how?"*
The e-portfolio does not provide a complete overview of competencies	Assessors and developer of PS	*"some teachers are not good writers, some teachers are able to write loads about nothing"* *"...e-portfolios are different, some are more scientific; others in essay form – which make it difficult to find the important points in them."*
Weak self-analysis skills	Assessors and developer of PS	*"...so that applying teachers would be more capable of analysing their work and not rely on their gut feeling"* *"The most difficult thing in self-analysis is to identify the areas in myself that I can contribute to the life of the school or community"*
A lack of recognition of the teacher's work by the school management	Applicants and assessors	*"... mandatory school support, school-based analysis might be necessary. Let's say a person (headteacher) who has attended the classes, their letter of recommendation."*

Study 1 finding	**Target group**	**Illustrative quotes**
Applicants do not know what is expected of them in the interview	Applicants and assessors	*"Later, I realized that I was stuck in too much detail, I should have seen the bigger picture. I should have brought out scientifically sound or my own views, but I was just stuck in details..."*
There are no uniform requirements for the structure and conduct of the interview	Assessors	*"I didn't understand exactly what to write and where. It seemed like there was a lot of repetition."*
The quality of the feedback from the professional assessors to the applicant	Developer of PS	*"It would be necessary to highlight those strengths and the specific competences that need to be developed from the point of view of the applicants so that they not only receive the analysis but also receive a meaningful assessment."*

Appendix F
Study I findings (2) illustrated with quotes from participants

Findings of the second research question – *What are the expectations and needs of different target groups regarding professional standards and application procedures?* of Study I illustrated with quotes from participants

Study 1 finding	**Target group**	**Illustrative quotes**
Expectations and needs		
Improving the wording of the PS performance indicators	All target groups	*"It is necessary to remove repetitions, as they are truly misleading when the focus shifts."*
E-portfoolio structure	All target groups	*"The teacher's own experience is what is most important, theory is to confirm this. Not that you have a lot of theory and two sentences about yourself."*
Support for developing teachers' self-analysis skills	All target groups	*"... video lesson should be recorded or a member of the committee would come to watch your lesson or talk to you beforehand. I imagine that it would help a lot in terms of self-analysis."* *"...so that applying teachers would be more capable of analyzing their work and not rely on their gut feeling" (A3)*
Proving the evidence-based nature of performance indicators	Assessors and teachers	*"It doesn't have to be a 45-minute video, it could be one chosen clip I might like and another where I feel like I've failed as a teacher. It could be inside in the e-portfolio because it makes you analyze yourself. Otherwise, this self-analysis would remain very superficial."*
The interview reveals the applicant's personality traits and provides a more thorough overview of the applicant's professionalism and competence	Assessors and developer of PS	*"...face-to-face with the applicant to assure that everything in their digital portfolio and everything they have provided in answer to our supplementary questions is very good; that they are doing a good and necessary job and they do not have to underestimate themselves, even if they may not have the school feedback on their work, which can occasionally happen"..."*
Increase the scope of self-analysis (by supporting the development of various competences)	Assessors and developer of PS	*"So that this were not just a statement of what this teacher is doing, but this conversation would really highlight the strengths of the teachers and the points that need improvement. So, it would not be just another self-analysis but also an assessment of the activities they really excell at."*

Study 1 finding	**Target group**	**Illustrative quotes**
Put into use a letter of recommendation from the school management	Applicants and assessors	*"...as the teacher's professionalism does not only come from teaching, it is also thanks to cooperation with..."*
Standardize the content of the interview	Applicants and assessors	*"The basic issues of the conversations could also be standardized"*
Harmonizing the main points and structure of the interview	Assessors	*"We have some basic questions we ask during the interview. Training sessions have also been organized on the topics of the interview. There could be more training, as the committees now have very different working arrangements"*
The quality of the feedback provided, which should support applicants' self-esteem and self-development needs, highlight the best results and motivate applicants to develop further	Developer of PS Applicants	*"... the need to indicate those competencies that are scarce or would like to be questioned and clarified..."* *"Feedback should motivate me as a teacher. At the same time, it should be constructive and honest"*

Appendix G
Study II findings illustrated with quotes from participants

Findings of the third research question – *What are the needs and expectations of different target groups regarding the digital application Kutsepeegel in supporting teachers' professional development and application for the profession?* And Findings of the fourth research question – *What should be the design and functionalities of Kutsepeegel to support teachers' professional development and the application process?* of Study II illustrated with quotes from participants. The analysis of data for both research questions had the same subdivision.

Study II finding	**Target group**	**Illustrative quotes (third RQ)**	**Illustrative quotes (fourth RQ)**
Private, log in environment	All teachers and assessors	*"It should definitely be a protected environment – because there is my specific data, it is my self-analysis. What you want to exhibit, your materials or ... that would be the web version. But specific information about the teacher, it should be personal, accessible with personal identification code only."* *"My documentation should be collected in my own personal system, on the basis of which I can make my self-analysis."*	*"It would be very good, in this case all things in one place private environment. No need to surf in different environments. Also, the explicitness and clarity."*
Self-analysis based on professional standards perfomance indicators, to which recommend-dations have been added in the system	All target groups	*Self-assessment with the help of the application – is a supporter of the teacher's professionalism. It does not let you get bogged down in any performance criteria, you are forced to write a self-assessment within the framework of the application's self-assessment questionnaire. People get tired, but this application would not let them get tired."*	*"...the self-assessment based on performance indicators would be the supported analysis."*
Specific performance indicators are expected accompanied by recommendations for self-assessment. A form that supports length and structure is expected	All teachers All target groups	*...the maximum volume of self-analysis, how long I will write on this topic. And maybe some of these questions should be multiple-choice (yes/no) or there will be a system of boxes where I can enter my analysis."*	*"The self-assessment form in use and the analysis based on it help to maintain the structure of perfor-mance indicators for professional stan-dards."* *"... it is not necessary to write for the sake of*

Study II finding	**Target group**	**Illustrative quotes (third RQ)**	**Illustrative quotes (fourth RQ)**
		"It's a long way from wall to wall, there could be some kind of minimum and maximum somewhere, so some kind of intelligent limit should be set."	*writing, but make sure 1.I have assessed myself; 2. these are my evidence documents; 3. I have my self-analysis added to the perfor-mance indicators."*
PS perfomed based analysis, automatic feedback-determines the level of the qualification	All teachers	*"...so that the system would provide either visual or percentage feedback, based on which I could determine the qualification level."*	*"Such self-analysis would show me where I am, what I am missing and where I need to go. It's the kind of impartial machinery I wouldn't be angry at. I may be offended by a person, but if the Kutsepeegel tells me what the situation is, there is no point in arguing."*
System-based data collection (protected environments and open web)	All focus groups	*"The system collects all kinds of links and evidence-based materials – and then you just submit it."*	
Evidence-based Possibility to upload files (letters of recommendation, CV and etc)	All focus groups Assessors focus group	*"So that it would be possible to add your own description or analysis and evidence-based facts or documents to the statements described in the Professional Standards Performance Indicator, which would be stored in the application environment and accessible if necessary."* *"Evidence-based – this is very important. The teacher claims to do it, but has no documentation that he actually does it."*	*"Evidence-based is very important. Teachers claim that they do something, but have no documents to prove it."* *"... Kutsepeegel allows concreteness, evidence based, description is also a proof."*
Feedback for each level of the professional application process	All target groups	*"And then there would be an overview, for example, a colored line running next to it – that's how much you still need, how much you haven't done and has turned green – it's already been filled"*	*"The progress bar shows the performance of the activities. It shows how many activities have been performed, how much more needs to be done – provides an overview of the necessary documentation. It would help the applicant a lot."*

Study II finding	Target group	Illustrative quotes (third RQ)	Illustrative quotes (fourth RQ)
			"The feedback gives me support as to whether I am on the right track, what competencies I could still develop."
Feedback from the school, and from the professional assessors with guidelines for further self-development	All target groups	*"I look forward to feedback that high-lights my strengths and also indicates my further development needs."*	*"The feedback supports teachers and gives them more confidence."*

Appendix H
Study III findings illustrated with quotes from participants

Findings of the fifth research question – *How do teachers and professional assessors evaluate the usefulness and effectiveness of the digital application in supporting their professional development and identifying their professional developmental needs when applying for a qualification?* of Study III illustrated with quotes from participants

Study III finding	**Target group**	**Illustrative quotes**
A secure environment that is tied to the teacher's educational institution and requires authentication to log in	All target groups	
The *Kutsepeegel* allows for suggestions and feedback from colleagues, school leaders, and evaluators.	All target groups	*"The opportunity to share self-analysis with an assessor is great. This functionality simplifies the work of both the applicant and the assessor. At the same time, the assessor can give their own recommendations."*
Kutsepeegel supports teacher's professional development path	Teachers ans assessors	*"I find that the TAPP definitely supports the qualification application process. It also simplifies the understanding of what level the teacher is and what they do."* *"I have done self-analyses over the years. I can look at my professional development path and analyze my previous self-analyses and set new goals for further development according to the identified development needs."*
The opportunity to set your future development goals based on identified development needs	All teachers	*"I have done self-analyses over the years. I can look at my professional development path and analyze my previous self-analyses and set new goals for further development according to the identified development needs."*
Kutsepeegel makes the self-analysis process understandable and simple	Teachers and assessors	*"Teachers often have trouble reading the professional standard and making sense of it. The Kutsepeegel offers the applicant simply and comprehensibly explained competencies, to understand what is expected of the teacher."*
It was found that due to the complexity of the process, any guiding instructions for the teacher will certainly be useful	All target groups	*"It is one of the most necessary tools for analysis. Our teachers are of very different levels: there are teachers who are used to constantly reflecting on themselves and those who do not understand what they must do at all. The more guidelines, the better."*
The opportunity to make your own choices based on the collected data, what to include in the self-analysis or not, was highly appreciated.		*"The application collects my evidence-based material (for real verification of the performance indicators) from both profession-related environments and the open web. All that remains for me is to choose what I want to add and what not."*

Study III finding	**Target group**	**Illustrative quotes**
Automated visual feedback	All teachers	*"Such functionality is very helpful for a person doing self-analysis. I get encouraged, and the visual of my competencies gives me accurate feedback and possibly raises my self-esteem."*
Progressive and supportive feedback from assessors	Assessors	*"The applicant receives adequate information about what they lack professionally. They get an overview of what they should do, in which direction to develop. They also see what their strengths are."*
Kutsepeegl ability to highlight a teacher's strengths and development needs	All target groups	*...it is important to follow the rose diagram and verbal explanation of your choice. As a self-assessment tool, the app is very, very good.*

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SUMMARY

The doctoral thesis is based on the conceptual design, development, and evaluation of the digital application *Kutspeegel*. *Kutspeegel* is a digital application that uses learning analytics to support teachers' professional self-assessment, development, and qualification in line with Estonian and European professional standards. Drawing on the learning analytics framework and the learning professional model, the study aims to make self-assessment more structured, meaningful, and dialogical, while strengthening evidence-based professional learning.

Derived from three interrelated studies, the study identified key challenges in existing qualification procedures, including difficulties in selecting appropriate qualification levels, inconsistent interpretation of standards, and the complexity of evidence collection. Teachers often reported uncertainty in assessing their competencies and limited self-reflection skills. Stakeholders also highlighted the importance of video-based lesson analysis and the involvement of school leaders to make the qualification process more collaborative and formative.

In light of these findings, *Kutspeegel* was created to support reflective practice, self-regulation, and evidence collection. The tool is structured around four main functional areas: self-assessment monitoring and progress visualization, development needs identification, competency alignment with standards, and evidence management. The dashboard provides a visual competency profile and enables secure authentication, evidence upload, and shared feedback between teachers, school leaders, and assessors.

The final study evaluated the usability and impact of the *Kutsepeegel*. The results showed that the tool improved teachers' reflective thinking, improved their ability to gather evidence, and increased their readiness to apply for qualifications. Teachers appreciated the clear instructions, visual summaries, and feedback mechanisms, while assessors noted greater consistency, transparency, and efficiency. The secure environment was also considered more reliable than previous portfolio systems.

Overall, the thesis shows that the *Kutsepeegel* strengthens reflective and evidence-based practice, reduces administrative burdens, promotes professional autonomy and confidence, and improves communication between teachers and assessors. The tool is well aligned with national and European policy priorities and provides a solid foundation for school-based qualification processes. Future directions include exploring long-term impacts, incorporating AI-enhanced feedback, and integrating the system with national databases. By translating abstract standards into personalized development pathways, the *Kutsepeegel* supports teachers in shaping their professional identity and engaging in continuous, meaningful professional growth.

SUMMARY IN ESTONIAN

Õpianalüütika võimekus toetada õpetajate professionaalset arengut ja kutsekvalifikatsiooni taotlemist

Käesolev doktoritöö keskendub õpianalüütikal põhineva digitaalse rakenduse *Kutsepeegel* kontseptsiooni ja rakenduse loomisele, arendamisele ja hindamisele eesmärgiga toetada õpetajate professionaalset enesehindamist ja -arengut ning kvalifikatsiooniprotsessi kooskõlas Eesti kutsestandarditega. Töö lähtekohaks oli arusaam, et õpetajad on haridussüsteemi kvaliteedi keskmes, kuid nende professionaalset arengut on keeruline süsteemselt toetada. Muutuv haridusmaastik – õpetajate nappus, kasvavad ootused kvaliteedile, tehnoloogia kiire arenguga seotud muutused ning kvalifikatsiooninõuete täpsustumine – suurendab vajadust lahenduste järele, mis ühendaksid professionaalse arengu toetamise ja selle tõenduspõhise nähtavaks tegemise.

Töö keskne eesmärk oli kujundada ja uurida digitaalset rakendust, mis muudaks õpetaja enesehindamise struktureerituks, tõlgendatavaks ja dialoogiliseks. Teoreetiliselt tugineb töö kahe käsitlusviisi sünteesile: õpianalüütika raamistikule ning õppiva professionaali mudelile. Õpianalüütika perspektiivist käsitletakse andmeid mitte kontrolli- ega hindamisvahendina, vaid refleksiooni ja kutsealase arengu toetamise instrumendina. Õppiva professionaali käsitlus rõhutab eneseregulatsiooni, refleksiivset praktikat ja professionaalse identiteedi kujunemist. Nende kahe raamistiku ühendamine võimaldas kujundada lahenduse, mis toetab õpetaja autonoomiat, kuid samal ajal pakub selget struktuuri ja tõenduspõhist tagasisidet.

Empiiriline uurimistöö koosnes kolmest järjestikusest ja omavahel seotud uuringust. Esimese uuringu eesmärk oli kaardistada olemasoleva kvalifikatsiooniprotsessi kitsaskohad õpetajate, hindajate ja kutsestandardite arendajate vaatenurgast. Tulemused näitasid kolme peamist probleemi: (1) raskused sobiva kvalifikatsioonitaseme valimisel, (2) kutsestandardite ebajärjekindel tõlgendamine ning (3) tõendite kogumise (kaitstud keskkond) ja esitamise keerukus. E-portfoolio loomise protsessi tajuti killustatuna ja ajamahukana ning õpetajad tundsid sageli ebakindlust oma pädevuste hindamisel. Samuti ilmnes, et kvalifikatsiooni taotlemise motivatsioon on nihkunud sisemistelt arengumotiividelt välistele ajenditele, näiteks tööandjate nõuetele. Veel selgus, et õpetajad tundsid puudust tööandja toetusest ning olid sageli väga enesekriitilised. Need leiud osutasid vajadusele turvalise, juhendatud ja standarditele vastava digitaalse keskkonna järele, mis toetaks süstemaatilist eneseanalüüsi ning ühtlustaks kutsestandardite tõlgendamist.

Teine uuring keskendus rakenduse funktsionaalsete nõuete määratlemisele koostöös eri sidusrühmadega. *Kutsepeegel* kujundati viisil, mis toetab refleksiivset praktikat, arengulünkade diagnoosimist ja tõenduspõhist otsustamist. Rakenduse põhifunktsioonid on:

1. juhendatud enesehindamine Eesti kutsestandarditest tuletatud mina-vormi väidete kaudu, mis aitavad õpetajal siduda abstraktsed standardid oma igapäevapraktikaga;
2. turvaline tõendite haldamine, võimaldades nii dokumentide üleslaadimist kui ka linkimist kaitstud või avalikele allikatele;
3. visuaalne armatuurlaud (sh roosidiagramm), mis kuvab õpetaja pädevusprofiili ja arengudünaamika tõlgendatavas vormis. Roosidiagramm (või võrreldav pädevuskaart) on kõige kasulikum siis, kui see on otseselt standarditeni jälgitav, ühendatud tekstipõhjenduste ja näidistõenditega ning seotud järgmise sammu soovitustega (nt soovitatud artefaktid, mikroeesmärgid, vastastikuse hindamise küsimused);
4. koostööl põhinev hindamine, kus kolleegid, koolijuhid ja professionaalsed hindajad saavad anda struktureeritud tagasisidet samas keskkonnas. Kolleegide, juhtide ja hindajate sisseehitatud rollid (kommenteerimine, küsimuste esitamine, toetamine) muudavad eraldiseisva ülesande professionaalseks dialoogiks;
5. lisaks võimaldab süsteem turvalist autentimist, edusammude ajajoone jälgimist ja standardipõhist visualiseerimist. Selline ülesehitus loob läbipaistva seose enesehinnangute, tõendusmaterjalide ja hindamisotsuste vahel.

Kolmas uuring hindas *Kutsepeegli* kasutatavust ja mõju õpetajate (kutseta, kutsega) ning hindajate seas. Tulemused kinnitasid, et rakendus parandas eneseanalüüsi kvaliteeti, toetas refleksiivset mõtlemist ning aitas õpetajatel selgemini määratleda oma arenguvajadusi. Õpetajad tõid esile, et väidetel põhinev juhendamine ja visuaalsed ülevaated aitasid paremini mõista kutsestandardeid ning kalibreerida oma enesehinnanguid. Samuti suurenes valmisolek kvalifikatsiooni taotlemiseks ning vähenes halduskoormus. Hindajate hinnangul muutus protsess läbipaistvamaks, järjepidevamaks ja tõhusamaks, kuna otsused tuginesid struktureeritud ja võrreldavatele andmetele. *Kutsepeegli* võime koguda eneseanalüüse ja tõendeid aastate jooksul toetab taastaotlemise tsükleid, vähendades halduskoormust ja võimaldades õpetajatel näha arengutrajektoore, mitte ainult hetktõmmiseid. Selged juhised ning võime enesehinnangu protsessi peatada ning sobival ajal jätkata ei ole mugavused, need on eeldused suuremahuliste eneseanalüüside sisestamiseks rakendusse. Turvaline ja suletud keskkond suurendas õpetajate usaldust võrreldes varasemate avalike e-portfoolio lahendustega. Eetiliste kaitsemeetmete – näiteks õpetaja kontrollitud andmete jagamise ja autenditud juurdepääsu – integreerimine süsteemi ülesehitusse mitte ainult ei taga vastavust õigusaktidele, vaid soodustab ka usaldust ja kasutuselevõttu, tugevdades analüütikapõhise professionaalse õppe elujõulisust.

Antud doktoritöö teoreetiline panus seisneb õpianalüütika ja professionaalse õppimise käsitluste integreerimises õpetajate eneseanalüüsi ja kvalifikatsiooniprotsessi kontekstis. *Kutsepeegel* demonstreerib, kuidas andmepõhine tagasiside saab toetada mitte üksnes hindamist, vaid ka professionaalse identiteedi kujune-

mist ja autonoomiat. Rakendus aitab tõlkida abstraktsed kutsestandardid isikupärastatud arenguteekonnaks, muutes kvalifikatsiooniprotsessi kontrollimehhanismist refleksiivseks ja arengut toetavaks praktikaks.

Praktiline panus seisneb kontseptsiooni tõestuses, et digitaalne, õpianalüütikal põhinev lahendus võib täita olulisi tõlgendus- ja protsessilünki kutsestandardite rakendamisel. *Kutsepeegel* pakub hinnangut kvalifikatsiooni taseme määratlemisel ning loob võimaluse suunata kvalifikatsiooni taotlemist senisest enam koolipõhiseks ja koostööl põhinevaks protsessiks. Läbirääkimised Õpetaja Liiduga rakenduse reaalseks kasutuselevõtuks viitavad selle potentsiaalile.

Kutsepraktika tasandil näitavad tulemused, et väidetel põhinev refleksioon koos visuaalse tagasisidega parandab märkimisväärselt enesehindamisprotsesside kvaliteeti. Kutsestandardite tõlgendamise ebaselguse vähenemine ja professionaalse hinnangu täpsem kalibreerimine võimaldavad õpetajatel koostada tugevamaid ja sisuliselt sidusamaid kvalifikatsioonidokumente. Lisaks kohesele visuaalsele tagasisidele toetab protsess tugevama professionaalse identiteedi kujunemist: pädevuste kaardistamine, arutamine ja kinnitamine kolleegide ning hindajate poolt suurendab enesetõhusust ja toetab õpetaja professionaalset arengut. Pidev tõendite kureerimine arendab portfooliopädevust kui digipädevust, andes õpetajatele ülekantavad oskused oma praktika dokumenteerimiseks, tõlgendamiseks ja esitlemiseks erinevates kontekstides. *Kutsepeegel* toetab koolijuhtide arengule orienteeritud juhtimispraktikaid, pakkudes juurdepääsu koondatud ja õpetaja kontrollitud analüütilistele ülevaadetele, mis suunavad professionaalset dialoogi, mentorlust ja jätkuva kutsealase arengu planeerimist, ilma et analüütika taanduks järelevalvevahendiks. Struktureeritud toetuste ja narratiivse tagasiside kättesaadavus loob tunnustusinfrastruktuuri, mis aitab leevendada õpetajate kogemust ebapiisavast organisatsioonilisest tunnustusest ning tugevdab motivatsiooni ja professionaalset pühendumust.

Hindajate ja hindamiskomisjonide vaatenurgast parandab standarditele vastavate tõendite, õpetaja koostatud põhjenduste ja sihipäraste visualiseeringute integreerimine hindamise tõhusust. Tähelepanu nihkub tõendite otsimiselt professionaalsele arutelule ja otsustamisele. Ühtselt tõlgendatavad tugistruktuurid suurendavad järjepidevust ja õiglust, vähendades subjektiivset varieeruvust kriteeriumite kohaldamisel ning toetades ootuste ühtlustamist.

Hariduspoliitika ja -süsteemi tasandil näitab uuring, et riiklikud õpetajate kutsestandardid saavutavad praktilise legitiimsuse siis, kui neid rakendatakse toetavate digitaalsete tööriistade kaudu, mis hõlbustavad tõlgendamist, vähendavad halduskoormust ja integreerivad tagasiside kvalifikatsiooniprotsessi. Eesti kontekstis saab *Kutsepeeglit* käsitleda valikulise, kuid institutsionaalselt toetatud teekonnana reflekteeriva ja tõenduspõhise kutsekvalifikatsiooni omandamiseks. Turvaline ja skaleeritav rakendamine eeldab integratsiooni riikliku e-identimise infrastruktuuriga, selgeid andmesäilituse põhimõtteid, õpetaja omandiõiguse tagamist oma materjalidele ning rollipõhise juurdepääsu kokkuleppeid.

Kooli tasandil võimaldab õpianalüütika abil tuvastatud pädevuslünkade sidumine täiendkoolituse pakkumistega kujundada sihipärasemaid ja ajakohasemaid

professionaalse arengu võimalusi, ületades ühtsete ja pakkumispõhiste koolitusmudelite piirangud. Samal ajal peavad poliitikaraamistikud tagama portfoolio arendamiseks aja, kehtestama kaitsemeetmed ning pakkuma tuge piiratud digivõimekusega koolidele, et vältida ebavõrdsuse süvenemist. Avatud tehniliste standardite, näiteks ühtsete metaandmete skeemide ja API-ühenduste – arendamine vähendab integratsioonikulusid ja suurendab lähenemisviisi ülekantavust nii üld- kui ka kutseharidusse.

Uuringute piiranguteks võib pidada väikesi valimeid ja lühiajalist kasutusperioodi. Samuti ei sisalda praegune prototüüp veel tehisintellektil põhinevat juhendamist, hindajate moodulit ja väliseid andmeliideseid. Edasised uurimissuunad peaksid keskenduma edasistele uuringutele, tehnilise laiendamise ning vastutustundlike tehisintellekti lahenduste arendamisele, mille tulemusena oleks õpetajatel võimalik saada reaalajas konstruktiivset ja edasiviivat tagasisidet.

Kokkuvõttes näitab doktoritöö, et kutsestandardite loogikast lähtuv ja õpianalüütikast inspireeritud professionaalne enesehindamine võib muuta õpetaja professionaalse arengu nähtavamaks, läbipaistvamaks ja dialoogilisemaks. *Kutsepeeg*el ei ole üksnes tehniline lahendus, mis ühendab professionaalse identiteedi kujunemise, tõenduspõhise praktika ja süsteemse kvaliteeditagamise. *Kutsepeegel* pakub haridussüsteemidele võimalust siduda kutsestandardid ja digitaalsed analüütilised vahendid tugevdamaks õpetajate autonoomiat, motivatsiooni ja jätkusuutlikku arengut.

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