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Activity-based model of independent professional development of a teacher

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Abstract

The relevance of studying independent professional development (IPD) stems from the need to adapt education systems to rapidly evolving technologies and teaching methods. In conditions of limited resources and restricted access to traditional PD programs—particularly in rural areas—flexible and personalized approaches are essential. This article aims to develop an activity-based model of professional development management that enables teachers to self-direct their learning and overcome systemic constraints. The study employs a quantitative method (pre- and post-tests) to assess teacher engagement and progress, alongside qualitative tools (interviews, focus groups) to explore individual and collective needs, motivations, and barriers. Findings demonstrate high teacher engagement in self-development, improved reflective skills, and enhanced adaptation to educational technologies. The model proves effective in promoting professional growth and fostering sustainable improvements in education quality. Practically, it offers a framework for integration into Kazakhstan's educational policy to enhance student outcomes. Theoretically, it contributes to the discourse on continuous professional development and may be adapted to other educational contexts.

Keywords: Algorithmic model, Development of competencies, Innovative methods, Pedagogical improvement, Professional development of teachers.

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1. Introduction

Teacher professional development (PD) is recognized as a critical factor in enhancing education quality and fostering adaptive learning systems [1, 2]. Yet many teachers, particularly in rural and resource-constrained contexts, face systemic barriers such as limited access to training, insufficient mentoring, and difficulty in integrating digital technologies [3-5]. These challenges highlight the urgent need for flexible, individualized models that empower teachers to self-direct their learning and adapt to evolving pedagogical demands [6, 7]. Global educational systems are shifting toward competency-based and self-directed approaches, emphasizing autonomy, digital literacy, and reflective practice [8-11]. In Kazakhstan, national CPD initiatives aim to modernize teacher training but remain predominantly centralized and prescriptive, often failing to meet the diverse needs of educators in remote regions [12, 13]. Consequently, there is a growing need for professional development strategies that are both scalable and responsive to local conditions. Despite national efforts, current CPD systems in Kazakhstan do not adequately support teacher autonomy, contextual relevance, or ongoing learning. Educators lack access to continuous, practice-oriented development pathways, particularly in rural and underserved areas. Although independent professional development (IPD) has shown promise globally, its integration into national teacher training systems, especially through structured, activity-based models, remains underexplored in the Kazakhstani context. This study aims to design and test an activity-based, algorithm-supported model of IPD. It seeks to answer the following questions:

- How does the proposed IPD model affect teacher engagement and self-directed learning?
- What are the perceived barriers and motivators to adopting IPD among Kazakhstani educators?
- How can this model be scaled to inform national education policy?

The study adopts a mixed-methods approach. Quantitative data (pre- and post-tests) assess teacher progress, while qualitative methods (interviews, focus groups) explore user experiences and contextual factors. The proposed model was piloted in selected schools, with data collected and analyzed to evaluate its feasibility and impact.

2. Literature Review

Professional development (PD) has long been acknowledged as a core component of educational quality and teacher effectiveness. Traditional models, often characterized by top-down approaches, are increasingly criticized for their limited adaptability to local needs and lack of teacher agency [3]. Recent studies emphasize a paradigm shift toward self-directed and competency-based learning as more sustainable and context-sensitive approaches to teacher growth [14]. In this regard, independent professional development (IPD) is gaining traction. IPD fosters teacher autonomy, continuous reflection, and personalized goal setting [15, 16]. It aligns with adult learning theories, particularly andragogy, where self-motivation [17] and relevance to practice are essential [9]. Research by Ghamrawi et al. [6] and Mhlongo et al. [7] highlights the growing importance of digital literacy and technology integration in PD. However, many teachers, particularly in developing countries, struggle with access to digital tools and infrastructure [18]. In Kazakhstan, despite state-supported CPD programs, the system remains largely centralized and theory-heavy, offering few options for rural educators or practice-oriented learning [12, 13]. Scholars call for new models that integrate activity-based learning with algorithmic planning to support personalized professional pathways [19, 20]. Algorithm-supported IPD enables teachers to identify development goals, monitor progress, and select relevant resources autonomously. Yet, empirical research on the effectiveness and scalability of such models remains limited in Central Asian contexts. Furthermore, studies [21, 22] confirm that flexible PD models improve teacher motivation and retention, particularly when institutional support mechanisms are in place. Caution, however, that without a supportive ecosystem, self-directed approaches risk becoming fragmented and ineffective [23]. In summary, the literature confirms the relevance of IPD as a response to the limitations of traditional CPD. However, there remains a significant research gap regarding context-specific models that combine digital tools, teacher agency, and scalable design, particularly within Kazakhstan's evolving education system.

3. Research Methodology

3.1. Research Approach and Research Method

The study employed a quantitative research design to measure teacher engagement, progress in achieving self-set goals, and the overall impact of the model. Pre- and post-test questionnaires assessed pedagogical knowledge, technological literacy, and professional competencies, ensuring scalability and replicability [24]. Based on prior research [25, 26], an activity-based model of self-directed professional development (SDPD) was developed, structured around six sub-processes:

- Self-awareness – reflection, self-assessment, feedback analysis.
- Self-determination – goal-setting (e.g., SMART goals).
- Self-manifestation – applying knowledge, publishing, and collaboration.
- Self-organization – planning, time management, resource allocation.
- Self-actualization – participating in advanced training and innovative projects.
- Self-realization – analyzing outcomes, aligning achievements with values.

These stages are cyclical and interconnected, allowing continuous growth. To support this model, qualitative methods (interviews and focus groups) were used to explore teacher motivations, challenges, and needs. Interviews revealed individual strengths and growth areas (e.g., digital skills), while focus groups uncovered common barriers like time management and interdisciplinary teaching. The teacher portfolio was used as a tool for assessment, reflection, and documentation of progress. It included lesson plans, student work, training records, and reflections. The portfolio supports feedback exchange and continuous improvement. According to the Darling-Hammond et al. [27] framework, the study also incorporated the seven

principles of effective PD: content focus, active learning, collaboration, modeling, coaching, feedback, and sustainability. Ultimately, the combined quantitative and qualitative approach provided a holistic understanding of how the SDPD model supports teacher growth while addressing accessibility and personalization in professional development, especially in resource-constrained contexts like Kazakhstan.

3.2. Research Questions

Q1: To what extent does the IPD model contribute to increasing teachers' involvement in the use of innovative teaching methods?

Q2: What characteristics and initiatives do teachers demonstrate in the process of self-management of their professional development?

Q2: To what extent does the IPD model influence the development of teachers' reflective skills and their ability to adapt to new educational technologies?

Q3: Can the IPD model be an effective and sustainable solution for teacher professional development in resource-poor settings?

These questions provide an opportunity to explore in more depth the impact of the model on teacher professional development and its potential for widespread implementation in a variety of educational contexts.

3.3. Objectives of the Research

This study aims to analyze the influence of the self-directed professional development (SDPD) model on the formation and development of teachers' professional competencies, as well as to assess their ability to independently manage their own professional growth within the context of modern educational realities.

3.4. Research Location, Sample and Data Collection Method

Formation of the research sample. The study involved 60 teachers (from moderator to master) from different comprehensive schools located in the Almaty region of Kazakhstan. The participants were divided into two groups: an experimental group (EG), including 30 people (n = 30) and a control group (CG), also consisting of 30 people (n = 30). The age of the respondents ranged from 32 to 57 years, with an average of 43.43 ± 6.4 years (standard deviation (SD = 6.4). The sample included 8 men and 52 women, covering various age categories (Table 1).

Table 1.
Descriptive information about respondents.

Group	Qualification Category	N	%	Group	Qualification Category	N	%
Experimental	Men	5	17%	Control	Men	3	10%
Experimental	Women	25	83%	Control	Women	27	90%
Experimental	32–37 years	5	17%	Control	32–37 years	6	18%
Experimental	38–43 years	10	33%	Control	38–43 years	11	37%
Experimental	44–49 years	11	37%	Control	44–49 years	9	30%
Experimental	50–56 years	2	7%	Control	50–56 years	2	8%
Experimental	57+ years	2	7%	Control	57+ years	2	7%
Experimental group: Mean age: About 43.73 years							
Standard deviation: About 6.49 years							
Control group:							
Mean age: About 43.13 years							
Standard deviation: About 6.68 years							

Analysis of age distribution and gender ratio in the groups shows that they are sufficiently relevant for comparison. The similarity in age structure and number of participants minimizes the influence of these factors on the results of the study. However, when interpreting the results, it is important to take into account the significant predominance of women in both groups, which may affect the overall conclusions.

3.5. Selection of Participants

Two groups of teachers were formed to participate in the study:

- Experimental group – teachers working according to the IPD model.
- Control group – teachers continuing their education according to the standard college advanced training programs.

To ensure the comparability of the groups, participants were selected considering gender, age, teaching area, and level of training. Pre-test diagnostics: both groups underwent preliminary testing (pre-test) aimed at assessing their initial professional competencies. The test included quantitative questions to measure the level of pedagogical knowledge, proficiency in digital tools, and their integration into the educational process; it also assessed self-confidence in various professional skills.

3.6. Data Collection Tools

Pre-test and Post-test Questionnaires. The main instruments were pre- and post-test questionnaires administered to both groups. They measured:

- Pedagogical knowledge: Understanding of teaching methods, classroom management, and assessment.
- Technological literacy: Proficiency in digital tools and their integration into teaching.
- Professional competence: Confidence in skills such as communication, student engagement, and collaboration.

To ensure data reliability, a multi-stage verification process was applied. The questionnaire, based on modern frameworks [27], underwent expert review and piloting with 30 teachers for refinement. Reliability was confirmed by Cronbach's α (> 0.80), and validity through factor analysis, which supported item grouping and correlation with professional development indicators. To minimize bias (e.g., social desirability), anonymity and data triangulation were used, comparing questionnaire results with teacher observations and portfolio analysis. This verification ensured a reliable and valid tool for objectively evaluating teacher professional development in Kazakhstan.

Self-Assessment Tools. Teachers assessed their ability to apply various teaching strategies and monitored progress toward program goals.

SDPD Model Monitoring (Experimental Group). The SDPD model guided professional growth through six sub-processes: self-awareness, self-determination, self-manifestation, self-organization, self-actualization, and self-realization. Progress was evaluated by: percentage of stages completed, number of participants at each stage, and engagement in workshops, peer collaboration, and reflection. These metrics assessed how teachers applied new strategies and interacted professionally.

Additional analysis included pre-/post-program self-assessments, feedback from students and colleagues, innovation implementation, and student performance dynamics. Reflective reports and participation in professional communities further revealed how the SDPD model fostered reflective skills and adaptation to new educational technologies.

3.7. Data Analysis

The results of the data analysis obtained during the initial testing were used to identify ways to improve competency-based training for professional development. Quantitative descriptive approaches were used to examine the results of the initial testing. Analysis of the pre-test results will allow further analysis of changes in professional competencies, technological literacy, and the degree of pedagogical knowledge. The data analysis in this study was conducted using descriptive statistics to evaluate the effectiveness of the self-directed professional development (SDPD) model.

3.8. Methodological Innovation and Distinction from Past Studies

This study adopts a mixed-methods approach, combining quantitative and qualitative techniques to evaluate the effectiveness of an activity-based, self-directed professional development (SDPD) model. Pre- and post-test questionnaires were used to measure growth in pedagogical knowledge, technological literacy, and professional competence. Complementary qualitative methods interviews, focus groups, and portfolio analysis, explored teachers' motivations, challenges, and behavioral changes. Distinctively, the SDPD model was structured around six interconnected sub-processes (self-awareness, self-determination, self-manifestation, self-organization, self-actualization, and self-realization), offering a cyclical and personalized framework for professional growth. Unlike conventional CPD models that are often linear, centralized, and prescriptive, this model emphasizes teacher agency, algorithmic self-assessment, and flexible, context-specific planning. Additionally, the incorporation of ADDIE design principles and heutagogical elements (learner-defined goals and adaptive learning) sets this study apart from traditional PD research, which typically lacks iterative, reflective, and scalable design elements. This novel integration allows for real-time feedback, greater ownership of development paths, and adaptability to resource-limited settings, particularly relevant for Kazakhstan and similar educational contexts.

4. Results

4.1. Analysis Stage

The study consisted of several sequential stages, for which the ADDIE model was used, which includes the stages Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model relies on each stage being carried out in a given order, but emphasizes reflection and iteration. The model offers a streamlined, focused approach that provides feedback for continuous improvement (Figure 1).

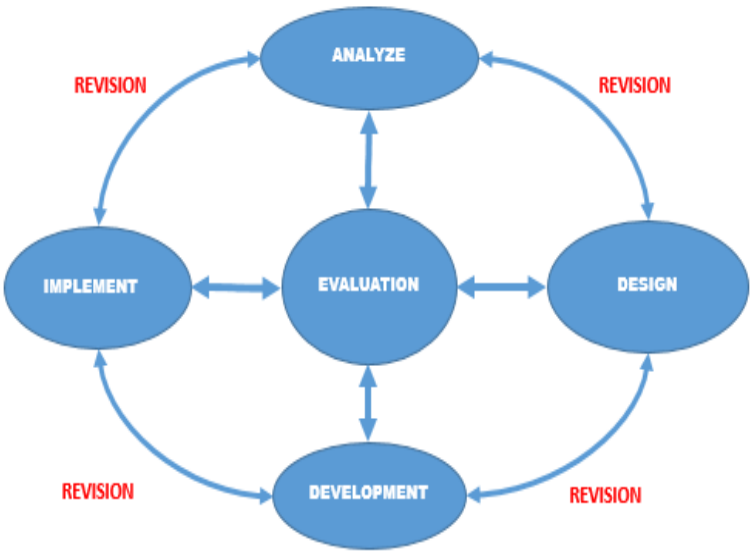

Figure 1.
5 Steps of the ADDIE Process.

The analysis phase was the first step in developing a model of the teacher education system through competency-based learning management, with the aim of improving the quality of education in secondary schools.

4.2. Design and Development Stage

The competency-based Independent Professional Development (IPD) model was designed and developed using the ADDIE framework, encompassing two main phases:

- Design stage: development of module structure and templates, assessment tools, and research instruments.
- Development stage: preparation of training modules, model structuring, questionnaire design, and expert validation.

The resulting Competency-Based Learning Management Model using Heutagogy (Figure 2) was shaped through focus group discussions with secondary school teachers. This approach centers on self-determined learning, where teachers independently define goals, content, and learning strategies.

Key components of the model include:

- Heutagogy – emphasizes learner autonomy, self-reflection, and adaptability.
- Competency-based approach – focuses on mastering relevant skills, co-defined with the learner.
- Flexibility – allows customization of pace, content, tools, and methods.
- Self-assessment – learners evaluate and adjust their development pathways.
- Digital technologies – facilitate access to resources, collaboration, and continuous learning.

This model is particularly relevant in dynamic educational environments, supporting lifelong learning and the development of adaptable, reflective teaching professionals.

4.3. Implementation Stage

Based on the results of the studies reviewed, it is possible to propose a model of teacher activity focused on the systematic management of one's own professional development. Description of the model of self-directed professional development of a teacher (SDPD). The SDPD model is designed to provide teachers with practical tools and strategies for their professional development, which is especially relevant in conditions of limited opportunities to participate in formal professional development programs. It promotes the development of new pedagogical approaches, adaptation to modern technologies, and improvement of the quality of teaching.

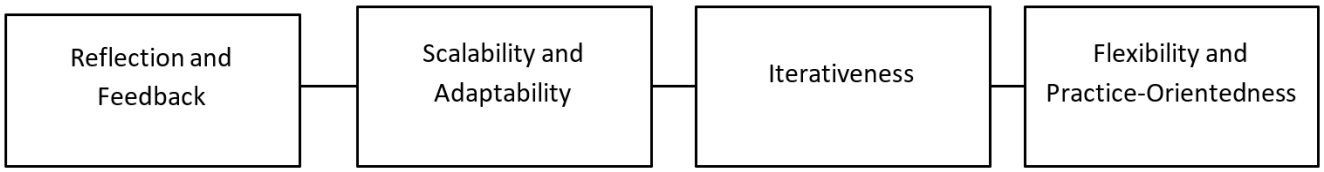

Figure 2.
Key features of self-directed professional development of teachers (SDPD).

Figure 3 presents an activity-based model for structured management of teacher professional development, comprising six interrelated stages: self-awareness, self-determination, self-manifestation, self-organization, self-actualization, and self-realization. Each stage builds upon the previous one, ensuring coherence and continuity in the development process. The

model integrates two key components: algorithmic and activity-based. The algorithmic component enables personalized planning by identifying teacher needs through self-assessment and generating individualized development trajectories with recommended materials, activities, and checkpoints. It provides systematic progress monitoring and adaptation to individual contexts. The activity component emphasizes practice-oriented learning, including workshops, collaborative discussions, micro-learning, and technology tasks. Teachers are encouraged to initiate and implement their own projects, integrating new methods into their teaching. The flexible format supports learning at one's own pace and immediate application of acquired knowledge. Reflection and feedback are integral, involving reflective journals and peer or mentor interaction via digital platforms. This enhances understanding and reinforces learning. The model is scalable and adaptable to diverse educational contexts, aligning with professional standards and grounded in constructivist learning theory. It promotes autonomy, continuous learning, and practical relevance, making it a sustainable and theoretically robust approach to teacher professional development.

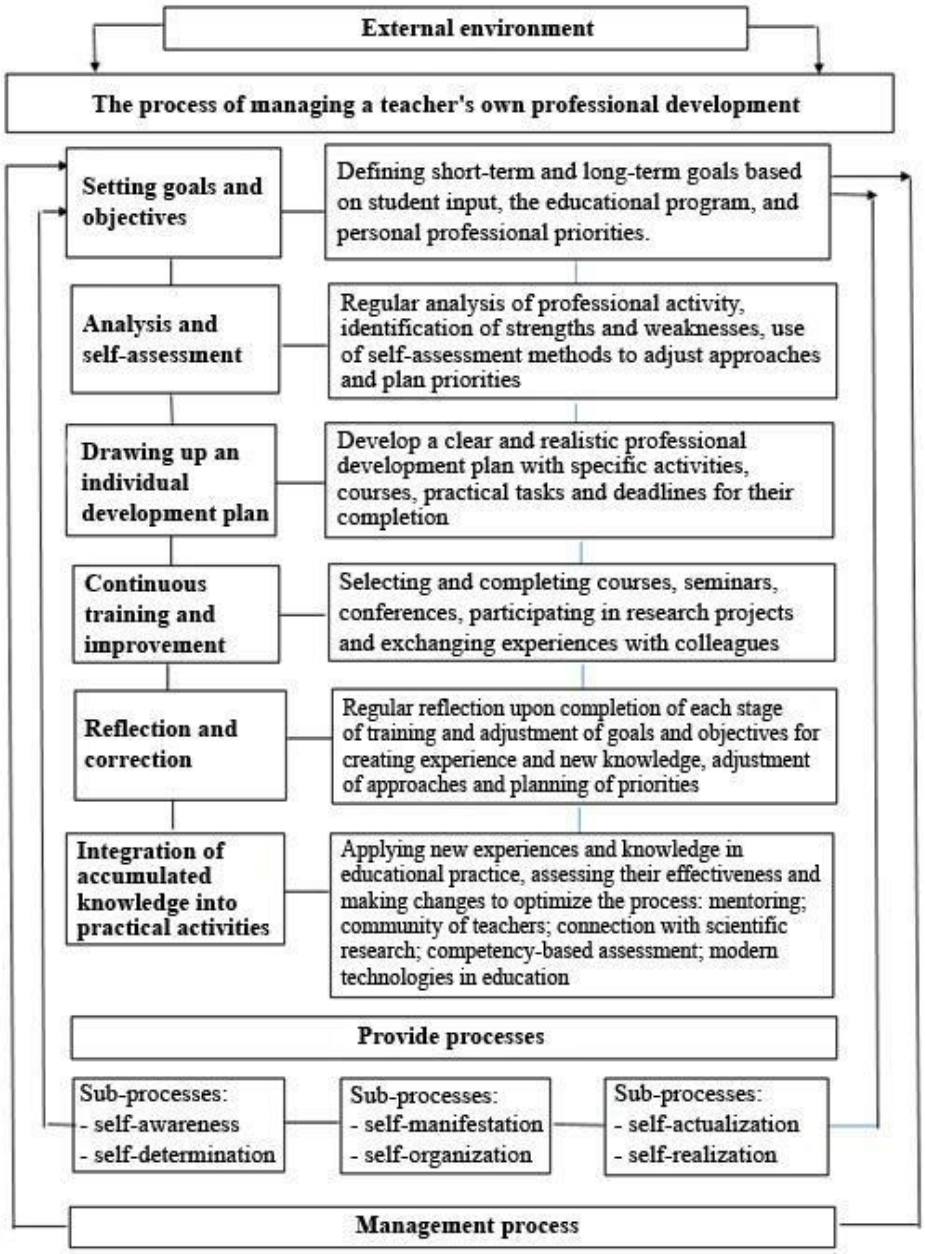

Figure 3.
Activity-based model of teacher management of his/her own professional development.

4.4. Evaluation Stage

4.4.1. Comparison, Pre-Test and Post-Test Diagnostics

Six months after the start of the experiment, both groups underwent a final test (posttest), similar to the pretest. The results of the posttest allowed us to analyze changes in professional competencies, pedagogical knowledge, and the integration of technologies into the educational process. The experimental group demonstrated higher results compared to the control group, which is confirmed by the descriptive statistics presented in Table 2.

Table 2.
Descriptive statistics of pre-test and post-test results.

Group	Test	Average result	Standard deviation (SD)	Minimum	Maximum
Experimental (EG)	Pre-test	60.8	4.5	55	66
	Post-test	85.4	5.2	78	92
Control (CG)	Pre-test	59.3	4.8	52	65
	Post-test	70.3	6.1	60	82

Data analysis shows that the experimental group (EG), trained using the SDPD model, demonstrated a significant increase in results from the pretest to the posttest, an average of 24.6 points. At the same time, in the control group (CG), the improvement was less pronounced, with an increase in the average score of only 11 points (Table 3). The low standard deviation in the pre-test and post-test results of the experimental group indicates a more uniform growth of knowledge and skills among the participants. In contrast, the control group showed greater variability in results. This confirms that the SDPD model has a more pronounced positive impact on the development of pedagogical knowledge, technological competencies, and professional skills of teachers compared to traditional methods used in the control group.

The results of the paired t-test also confirm that the application of the SDPD model led to a statistically significant improvement in the professional competencies of teachers. In the experimental group, a more significant difference in mean values, a higher t-test, and a p-value were observed, indicating a high level of statistical significance. Positive changes were also recorded in the control group, but their effect was significantly weaker.

Table 3.
Paired t-test results for experimental and control groups.

Group	Comparison	Difference between averages	t-value	p-value
Experimental (EG)	Pre-test vs. Post-test	24.6	9.24	< 0.001
Control (CG)	Pre-test vs. Post-test	11.0	3.12	0.003

4.5. Results of Statistical Analysis

The results of the independent t-test show (Table 4) that the participants in the experimental group (EG), working according to the SPR model, demonstrated significantly higher scores on the post-test compared to the control group (CG), which used traditional methods of professional development. This confirms the effectiveness of the SDPD model in developing teachers' professional competencies, including technological preparedness and pedagogical skills. The extremely low p-value (< 0.001) indicates a high level of statistical significance of the differences obtained, which indicates that the identified improvements are not random.

Table 4.
Results of the independent t-test for post-test results.

Group	Average (Post-test)	Standard deviation (SD)	t-value	p-value
Experimental (EG)	85.4	5.2	9.15	< 0.001
Control (CG)	70.3	6.1	-	-

The high effect size (Cohen’s d = 2.74) confirms that the SDPD model had not only a statistically significant but also a practically important impact on the development of professional competencies of teachers in the experimental group (Table 5). This suggests that the use of the SDPD model led to significant improvements in the skills and knowledge of teachers, surpassing the results obtained in the control group using traditional methods. Estimating the effect size and involvement in the SDPD model.

Table 5.
Effect size (Cohen's d) for the self-directed professional development (SDPD) model.

Group	Average (Post-test)	Standard deviation (SD)	Effect size (Cohen’s d)
Experimental (EG)	85.4	5.2	2,66
Control (CG)	70.3	6.1	-

An analysis of the involvement in the SDPD model showed that high activity of participants was directly related to a more significant improvement in professional competencies. The strongest correlations were observed between the level of task completion, time spent participating in the program, and the final posttest scores, indicating that the more teachers interacted with the components of the SDPD model, the more they developed their professional skills. In addition, collaboration with colleagues and participation in reflective sessions also contributed to professional development, although their impact was somewhat less pronounced. This confirms that these elements of the SDPD model play an important supporting role in the comprehensive development of teachers. For a qualitative assessment of the study, which not only ensures the collection of information but also promotes the personal and professional growth of teachers, various assessment methods were used, corresponding to the self-management sub-process, based on six criteria of self-development (self-awareness, self-determination, self-manifestation, self-organization, self-actualization, self-realization) (Table 6).

Table 6.
Methods and criteria for assessing the sub-processes of self-management of professional development of teachers.

Sub-process of self-management	Assessment methods	Description of criteria for evaluation
Self-awareness (understanding yourself, your values, interests, strengths and weaknesses)	Reflective essays – analysis of experience, values, beliefs, strengths and weaknesses. SWOT analysis of personality – self-assessment through strengths and weaknesses, opportunities and threats. Self-diagnosis methods (questionnaires, emotional intelligence tests, personality questionnaires, 360-degree feedback). Analysis of biography and career path – what influenced development, what lessons were learned?	How deeply does the teacher understand his/her personal qualities, professional, and personal goals? Depth of reflection: How meaningful are the conclusions? Specificity of examples: Are there any real cases from experience? Sequence of reflections: logic and validity of judgments.
Self-determination (choosing a path of development, setting goals)	Map of goals and values – how clearly life and professional guidelines are defined. Individual development plan (IDP) – presence of short-term and long-term goals, thoughtfulness of steps. Interview/self-presentation – ability to formulate your mission and goals. Career guidance testing – analysis of the correspondence between interests and career path.	How clearly are the goals and directions of professional and personal development defined? Clarity and realism of goals. Connection of goals with personal values. Availability of specific steps toward implementation.
Self-manifestation (activity in implementing ideas, initiative, creativity)	Portfolio of achievements – projects, publications, initiatives, cases. Analysis of initiative in projects – how actively does a person come up with ideas, take responsibility? Creative task or project – creativity in solving problems. Participation in conferences, competitions, and speeches – examples of personal involvement.	To what extent does the author demonstrate initiative, creativity, and independence in work and study? Uniqueness and originality of ideas. Level of complexity and scale of projects. Impact on the environment (colleagues, students, professional community)
Self-organization (ability to manage your time, planning)	Time management analysis – keeping diaries, task trackers, and plans. Productivity analysis – meeting deadlines, completing tasks. Project retrospective – to what extent can a person analyze their work process? Flexibility and adaptability – how does a person cope with changes and surprises?	How effectively a person manages their time, completes assigned tasks and monitors their progress. Structured actions (is there a clear system). Independence in task management. Ability to effectively allocate resources and time.
Self-actualization (development of potential, finding opportunities for growth)	Analysis of educational activities – courses, trainings, reading, conferences. Results of implemented changes – how does a person use the knowledge they have acquired? Development of competencies – new skills, certificates, diplomas. Personal and professional development projects – blogging, mentoring, participation in professional communities.	To what extent does a person strive for development, utilize opportunities for learning and improvement? Regularity of learning and self-development. Application of knowledge in practice. Impact on career growth and personal development.
Self-realization (achieving success, bringing potential to life)	Analysis of achieved results – completed projects, career achievements, recognition. Reviews and recommendations – what do colleagues, clients, and students say? Personal brand and influence – publications, speeches, expert opinions. Social contribution – participation in volunteer projects, mentoring, and contributions to the community.	To what extent have the set goals been achieved and personal potential realized? To what extent have the set goals been realized? Influence on others. Level of recognition of achievements.

For convenience, a point scale was used (1-3 points for each criterion), 1 point is the initial level (basic knowledge and skills, lack of consistency), 2 points is the average level (development of competencies, application in practice). 3 points is a high level (deep understanding, creation of something new, influence on the system), as well as a descriptive assessment with examples of successful cases. The sum of points for all 6 criteria determines the level of the teacher: 6-9 points → Teacher-moderator, 10-13 points → Teacher-expert, 14-17 points → Teacher-researcher, 18 points → Teacher-master. Thus, the higher the level of the teacher, the more pronounced and systematized all six criteria are.

Let us present some of the results of the final assessments of the participants in terms of their qualification level (Table 7).

Table 7.
Summary table of self-management assessment of teacher N. (teacher-researcher, 44 years old).

Criterion	Description of the assessment	Points (1-3)
Self-awareness	Depth of reflection, Concreteness of examples, Sequence of thoughts	3
Self-determination	Clarity of goals, a realistic plan.	2
Self-manifestation	Initiative, creativity, and participation in projects.	3
Self-organization	Planning, productivity, time management.	2
Self-actualization	Continuous development, professional growth.	3
Self-realization	Achievements, recognition, influence on others.	3
Total	Total points	16/18

The system enables an objective assessment of teachers' progress toward self-realization and areas requiring development. To confirm the model's reliability, four teachers with different qualification levels from the experimental group were analyzed.

Teacher-moderator A (32, male, novice) aware of his basic competencies and the need for growth, but lacks work structuring skills. He experiments with methods and collaborates with peers, though he still relies on their guidance. Uses ready-made tools without systematic organization. Takes courses and explores technologies. Shows initial results but limited influence. Assessment: 9/18 – beginner level, focused on basic teaching skills.

Teacher-expert (38, female) – Understands strengths and development areas, analyzes her practice. Specializes in certain domains, creates original methods, and is active in professional networks. Shares innovations through webinars and master classes. Manages time and training effectively, regularly participates in conferences, and publishes. Assessment: 12/18 – Confident professional influencing the educational environment.

Teacher-researcher (44, female) – Conducts in-depth analysis of her practice, explores new pedagogical directions. Engages in scientific research, develops and tests new educational models. Publishes findings, leads projects, and integrates science into teaching. Maintains a balance between research and teaching, and cooperates with institutions. Assessment: 16/18 – High-level professional contributing new knowledge.

Teacher-master B (57, female) – Fully aware of her competencies and values, acts as a mentor and field leader. Develops programs, leads strategic initiatives, and inspires others. Manages professional and personal responsibilities effectively. Seeks continuous challenges and supports colleagues' growth. Assessment: 18+ – Recognized leader with system-level impact.
Generalized data on professional growth dynamics are summarized in Table 8.

Table 8.
Development of sub-processes of self-management of professional growth of teachers at different levels of their professional competence.

Sub-processes of self-management	Teacher-moderator (over 2 years of experience)	Teacher-expert	Teacher-researcher	Teacher-master
Self-awareness	A basic understanding of your strengths.	Deep reflection, awareness of one's role.	Analyzes himself, identifies educational problems.	Fully aware of his mission and competencies.
Self-determination	Form career goals.	Determined specialization builds a trajectory.	Builds his research activities.	Clearly understands his role in the education system.
Self-manifestation	Starts trying new methods.	Actively implements innovations and shares experience.	Develops new educational technologies.	Creates unique proprietary techniques.
Self-organization	Manages his time at a basic level.	Effectively plans work and trains others.	Organizes research groups and projects.	Manages educational processes at a high level.
Self-actualization	Studies, but mostly under duress.	Actively takes courses and participates in seminars.	Constantly expands competencies and introduces new approaches.	Constantly studies the latest trends and develops the teaching community.
Self-realization	Had initial successes, but has not yet received recognition.	Influences colleagues and students, gets published.	Well-known in scientific and professional circles.	Leader of the educational process, recognized expert.

According to the specified criteria, teachers assessed themselves, collected information from all teachers and received the following Table 9. The sum of points for all 6 criteria determines the level of the teacher: 6–9 points → Teacher-moderator, 10–13 points → Teacher-expert, 14–17 points → Teacher-researcher, 18 points → Teacher-master. Thus, the higher the level of the teacher, the more pronounced and systematized all six criteria are.

Table 9.
Final table of teachers' evaluation.

Level	Teacher-moderator		Teacher-expert		Teacher-researcher		Teacher-master	
Number of teachers	Exp. group	Control group	Exp. group	Control group	Exp. group	Control group	Exp. group	Control group
	7	14	10	8	12	5	1	3
Average score	10	6	14	10	17	15	18	18
St. dev.	Exp. group 3.21 Control group 4.24							
Increased efficiency (%)	51.8%							

The efficiency calculation is correct, but there is one thing - the standard deviation (St. dev..) cannot be negative. It is always positive or zero. Conclusion: In the experimental group, improvement is noticeable only among research teachers (+6.25%), and there are no changes in the other categories. The average score in the experimental group is higher for all levels, especially for Experts. There are more Expert and Master level teachers in the experimental group than in the control group. The spread of assessments among the "Experts" in the experimental group is smaller, which indicates a stable professional level within the group. The connection between the criteria and the levels of teachers is based on the accumulation of competencies and their application. Moderator → Masters the basics. Expert → Influences colleagues, shares experience. Researcher → Creates new knowledge and methods. Master → Changes the education system. Teacher-moderator: 40-50% of the total number of teachers. These are teachers with a basic level of competence who are actively developing and mastering new methods. Teacher-expert: 30-40%. These are experienced teachers who have deep knowledge in their field and are actively involved in methodological work. Teacher-researcher: 10-20%. These are teachers involved in scientific activities, developing new methods, and introducing innovations. Teacher-master: 5-10%.

5. Discussion

Global studies identify diverse PD models aimed at enhancing teaching practices and promoting continuous professional growth. One widely used structure is the Individual Professional Development Plan (IPDP), which includes needs assessment, plan creation with mentor involvement, implementation, monitoring, evaluation, and portfolio compilation. The teacher develops competencies through training, reflection, and self-assessment, supported by mentor feedback [28]. The Teacher Activity Groups (TAGs) model functions as a formal community of practice, characterized by structured peer discussions, facilitated meetings, a practical focus on classroom challenges, and reflective analysis. Digital platforms (e.g., WhatsApp, Facebook) support ongoing engagement. TAGs are effective in enhancing teacher confidence and collaborative problem-solving, with proven success in India, Egypt, Romania, and Palestine [29, 30]. Propose a four-component PD model: Insight (I), Motivation (M), Technique (T), and Practice (P). Programs incorporating all four elements demonstrate the strongest impact on teaching quality and student outcomes. Explore gamified digital rubrics as an innovative PD method [31]. Key elements include formative assessment, badge systems (competitive and self-improvement), real-time feedback, collaborative learning, and digital skills training (e.g., AI, Big Data). Gamification fosters motivation and the integration of innovative pedagogical strategies.

Other established PD models include:

- Standards-based PD [32]– aligned with national criteria.
- Mentoring and coaching [33] – novice-expert collaboration.
- Lesson Study [34] – group lesson planning and analysis.
- Continuous PD [35] – collegial knowledge sharing.
- Transformational PD [36]– critical reflection and integration of practices.
- Open PD [37]– lifelong learning and competency gap reduction.
- Action research PD [38]– empirical inquiry into teaching practices.

In Europe, the DigCompEdu framework García-Vandewalle García et al. [39] is prominent, offering a digital competence matrix covering communication, digital resources, assessment, and student support. Overall, PD structures vary in approach but share common goals: equipping teachers for modern educational demands, fostering innovation, and ensuring sustainable teaching quality. The Activity Model discussed in this article (Figure 1) can be compared with these models across several key parameters (Table 10).

Table 10.
Comparison of aspects of the activity model with other models.

Aspect of the model	Description of the Activity Model of the PRP	Similarity with modern models
Structured process	The process is presented as a sequence of stages: goal setting, analysis, self-assessment, drawing up an individual plan, learning, reflection, and integration of new knowledge.	Corresponds to cyclical models such as the mentoring and coaching model (emphasis on reflection) and the Lesson Study (analysis and adjustment).
Individualization of development	The importance of an individual development plan is emphasized, as it allows for the personal needs and goals of the teacher to be taken into account.	Similar to the open professional development model and the DigCompEdu concept (personalized routes for mastering competencies).
Feedback and reflection	Reflection and adjustment are key elements that enable teachers to analyze their practice and implement changes.	Characteristics of the transformational model of PD and Lesson Study.
Integration of new knowledge	The final stage of the model aims at implementing the acquired knowledge into teaching activities and assessing its effectiveness.	It echoes the concept of "Professional Learning Communities" (PLCs), where the emphasis is on introducing innovations into the educational environment.
Supporting processes	The model highlights self-esteem, self-development, and self-regulation, which emphasize the focus on independent management of professional development.	Close to the concept of Self-directed Professional Development, based on the initiative and autonomy of the teacher.

The proposed Activity Model represents a comprehensive and flexible approach to the professional development of teachers, combining the key principles of models such as Lesson Study, DigCompEdu, the transformational PD model, and PLC. It emphasizes the importance of planning, learning, reflection, and practical implementation of knowledge, and is also focused on the self-development of the teacher, which makes it universal and applicable in different educational systems. Cultural ideas about the professional autonomy of teachers have a significant impact on the success of the professional development (PD) model of teachers. Different educational systems interpret the autonomy of teachers differently, which affects the perception and effectiveness of the implementation of PD models.

5.1. Cultural Context of Professional Development (PD)

The effectiveness of PD models depends heavily on cultural perceptions of teacher autonomy. In individualistic cultures (e.g., USA, UK, Germany), autonomy is personal; self-directed models like SDL and DigCompEdu work well. In collectivist cultures (e.g., Japan, China, South Korea), autonomy is collective; group-based models like Lesson Study and PLCs are more effective. In regulated systems (e.g., France, China, Turkey), PD must align with policy and include administrative support. In flexible systems (e.g., Finland, Canada, Netherlands), personalized and self-driven PD flourish. In cultures valuing the teaching profession (e.g., Finland, Japan), reflective PD models are more successful. Where teaching is less prestigious, combining external incentives (e.g., career growth) with internal motivation is crucial. Cultural adaptation is essential: while Anglo-American PD focuses on career outcomes, Scandinavian and Asian models emphasize community and mentorship.

5.2. Biases in Self-Assessment and Mitigation

Biases in self-assessment, such as underestimation (common in collectivist cultures), the Dunning-Kruger effect, imposter syndrome, and socially desirable responses, can skew results.

Mitigation strategies include:

- Combining self- and expert assessments.
- Reflective practices (e.g., journals, DigCompEdu tools).
- Formative diagnostics and peer feedback.
- Digital analytics (e.g., learning portfolios).
- Anonymous surveys.
- Mentoring and coaching [28].
- Role of Mentoring and PLCs.

Mentoring accelerates adaptation to innovations, supports reflective practice, and enhances confidence. PLCs foster collaboration and shared learning, both in-person and online. These approaches increase relevance and help build a sustainable, practice-oriented PD culture [29]. In Kazakhstan, where both collectivist and individualist norms exist, teachers may undervalue their skills. Effective PD tools include mentoring, adapted Lesson Study models, and digital analytics to reduce bias.

5.3. Prospects and Challenges

The self-directed professional development (SDPD) model fosters continuous teacher engagement by adapting learning to individual progress, thus promoting long-term professional growth, an essential factor in today's rapidly evolving educational landscape. These results align with prior research highlighting the benefits of self-directed and personalized development. Reported higher satisfaction and improved teaching performance among teachers using self-directed methods [40]. Emphasized that autonomy enhances engagement in professional learning [41]. The model's flexibility is also supported by Yan et al. [42], who found that online and self-organized formats reduce time and location constraints. Showed that adaptive learning systems lead to better outcomes than uniform approaches [43]. Noted that peer interaction significantly boosts the application of new practices, consistent with this study's findings [44].

5.4. Adaptation of the Model for Other Educational Systems

The model of activity-based independent professional development of teachers (PD) proposed by us has a high degree of flexibility and can be adapted to different educational systems. For successful adaptation, it is necessary to take into account key differences in resource provision, cultural characteristics, and professional development policies in different countries. Table 11 considers the possibilities of adaptation for different educational systems, including aspects of mentoring, professional communities and barriers to the implementation of digital technologies.

Table 11.
Flexibility of the model of activity-based independent professional development of teachers in different educational contexts.

Type of educational system	**Features of model adaptation**	**Integrating Mentoring and Professional Learning Communities (PLCs)**	**The Impact of School and National Policies on Teacher Engagement**	**Barriers to the implementation of digital technologies**
Developed countries (USA, Canada, Finland, Great Britain, etc.)	Use of digital technologies and platforms (MOOCs: Coursera, EdX, national platforms). Personalized learning with AI (adaptive recommendations).	Digital mentoring via platforms (LinkedIn Learning, Google for Education). Online PLC for sharing experiences.	Flexible models with individual plans and mentoring support teachers' self-development. Administrative support for schools increases engagement, but funding, bureaucracy, and high workloads remain barriers.	Insufficient digital competence of teachers, resistance to change, and fragmented use of technology.
Countries with a centralized system (France, China, Türkiye, Kazakhstan, etc.)	Hybrid format, mandatory courses, and a choice of specializations. Integration with state programs (e.g., "Certification of teachers" in Kazakhstan) and digital tools.	Mentoring through government programs. PLCs within local or online networks to support flexibility.	National policies, such as those in Kazakhstan, often focus on centralized professional development programmes that provide uniform standards but do not always take into account the individual needs of teachers.	Limited freedom of choice of trajectories, lack of methodological support, administrative barriers, low motivation.
Resource-limited regions (Africa, South Asia, Latin America, etc.)	Offline focus: PLC, mentoring, peer learning. Use of mobile technologies (SMS courses, podcasts) instead of online learning.	Face-to-face mentoring and local professional networks. PLC serves as a basis for sharing experiences without dependence on the Internet.	Limited funding, a shortage of qualified personnel, and inadequate infrastructure make it difficult to implement modern educational technologies and professional development programs for teachers.	Limited access to the internet and resources, outdated equipment, low digital competence, and lack of technical support.

5.5. Limitations and Recommendations

Despite its effectiveness, the SDPD model faces several challenges. The study's limitations, small sample size, lack of long-term tracking, and potential data bias affect the generalizability of results. In Kazakhstan, these issues are intensified by systemic barriers such as underfunding, limited digital integration, lack of resources, and low teacher motivation for continuous learning. While the SDPD model offers a flexible, personalized alternative to traditional development programs, its success depends on adequate support. Warns, self-directed models can result in uneven engagement [45]. In this study, structured activities and regular reflection helped maintain stable participation. Overall, the SDPD model holds strong potential for enhancing teacher competence in resource-constrained settings. Its adaptable, activity-based design supports modernization, though improved support systems are essential to ensure equitable engagement and long-term impact.

6. Conclusion

This study evaluated the effectiveness of the Self-Directed Professional Development (SDPD) model in enhancing teachers' professional growth. It focused on increasing engagement in innovative teaching practices, fostering reflective skills, and supporting adaptation to educational technologies.

6.1. Implications

The SDPD model significantly improved teacher engagement in implementing modern teaching strategies. Participants reported greater motivation and readiness to apply innovative methods in classrooms. The model also contributed to the development of reflective skills and technological adaptability, enabling educators to critically assess their teaching and integrate digital tools effectively.

Importantly, the model's cyclical, activity-based structure, with its emphasis on self-assessment, planning, and reflection, proved suitable for resource-constrained environments. Its scalability and adaptability make it a practical framework for teacher development, not only in Kazakhstan but also potentially in similar educational contexts globally. Furthermore, the model offers valuable insights for policymakers aiming to modernize professional development systems in line with autonomy and lifelong learning principles.

6.2. Limitations

Despite its strengths, the study faced several limitations. The sample size was relatively small and geographically confined to the Almaty region, limiting generalizability. The study's duration was also short, preventing long-term impact assessment. Additionally, the strong gender imbalance among participants and potential self-assessment bias may have influenced the results.

6.3. Future Research

Future studies should focus on longitudinal evaluation of the SDPD model to assess its sustained impact on teaching practices and student outcomes. Comparative studies across different regions and educational systems are recommended to explore the model's adaptability and scalability. Further inquiry into digital tools that support SDPD, as well as the role of mentoring and peer collaboration within self-directed frameworks, would also enhance understanding and effectiveness of the model in varied contexts.

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