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MECHANISMS AND TECHNOLOGIES FOR FOSTERING THE RESEARCH AND INNOVATIVE CAPABILITY IN UNIVERSITY TEACHERS

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Abstract

This study aims to examine the effects of the "Unlocking Research & Innovative Capability" program for university teachers. A total of 80 teachers from the Abai Kazakh National Pedagogical University were enrolled. All participants were divided into groups based on their age and teaching experience. Data were collected via surveys. The proposed program was found to have different effects across groups. Young university teachers (28 to 35 years; teaching experience, 3 to 5 years) exhibited improvement in all research and innovative capability variables, ranging from 0.84 in Interdisciplinary Cooperation to 2.63 in Innovative Teaching. The same is true for early middle-aged university teachers (36 to 45 years; teaching experience, 5 to 10 years) who showed improvement ranging from 1.52 in Interdisciplinary Cooperation to 3.00 in Integration of Technology. Older middle-aged university teachers (46 to 55 years; teaching experience, 10 to 20 years) exhibited improvement in their Innovative Teaching, Research Practice, and Integration of Technology; yet, it did not exceed 1.85 points. Older university teachers (older than 56 years; teaching experience, 20 years) demonstrated minimal improvement in all dimensions. This study was conducted as part of governmental research on "Managing the Development of Research & Innovative Capability in the Research University Staff under the Participatory Management Model" launched by the RK Ministry of Education and Science (Project number: AR14872123). The study emphasizes the importance of empowering university teachers as key drivers of research, knowledge generation, and innovative teaching. The present findings can be used to cultivate a culture of innovation and research in academic institutions.

Keywords – Educational programs, Higher education, Innovation, Participatory management, Potential, Research activity, Science.

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1. Introduction

In today's world where advanced technologies redefine the way we educate future generations (Yang & Deng, 2023), a university teacher shifted from simply delivering knowledge to acting as a catalyst for research and innovation (Vincent-Lancrin, Urgel, Kar & Jacotin, 2019). Striving for academic excellence, universities put their efforts into harvesting the full potential of educators as scholars and innovators (Compagnucci & Spigarelli, 2020). Potentially, this will enable educational institutions to promote cutting-edge research, foster a culture of innovation, and create a stimulating learning environment. As the foundation of a knowledge-based society, universities are crucial for the production of professionals, researchers, and innovators. At the center of this process, the university teacher, if endowed with the necessary tools, promotes the development of the educational institution (Leal-Filho, Shiel, Paço, Mifsud, Ávila, Brandli et al., 2019). To pursue academic excellence and bolster cutting-edge research, one must determine how to cultivate the research and innovative (R&I) capability of university teachers effectively (van Driel, 2021). Many studies begin in academic institutions, so it seems reasonable to keep educators at the forefront of cutting-edge methodologies, for, through cultivating a research culture, universities can create an environment conducive to innovation and interdisciplinary collaboration (Bayuo, Chaminade & Göransson, 2020; Mejía, Henriksen, Xie, García-Topete, Malina & Jung, 2023). By harnessing the academic potential of the teaching staff, universities can make their research efforts more effective, establish close partnerships with various industries, and boost socioeconomic growth in the region (Asbari, Purwanto, Ong, Mustikasiwi, Maesaroh, Mustofa et al., 2020).

The *research capability* of a university teacher is the ability to contribute to the existing body of knowledge and actively participate in research activities (Peters-Burton, Dagher & Erduran, 2023). In addition to their duties as instructors, educators are encouraged to explore new frontiers of knowledge in their respective disciplines. The unleashing of the research potential brings multifaceted benefits, including the opportunity to create an inspiring learning environment in which students try out the latest developments and learn to think critically (Zakharova, Mezinov & Mironova, 2020). It helps to foster a collaborative climate in academia, promoting interdisciplinary research and discovery (Al-Husseini, El-Beltagi & Moizer, 2021). The *innovative capability* of a university teacher is the ability to integrate new teaching methods and develop advanced curricula (Artyukhova, Kozyreva, Fedorova, Kirgizova, Benkov & Chupina, 2021). Innovation in teaching and learning is all about embracing technology and experiential learning to create engaging experiences (van der Rijst, Baggen & Sjoer, 2019). By building faculty capability, universities can adapt to a rapidly changing educational environment, cater to different learning styles, and equip students with the skills needed to succeed in a highly competitive world (de Carvalho-Filho, Tio & Steinert, 2020).

This study offers a comprehensive analysis of mechanisms and technologies that underlie the R&I capability development in university teachers. By understanding these tools and strategies, academic institutions can adjust and implement what is best to enhance academic excellence. The study examines the role of university professors in promoting research and innovation and their growth opportunities. From a practical standpoint, this study can be useful for university administrators, policymakers, and faculty development committees. In addition, the presence of a research-oriented culture can attract talented researchers and strengthen the partnership between practice and academia.

2. Literature Review

Research inside and outside of educational institutions cannot be overestimated (Toescu & Tuboly, 2023). As stated earlier, the research capability is the ability to participate in research (Mukhamedov, Khodjamkulov, Shofkorov & Makhmudov, 2020), which goes beyond the conventional duties of a teacher and involves a set of personal attributes that make for effective researchers, thought leaders, and organizers of research initiatives (Tatto, 2021). A teacher-researcher exhibits a high level of research proficiency, including skills like research planning and data collection, analysis, and interpretation. In addition, such teachers actively publish research papers in peer-reviewed journals and participate in conferences (Gabdulchakov, Kusainov & Kalimullin, 2016). They are open to interdisciplinary collaboration, show innovative thinking, in the sense that they find new research questions and offer new

solutions to existing problems, and educate a new generation of researchers (Semradova & Hubackova, 2014). Teachers who actively do research have several benefits, such as enriching the teaching experience, improving their reputation, obtaining funding for their projects, and enlisting highly productive collaborations (Dută & Rafaila, 2014). However, there are also challenges, namely: it can be hard to combine research and teaching, especially for new teachers who are just starting their careers. Other challenges are the lack of funding, limited access to research facilities, and working in an institution that prioritizes teaching over research (Fitzgerald, Danaia & McKinnon, 2019).

The innovative capability of a university teacher refers to the ability to introduce something new into teaching. By 'new' one should understand advanced technologies (Olayvar, 2023), as well as experiential and creative approaches (Cremin, Glauert, Craft, Compton & Stylianidou, 2018). An innovative teacher is proficient with technology, can show professional growth (Sánchez-García, 2023), is open to feedback, reflects on teaching practices, and looks for ways to improve teaching (Samuel & Rahman, 2018). The challenges faced by innovative teachers include technological barriers, time and resource constraints, and resistance to change due to uncertainty or perceived problems associated with the implementation of new approaches (Oke & Fernandes, 2020). There is also another side to this concept. Specifically, teachers can be innovative in research, that is, discover new areas of research and introduce new methodologies (Shokirovna, 2022). This requires them to think creatively and take risks. To unlock their potential for innovative research behavior, teachers should consider participation in interdisciplinary research (Ramírez-Montoya, Castillo-Martínez, Sanabria, J., & Miranda, 2022). Universities can promote the development of innovative research capability by creating a collaborative research environment and by encouraging teachers to participate in professional conferences and seminars. Another way of achieving that is to recognize the innovative research contributions that come from academic institutions (Gasevic, Tsai, Dawson & Pardo, 2019); this will also contribute to teacher satisfaction (Chen, Cheng, Zhao, Zhou & Chen, 2022).

The mechanisms for harnessing the potential of university teachers as catalysts for research and innovation involve providing teachers with the necessary support, resources, and opportunities to enhance their research skills and innovative efforts (Lambriex-Schmitz, van der Klink, Beausaert, Bijker & Segers, 2020). These include, but are not limited to, faculty development programs, research grants, collaborative research platforms, advanced technology learning, innovation project platforms, networking at scientific conferences, and exchange programs (Al-Husseini et al., 2021; Paniagua & Istance, 2018). These mechanisms, however, must be implemented effectively to achieve the desired result (Ferguson, Coughlan, Egelandsdal, Gaved, Herodotou, Hillaire et al., 2019). The obstacles along this road are the lack of funding, limited access to advanced technologies, low motivation to change and improve among teachers, low institutional support, and the need for additional teacher training (Hiep, Phong & Van, 2020). Other factors influencing the effectiveness of R&I capability development campaigns are the teacher's age and experience: young teachers may be more open to the idea of using such mechanisms, but those who are more experienced are no less adaptable (Lambriex-Schmitz et al., 2020). The effectiveness of such mechanisms may also vary depending on the institutional culture, the level of support provided by the university administration, a particular discipline, or the teaching load (Mutohhari, Sutiman, Nurtanto, Kholifah & Samsudin, 2021). Therefore, fostering the R&I capability of university teachers requires a thoughtful and supportive approach (Nurtanto, Kholifah, Masek, Sudira & Samsudin, 2021).

3. Problem Statement

The significance of the current study is underscored by the imperative to enhance the scientific and innovative skills among the teaching faculty, which constitutes a critical element in improving the quality of education and fortifying the scholarly foundation of universities (Qiu, García-Aracil & Isusi-Fagoaga, 2023). According to several studies, investments in the development of the scientific and innovative potential of educators lead to a higher quality of the educational process and facilitate a swifter integration of academic institutions into the global scientific community (Gulamov, Ozatbekov & Ozatbekova, 2022; Kaputa, Loučanová & Tejerina-Gaite, 2022; Southworth, Migliaccio, Glover, Reed, McCarty, Brendemuhl et al., 2023). This study aims to examine the effects of the "Unlocking Research &

Innovative Capability" program for university teachers. The study offers an overview of strategies and approaches for institutions to employ to empower their staff as catalysts for research excellence and innovation in the academic community. The present findings may be useful to develop targeted activities and teacher development programs for innovation at the university. The objectives of the study are: (1) to measure the innovative potential of teachers based on their age; (2) to measure the innovative potential of teachers after six months of participating in the program; and (3) to determine which age group has responded most to the intervention.

4. Methods and Materials

Due to the lack of relevant data collection instruments, this study uses a specially developed online questionnaire as a tool to measure the R&I capability of university teachers (Appendix 1). The questionnaire looks at (1) teachers' quality as researchers; (2) innovations in their policy and practice; (3) interdisciplinary cooperation; (4) the extent to which a teacher integrates technology into practice, and (5) their research efforts. The questionnaire uses a 5-point Likert scale, with higher scores implying higher innovative potential. The total score for innovative potential is obtained by summing all subscale scores. The questions were presented in the Kazakh language. The overall Cronbach's alpha is α=0.92, ranging from 0.88 to 0.94 depending on the subscale.

Weeks	Block	Content	Activities	Outcomes
1	Introduction and Assessment of Significance	Goals and objectives of the program	Group discussions	Teachers will understand the purpose and objectives of the program
2	Research Qualification	Publications in peer-reviewed journals. Research grants. Participation in conferences	Lectures, demonstrations, and case studies	Participants will expand their research capability
3	Innovative Teaching Methods	Technology-assisted learning. Active learning methods. Flipped learning	Seminars in active learning. Practice sessions	Teachers will be capable of applying innovative teaching methods
4	Interdisciplinary Cooperation	Significance of interdisciplinary research. Cross-faculty collaboration	Listening to guest speakers. Networking events	Teachers will have the ability to collaborate with individuals engaged with other disciplines and sectors
5-6	Integration of Technology	Technologies for data analysis. Virtual laboratories and simulations	Practice sessions	Participants will have the ability to integrate technologies into practice
7-8	Cultural Development and Innovations	Development of creative thinking. How to inspire creativity	Brainstorms. Development of innovative projects	Teachers will have the ability to use innovative solutions during practice
9	Grant Writing and Funding	How to write effective research proposals. Sources of funding and how to identify them	Explore grant writing opportunities. Finding opportunities for fund raising	Teachers will improve their knowledge regarding research grants
10	Ethical Considerations in Research	Research ethics and integrity. How to settle conflicts of interest.	Case studies. Decision making exercises	Participants will know how to conduct research ethically
11	Interdisciplinary Research Project	Formation of interdisciplinary teams. Collaborative project-making	Project planning and implementation. Project presentation	Teachers will be able to manage interdisciplinary research projects
12	Conclusions and Action Plans	Program assessment and feedback. Personalized action plans	Program assessment. Action planning	Teachers will have a ready-made action plan

Table 1. Unlocking Innovative Potential: A Brief Program Outline

The "Unlocking Research & Innovative Capability" program is a voluntary intervention program for university teachers designed to enhance their innovative potential. The program contains various mechanisms and technologies that can be helpful in this regard (Table 1). The intervention consists of 24 sessions spaced across 12 weeks (2 sessions per week).

4.1. Participants

The study involved 80 teachers from the Abai Kazakh National Pedagogical University with expertise in Pedagogy and Psychology. All participants were divided into groups based on their age and teaching experience: young adults (28 to 35 years; teaching experience, 3 to 5 years); early middle-aged adults (36 to 45 years; teaching experience, 5 to 10 years); older middle-aged adults (46 to 55 years; teaching experience, 10 to 20 years); older adults (aged older than 56 years; teaching experience, 20 years). More details are presented in Table 2.

Groups	Total	Male	Female	Mean age (M)	SD	Mean experience (M)	SD
Young adults	20	8	12	30.12	1.57	4.08	1.17
Early mid-aged adults	20	7	13	39.84	6.34	8.12	2.09
Older mid-aged adults	20	10	10	50.34	8.14	15.87	5.66
Older adults	20	9	11	60.58	9.54	27.24	8.97

Table 2. Information about the respondents

Participation in the "Unlocking Innovative Potential" program was voluntary. The study took place within the framework of the education project launched by the Abai Kazakh National Pedagogical University.

4.2. Study Design

The study took place between October 2022 and May 2023. All teachers filled out the Innovative Potential Questionnaire before participation in the program. The study groups (20 participants per group) had the same experiences. Instructions were delivered through classroom learning. Upon completion of the 3-month program at the end of December, teachers received their certificates of completion. The post-intervention survey was conducted at the end of May 2023, before the end of the academic year, to check whether the innovative potential of teachers has changed and if yes, how.

4.3. Data Analysis

Data analysis was done in SPSS through Kruskal-Wallis and Wilcoxon tests.

4.4. Ethical Issues

All participants consented willingly to be part of the study. The study protocol was approved by the Ethics Committee of the Abai Kazakh National Pedagogical University. Anonymity and confidentiality were guaranteed.

5. Results

Table 3 provides descriptive statistics for the pre-intervention R&I capability of university teachers across four age groups. The table shows mean scores for each of the 5 variables from the R&I Capability Questionnaire.

The pre-intervention survey results show prominent differences between age groups. Young adults with a mean score of 16.00 on the Integration of Technology subscale seem to focus on using technology more compared to other age groups. Among all the age groups, early mid-aged teachers appear to have the strongest inclination to engage in research activities (mean score, 15.24), while older mid-aged participants have the best researcher quality (mean score, 13.95). Older adults having a relatively high mean score

(13.45) on Interdisciplinary Cooperation seem to be better collaborators because of their vast experience. Yet, they scored lowest on the Integration of Technology (8.65) and Innovative Teaching (9.25) subscales. The Kruskal-Wallis test shows that the medians are statistically significantly different across the groups (Table 4).

		Researcher quality	Innovative teaching	Interdisciplinary cooperation	Integration of technology	Research practice
Young adults	Mean	10.16	13.32	9.95	16.00	12.95
	Standard error of the mean	.220	.316	.223	.342	.179
	Standard deviation	.958	1.376	.970	1.491	.780
	Variance	.918	1.895	.942	2.222	.608
	Kurtosis	-1.952	-1.932	-1.139	-1.247	-1.271
	Skewness	-.346	.216	-.294	-.112	.096
Early mid-aged adults	Mean	10.81	12.05	12.29	13.62	15.24
	Standard error of the mean	.190	.176	.230	.320	.351
	Standard deviation	.873	.805	1.056	1.465	1.609
	Variance	.762	.648	1.114	2.148	2.590
	Kurtosis	-1.606	-1.417	-1.120	-1.267	-.952
	Skewness	.403	-.090	.207	.426	.129
Older mid-aged adults	Mean	13.95	11.20	14.70	11.75	13.40
	Standard error of the mean	.170	.296	.242	.204	.210
	Standard deviation	.759	1.322	1.081	.910	.940
	Variance	.576	1.747	1.168	.829	.884
	Kurtosis	-1.154	-.973	-1.228	-.371	-.798
	Skewness	.086	.049	-.161	-.378	-.101
Older adults	Mean	12.20	9.25	13.45	8.65	11.40
	Standard error of the mean	.506	.176	.211	.167	.234
	Standard deviation	2.262	.786	.945	.745	1.046
	Variance	5.116	.618	.892	.555	1.095
	Kurtosis	-1.530	-1.152	-.793	-.762	-1.134
	Skewness	-.336	-.496	-.257	.697	-.012

Table 3. R&I subscale scores across age groups before the intervention

	Researcher quality	Innovative teaching	Interdisciplinary cooperation	Integration of technology	Research practice
Chi-square	39.519	51.045	58.725	66.609	48.373
df	3	3	3	3	3
Asymp. Sig.	.000	.000	.000	.000	.000

Table 4. Kruskal-Wallis test statistics

Table 5 provides post-intervention data. The results show significant changes.

For instance, young adult teachers exhibited improvement on all 5 of the R&I capability metrics, ranging from 0.84 in Interdisciplinary Cooperation to 2.63 in Innovative Teaching. The same is true for early mid-aged teachers who showed improvement ranging from 1.52 in Interdisciplinary Cooperation to 3.00 in Integration of Technology. Older middle-aged participants made smaller progress, by comparison, with the highest improvement being 1.85 (Integration of Technology). Older adults improved by less than one point on all scales. The Wilcoxon test shows statistically significant differences within groups (Table 6).

		Researcher quality	Innovative teaching	Interdisciplinary cooperation	Integration of technology	Research practice
Young adults	Mean	11.842	15.947	10.789	18.158	15.105
	Standard error of the mean	.2888	.3935	.2240	.3268	.2405
	Standard deviation	1.2589	1.7151	.9763	1.4245	1.0485
	Variance	1.585	2.942	.953	2.029	1.099
	Kurtosis	-.593	.024	-1.331	-.999	1.716
	Skewness	-.604	-.648	.068	-.309	1.063
Early mid-aged adults	Mean	12.619	14.524	13.810	16.620	16.905
	Standard error of the mean	.2533	.2897	.3424	.3272	.3645
	Standard deviation	1.1609	1.3274	1.5690	1.4992	1.6705
	Variance	1.348	1.762	2.462	2.248	2.790
	Kurtosis	-.607	1.194	-.993	-.525	-.802
	Skewness	-.001	1.007	.347	.632	.592
Older mid-aged adults	Mean	14.300	11.650	15.000	13.600	14.600
	Standard error of the mean	.2417	.3185	.2714	.1835	.2224
	Standard deviation	1.0809	1.4244	1.2140	.8208	.9947
	Variance	1.168	2.029	1.474	.674	.989
	Kurtosis	-.974	-.583	-1.011	-.065	.533
	Skewness	.439	-.519	.000	-.355	.585
Older adults	Mean	12.300	9.400	13.550	8.650	11.700
	Standard error of the mean	.5084	.1974	.2112	,.666	.2524
	Standard deviation	2.2734	.8826	.9445	.7452	1.1286
	Variance	5.168	.779	.892	.555	1.274
	Kurtosis	-1.365	-.760	-.684	-.762	-.389
	Skewness	-.204	-.429	-.159	.697	-.068

Table 5. R&I subscale scores across age groups after the intervention

	Researcher quality	Innovative teaching	Interdisciplinary cooperation	Integration of technology	Research practice
Young adults					
Z-statistic	-4.099b	-4.130b	-4.066b	-4.289b	-4.412b
Asymp. Sig. (2-tailed)	.000	.000	.003	.000	.000
Early mid-aged adults					
Z-statistic	-4.021b	-4.062b	-4.025b	-4.233b	-4.300b
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000
Older mid-aged adults					
Z-statistic	-2.646b	-3.000b	-2.449b	-4.264b	-4.233b
Asymp. Sig. (2-tailed)	.008	.003	.014	.000	.000
Older adults					
Z-statistic	-1.414b	-1.342b	-.816b	.000c	-2.449b
Asymp. Sig. (2-tailed)	.157	.180	.414	1.000	.014

* Note: b – based on negative ranks; c – the sums of negative ranks and positive ranks are equal

Table 6. Wilcoxon test statistics

Based on the above results, the proposed program seems to have a complex effect on the R&I capability of young and early mid-aged teachers; the asymptotic significance was below the threshold value of 0.05 across all subscales. Older mid-aged teachers were only partially affected: differences were significant for three out of 5 subscales, specifically Innovative Teaching, Integration of Technology, and Research Practice. As for older teachers, the intervention failed to significantly improve their R&I capability in either of the subscales.

6. Discussion

The present findings suggest that the proposed education program can boost the R&I capability of young teachers aged 28 to 45 years. This kind of susceptibility likely stems from their openness to adopting new practices and technologies; after all, they still have many years left in their career to actively seek career opportunities (Lian, Guo, Wang, Hu, Yang & Li, 2021). Younger teachers may also be more adaptable, more able to collaborate with others, and more willing to experiment with new methods in the classroom (Krolevetskaya, Nedostupenko, Shekhovskaya & Muromtseva, 2021). Young and middle-aged teachers may actively seek opportunities for professional development (McChesney & Aldridge, 2021), say, to move up the career ladder, and the proposed education program can potentially meet this need by providing a set of tools and strategies for R&I capability building. Surely, less ingrained habits may also play a role, making it easier for teachers to adopt novel teaching methods and research practices (Hobbiss, Sims & Allen, 2021).

Teachers aged 46 to 55 years with 10 to 20 years of experience had a mixed response to the proposed program. Despite some improvements, it failed to enhance their quality as researchers or their ability to collaborate, most likely because they belong to a higher age group and require further practice and targeted interventions (Keržič, Danko, Zorko & Dečman, 2021). The oldest teachers in the study exhibited no statistically significant improvements likely because of deep-rooted teaching practices and research habits. According to some researchers, teachers' rate of growth slows as their practice becomes habitual and mundane (Hobbiss et al., 2021). To effectively meet the specific needs of teachers older than 46 years, alternative approaches or more specific interventions may be needed.

The university teacher's innovative capability defined as an ability to take initiative or having a preference for activities that require innovation was labeled as a precondition for the university system development (Artyukhova et al., 2021). Young teachers were reported to have higher innovative capability than their older colleagues (Artyukhova et al., 2021), which coincides with the current study. Another study found that the effective professional development of university teachers heavily depends on how they interact with one another and their students in the digital learning environment (Zakharova et al., 2020). The proposed program sought to encompass the full range of research and innovative teaching activities to achieve the desired results.

Teachers who are supported by their supervisors and have greater access to innovations were reported to score higher in innovative work behavior dimensions (Lambriex-Schmitz et al., 2020). Their activity was influenced by personal background variables, such as gender, age, level of education, job tenure, working hours, and job position, which coincides with the present findings. Based on in-depth interviews (van der Rijst et al., 2019), there are three distinct learning pathways relating to teachers' learning preferences and activities: learning by performing daily teaching activities; deliberately experimenting with new teaching approaches; and reflecting on teaching experience. Hence, teaching experience is crucial to being innovative. The present study supports this assumption.

7. Conclusions

In this study, young teachers aged 28 to 35 years with a work experience of 3 to 5 years were more interested in using technology in the classroom and for research purposes than their older colleagues. Slightly more experienced teachers aged 36 to 45 years who have been working for 5 to 10 years were most interested in conducting research. Their 46-to-55-year-old colleagues with 10 to 20 years of work experience had the best researcher quality among all respondents. Those older than 56 years worked more than 20 years and were more able to collaborate with others compared to younger teachers.

The participating teachers responded differently to the proposed program. Young teachers exhibited improvements in all R&I capability variables, ranging from 0.84 in Interdisciplinary Cooperation to 2.63 in Innovative Teaching. The same is true for early mid-aged teachers who showed improvement ranging from 1.52 in Interdisciplinary Cooperation to 3.00 in Integration of Technology. Other age groups made

less progress: older mild-aged respondents improved on the Innovative Teaching, Research Practice and Integration of Technology subscales (+1.85 points max), and older teachers improved the least.

The present findings suggest that education programs for teachers intended to boost their research and innovative capability must be attuned to their age and teaching experience. The results of this study can be used to develop effective professional development programs for university teachers. Tailoring interventions to the specific needs of different teacher ages can lead to more comprehensive outcomes. The present findings can serve as a platform to foster a culture of innovation and research among teachers, which will ultimately enhance their teaching.

8. Limitations

This study has several limitations. First, the sample size was small. Second, all teachers were working in Kazakhstan and their experience may differ from that of teachers employed in other countries. Third, the study used an original self-report questionnaire that had not been previously tested. Future research should focus on addressing these limitations.

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Appendix 1

Research & Innovative Capability Questionnaire

On a scale of 1 to 5, where 1 = Strongly Disagree and 5 = Strongly Agree, please rate your level of agreement to the following items:

1: Researcher Quality

I want to publish scientific papers in reputable peer-reviewed journals.

I have received/sought to receive research grants for my research.

I actively participate in international conferences and present my research findings there.

I seek awards and recognition for my contributions to the field of research.

I put efforts to improve my research skills and knowledge to grow as a professional.

2: Innovative Teaching

I use high-tech learning tools to keep students interested and make it easier for them to learn.

I integrate innovative teaching methods (e.g., flipped classrooms, project-based learning, gamification) to improve student learning outcomes.

I encourage students to think critically and creatively by incorporating open-ended assignments and problem-solving exercises into the lessons.

I am attuned to the different learning styles and preferences of students.

I am constantly learning and experimenting with new teaching methods.

3: Interdisciplinary Collaboration

I actively collaborate with colleagues from different departments or disciplines.

I participate in interdisciplinary workshops to expand my knowledge and research perspectives.

I believe interdisciplinary collaboration enriches research outcomes and yields innovative solutions to complex problems.

I encourage students to participate in interdisciplinary projects and explore connections between different subject areas.

I appreciate the diversity of perspectives that interdisciplinary collaboration brings to the academic community.

4: Integration of Technology

I am comfortable using technology to improve my research activities, such as data analysis and modeling.

I integrate technology into the classroom to create a dynamic and interactive learning environment.

I follow the latest technological advances and explore their potential applications in research and teaching.

I use specialized software or tools to streamline research processes and improve accuracy.

I believe that technology plays a critical role in spurring innovation and advancing research across disciplines.

5: Research Practice

I am passionate about scientific research and contribute to developing knowledge in my field.

I am keen to explore new avenues of research and expand the frontiers of existing knowledge.

I am interested in taking on ambitious research projects that can have a significant impact.

I actively seek opportunities to collaborate with other researchers to promote innovation.

I view research challenges as opportunities for growth.

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