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Digital transformation of educators: Introduction of AR masks and social media as assessment tools Based on research in Kazakhstan

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Abstract

This study examines the factors influencing Kazakhstani teachers' readiness to adopt augmented reality (AR) masks and social networks for professional practice, particularly in assessing learning achievements. It aims to identify how demographic and professional characteristics, digital competence, and attitudes shape technology adoption. A questionnaire-based survey of 232 teachers was conducted, analyzing the interplay between age, teaching experience, subject area, digital competency, and attitudes toward innovation. Multivariate analysis of variance (MANOVA) was employed to assess correlations, with theoretical grounding in the Technology Acceptance Model (TAM) and digital divide theory. The analysis revealed several significant patterns in technology adoption among educators. Older teachers demonstrated lower acceptance of AR technologies ($\beta = -0.22$), highlighting persistent generational gaps in digital adaptation. Female educators showed markedly greater technological openness compared to their male counterparts, with this difference being statistically significant. Discipline-specific analysis uncovered that humanities teachers exhibited higher adoption rates of AR masks than science educators. The study findings highlight the need to develop specialized training programs that account for educators' age characteristics and subject-specific requirements, along with creating practice-oriented AR tools tailored to particular academic disciplines (especially for humanities).

Keywords: AR masks, social media, digital divide, digital transformation, educators in Kazakhstan, technological acceptance.

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1. Introduction

The modern educational paradigm requires educators to actively adopt digital technologies in the learning process, including assessment tools. This aligns with both global trends of digitalisation of education and the national educational policy of Kazakhstan. Of particular interest is the integration of augmented reality (AR) technologies through popular social networks, which opens up new opportunities for the transformation of pedagogical practice. Moreover, such technologies are of a visual-demonstrative and visual nature. This allows learners to interact with the learning material using physical, emotional, and intellectual capabilities [1].

Analysis of current research identifies the main key benefits from the application of social media, including AR masks in education: enhancing the visualization of learning material; stimulating interest in learning through gamification; and developing spatial and critical thinking [2]. However, as Santos et al. [3] point out, introducing this kind of technology into the classroom requires a reassessment of traditional teaching and assessment methods.

The main purpose of the study is to analyze the factors influencing the readiness of Kazakhstani teachers to use AR masks and social media in their professional activities. The relationship between professional and demographic characteristics of teachers (age, length of service), the level of their digital competence, and experience in using digital tools, i.e., the digital profile of a teacher, is analyzed. This research utilizes survey responses collected from 232 teachers in Kazakhstan and is designed to fill the gap in the study of regional features of digital transformation in education. The results obtained can be used to develop professional development programs and optimize the processes of introducing new educational technologies.

It is worth noting that the increase in the number of digital activity profiles among teachers in the educational environment reveals exactly the digital profile of a teacher to this kind of innovation. The digital profile of an educator is an integrative characteristic of a teacher's professional activity, reflecting a set of his/her competences, practices and attitudes in the use of digital technologies in the educational process [4]. Many studies have considered the positive aspects of such use, but it also directly depends on their digital competences and experience in using such technology in teaching.

The conducted research in the form of a systematic review and analysis showed that the most popular platforms for educational content in Kazakhstan are TikTok (35.4% growth), Instagram (15.8% growth), and Facebook (18.2% growth). Publications of educational materials gain hundreds and millions of views, which indicates that these platforms can be used as an informal way of learning and assessment. In Kazakhstan, the most effective directions of learning in social networks are the publication of educational materials, organization of group work, receiving feedback in the form of comments and various reactions, automated processes of issuing assignments, and their subsequent verification through content-AR masks Kazakhstan digital education report [5].

Data from Data Reportal (2024) indicates that in Kazakhstan 71.5% of the population actively uses social networks, and the audience of TikTok is 14.1 million people. The research findings underscore the pedagogical value of AR masks as innovative tools for digital learning and assessment. This study investigates educators' perceptions of AR technology in relation to their professional characteristics and technological preparedness, revealing important insights about the adoption of emerging educational technologies. The analysis provides a deeper understanding of both the facilitating factors and barriers that influence teachers' integration of digital tools into instructional practices, offering valuable perspectives for implementing AR-based approaches in modern education.

1. How do the professional and demographic characteristics of teachers affect their perception of AR masks as an assessment tool in the educational process?

2. What is the level of digital activity of Kazakhstani teachers in the context of using AR-masks and social networks in professional activities?

2. The Theoretical Basis of the Research

In the context of professional and demographic characteristics, the concept of digital divide, which in the works of Van Dijk [6] is revealed through the prism of age stratification of technological acceptance, is of particular importance. Empirical research by Scherer et al. [7] confirms the existence of a strong negative correlation between the age of educators and their

readiness to adopt innovative assessment tools, which is especially evident in the introduction of visual-interactive AR technologies.

The theory of professional identity [8], which explains the variability of technological adoption through the prism of subject specialization, is considered in parallel. For example, humanities teachers show greater openness to experimental assessment formats due to their focus on creative pedagogical approaches, while science educators are more likely to have a need for valid and standardized knowledge measurement tools [9].

Analyses of the level of digital competence are based on the DigCompEdu framework adapted for the Kazakh context [9], which highlights three key components:

1. Technical skills for working with digital platforms;
2. Pedagogical strategies for technology integration;
3. Value-motivational aspects of professional development.

Current research on the digital transformation of pedagogy reveals a non-trivial dynamic in the relationship between teachers' professional experience and their readiness for technological innovation. In contrast to traditional notions of a linear relationship [9], recent empirical evidence suggests a U-shaped nature of this relationship [7]. Educators with 10-15 years of experience show the greatest resistance to technological change, while novice professionals and experienced teachers (over 20 years of experience) show a markedly greater openness to digital innovations.

This paradoxical phenomenon can be explained within the framework of modern theoretical approaches. The theory of professional crises [10] interprets this phenomenon through the prism of the stages of professional development, when the period of 10-15 years of experience often coincides with the phase of professional stagnation.

The process of digital transformation is particularly difficult in the conditions of the Kazakhstani educational system. The adaptation of European standards of digital competence of teachers (DigCompEdu) faces a number of specific challenges. The language binarity of the educational space creates both unique opportunities for the development of innovative multilingual solutions and significant difficulties in the localization of digital content [11]. An equally significant problem is the pronounced regional differentiation in the level of digitalization of educational institutions Kazakhstan digital education report [5], which requires the development of differentiated approaches to the introduction of technological innovations. Modern educational policy of Kazakhstan, aimed at modernizing education using digital technologies, should take into account these complex interrelationships.

Modern research has shown that the readiness of educators to apply digital technologies in the context of rapidly evolving digital education is highly variable. As Redecker and Punie [12] note in a paper for the European Commission, educators' digital competence is a multi-dimensional construct that encompasses not only technical skills but also the ability to pedagogically integrate technologies. This aspect is especially relevant for innovative assessment tools such as augmented reality (AR) masks on social media platforms.

Empirical research in the Kazakh context [13] has revealed a significant gap between the formal digital literacy of teachers and their real readiness to implement interactive assessment technologies. Of particular interest are works on the age-related dynamics of digital competence. A study conducted by Tømte et al. [14] shows a paradoxical situation: young educators, despite being highly technically savvy, often have difficulties with the methodological integration of AR technologies, while more experienced colleagues show better results in the pedagogical design of digital assessment tools.

A study [15] analyzing the relationship between digital competence and pedagogical style seems to be a promising direction. The authors conclude that educators with student-centered approaches adopt digital assessment tools significantly faster than their colleagues with traditional teaching methods.

Some studies show that incorporating augmented reality into social media can effectively engage parents in their children's learning. For example, the use of AR effects on the social media platform Facebook optimizes learning and increases cognitive engagement of young children [16]. The conducted study revealed the fact that adolescents use AR masks (effects) as a way of self-identification, communication and creativity. However, it is worth noting that filters can increase self-esteem as well as social pressure. [17]. Nevertheless, the main incentive for the use of AR masks in social media remains a heightened desire for entertainment rather than functionality or usefulness. The effect of filters favors the presentation of visual content, spreading the recommendation, which increases user engagement and digital storytelling [18]. Visualisation of use of AR effects is also effective during social interactions. Studies have been conducted on the accuracy of gaze perception and heightened attention [19].

3. Materials and Methods

Our study involved 232 teachers working in secondary school education of different grades in Astana city, Republic of Kazakhstan. Of them, 37 people have an academic degree of Master's degree, teachers who have only basic education of Bachelor's degree made up 191 people, and also 4 people have an academic degree of PhD (Doctor of Philosophy). All participants voluntarily participated in the questionnaire. The respondents were 211 females (90.95%), and the mean age of all participants was 41 years. The mean length of service of all educators was 17.24 (SD=10.48). The sample was homogeneous; all survey participants were residents of the Republic of Kazakhstan, and the questionnaire was organized in Russian/Kazakh, which are the official and state languages of the country. All participants used various digital technologies in the learning process.

3.1. Procedure

The research team gathered all empirical data through voluntary participation of respondents in the first half of the 2024 academic year. The authors were involved throughout the duration of the experiment. All participants were briefed on

the purpose, procedure, and content of the questionnaire beforehand; subsequently, questionnaires were distributed to all respondents. The average time to complete the questionnaire was approximately 10 minutes. No inquiries were received from the pilot participants during the questionnaire administration period. However, all participants were informed that they could stop the questionnaire process or withdraw at any time.

3.2. Instrument

Part of the instrument included a demographic block of questions about the respondents, their experience of using digital technology in general and social media in particular in their professional sphere, and the nature of their use of it (CAS), developed by Selwyn [20]. The level of digital activity, in our case, we defined this term as the experience of using digital technology, specifically social networks in professional activities, assessed by asking participants: "How many years of experience of using social networks in professional activities?" Perceptions of the use of social media in professional life were measured by surveying respondents, with answers rated on a five-point scale from 1 = not at all confident to 5 = very confident. The questionnaire consisted of 20 questions and included several components of the educator's digital activity (Table 1).

The first component, "Informational," determines the level of interest in new information about the innovation. "Personal" reveals the assessment of the impact of the innovation on oneself, including the level of comfort and complexity, as well as the perception of digital technologies, including AR effects. The "Organisational" component identifies issues related to the process of implementation and planning. "Consequences" reveal the interest in the results of implementation on students. The "Collaboration" component involves active interaction with colleagues regarding the implementation of the innovation. "Improvement" indicates the search for new ways of integration and enhancement of approaches. Participants evaluated all Computer Attitude Scale (CAS) items using a standardized 5-point Likert scale, with response options ranging from "strongly disagree" (1) to "strongly agree" (5). Following data collection, researchers aggregated scores by component and applied reverse coding to negatively phrased items to ensure proper subscale interpretation. Psychometric analysis confirmed CAS as a reliable measure for evaluating educators' digital competencies. Sexton et al. [21], in the course of his study using CAS on 131 preschool participants, it was confirmed that CAS has high reliability (alpha = 0.90).

Table 1.
Elements of the scale for analysing the digital profile of the teacher.

Informational	INF1.	I am interested in new content related to my profession
	INF2	I use social media to search for information related to teaching activities
Personal	PER1.	Feeling the need to use AR masks, which may change my usual teaching style
	PER2	I have doubts that I will be able to use AR masks effectively in the teaching process
	PER3	I am not sure how much as a teacher I can use AR -masks in my teaching process.
	PER4	I am concerned that my skills are insufficient to implement digital technologies in the form of AR masks
	PER5	I believe that incorporating AR masks into my teaching process will make my work more interesting.
Organisational	ORG1	I prepare classes with my colleagues on social media
	ORG2	I create learning materials together with colleagues on social networks
Consequences	CON1.	I believe that the use of AR masks in the learning process increases student engagement
	CON2	AR masks activate students in assessment tasks
	CON3	I observe positive changes in students' learning outcomes from the implementation of AR masks
	CON4	I believe that AR masks make the assessment process fair and transparent
	CON5	Using AR masks in assessment helps students remember information better
Co-operation	COL1	I share teaching and research materials on social media sites
	COL2	I share important work-related information with colleagues
	COL3	I discuss research ideas on social media
	COL4	I conceptualise new educational ideas together with colleagues on social networks.
Improvement	IMP1	I share substantive content on social media
	IMP2	I use social media to seek subject-specific information from colleagues

4. Results

4.1. Level of digital activity.

The attitudes of Kazakhstani educators towards the use of social media in their professional activities and the impact on the use of AR masks in the classroom as an assessment tool were measured in terms of digital technology acceptance, identification of personal doubts and fears, planning and action, effectiveness of use, ability to collaborate, and striving for improvement. All 232 respondents answered all survey questions, and there were no missing data in the survey. Table 2 presents the participants' mean scores with standard deviations for the six subscales.

Overall, the α coefficient values vary from 0.73 to 0.87, indicating satisfactory and high internal consistency of the scales (standard: $\alpha > 0.70$ is acceptable, $\alpha > 0.80$ is good).

The highest mean value is observed for the Collaboration subscale (M=3.9; SD=1.5; α=0.81), indicating participants' positive perceptions of working together in a digital environment. This is followed by the Improvement subscale (M=3.6; SD=1.2; α=0.76), reflecting a desire for professional development through digital technologies. These indicators may indicate a high interest of educators in cooperative and self-developing digital activities.

The lowest mean is found in the Organisational subscale (M=1.5; SD=1.5; α=0.87), which may indicate a perception of institutional or administrative barriers to the adoption of digital tools. Despite the low mean, a high α indicates a high consistency of responses on this scale.

Of interest is the overall mean (M=3.1; SD=1.3; α=0.85), reflecting educators' generally moderately positive attitudes towards the use of digital technologies, including innovations such as AR masks.

Table 2.
Psychometric Properties of Subscales (N=232).

Subscale	No of items	Mean	SD	Alpha
Informational	2	2.7	1.5	0.73
Personal	5	3.2	1.3	0.78
Organisational	2	1.5	1.5	0.87
Consequences	5	2.9	1.4	0.47
Co-operation	4	3.9	1.5	0.81
Improvement	2	3.6	1.2	0.76
Overall	20	3.1	1.3	0.85

Table 3 presents the correlations with the subscales. All subscales are significantly correlated at the $p < .05$ level, with coefficients ranging from 0.10 to 0.62. Since the components obtained were sufficiently independent, they could be considered as independent variables. This makes it possible to study the attitudes of Kazakhstani educators towards the use of social media in their professional activities at different stages of education.

Table 3.
Intercorrelations Among Digital Competency Subscales (N = 232).

Subscale	Informational	Personal	Organisational	Consequences	Co-operation
Personal	0.45*				
Organisational	0.12	0.31*			
Consequences	0.28*	0.10	0.05		
Co-operation	0.33*	0.51*	0.22*	0.17	
Improvement	0.40*	0.62*	0.11	0.29*	0.55*

Confirmatory factor analysis (CFA) was conducted to test the validity of the CAS factor structure. The analysis was performed using AMOS 7.0 [22], applying the maximum likelihood (ML) method for estimation. Regarding the sample size adequate to reliably apply ML estimation on the data [23] requires a sample of 100 to 150 participants, we followed the recommendations of Boomsma [24] and McDonald and Ho [25] in assessing model fit, in addition to the chi-square criterion, other statistical measures were applied to evaluate the quality of the model. The root mean square error of approximation (RMSEA) measures how well the model fits the observed data given the degrees of freedom. It reflects the discrepancy between the model and the covariance matrix as a whole. The (SRMR) index shows the average difference between the observed correlations and those that would be obtained if the model accurately reproduced the data. The Non-Normed Fit Index (NNFI) measures how much better the proposed model fits the data compared to a simple model where all variables are independent of each other. The (CFI) evaluates the relative improvement in the quality of fit of the researcher's model compared to the baseline model. The results of confirmatory factor analysis (CFA) demonstrated good model fit, supported by the following values: Chi-square = 199.328, df= 179, $p < 0.142$; NNFI = 0.84; CFI = 0.98; RMSEA = 0.03; SRMR = 0.06. Table 4 shows the regression estimates and t values for the items and their respective scales.

Table 4.
Regression analysis results for the single factor model of the attitude scale.

Component	Item Code	Estimate (β)	S.E.	t-value	p-value	Interpretation
Informational	INF1	0.72	0.04	18.32	<0.001	Strong loading
	INF2	0.68	0.05	15.89	<0.001	Strong loading
Personal	PER1	0.62	0.03	21.45	<0.001	Key driver
	PER2	0.58	0.04	16.72	<0.001	Strong
	PER3	0.54	0.05	12.83	<0.001	Moderate
	PER4	0.49	0.06	9.12	<0.001	Acceptable
	PER5	0.71	0.03	24.11	<0.001	Strongest in component
Organizational	ORG1	0.83	0.02	32.67	<0.001	Excellent
	ORG2	0.79	0.02	29.45	<0.001	Excellent
Consequences	CON1	0.38	0.07	5.71	<0.001	Weakest (needs revision)
	CON2	0.42	0.06	6.83	<0.001	Low
	CON3	0.35	0.08	4.91	<0.001	Marginal
	CON4	0.45	0.06	7.12	<0.001	Moderate-low
	CON5	0.41	0.07	6.24	<0.001	Low
Collaboration	COL1	0.76	0.03	26.33	<0.001	Strong
	COL2	0.73	0.03	25.17	<0.001	Strong
	COL3	0.69	0.04	19.82	<0.001	Strong
	COL4	0.71	0.03	22.54	<0.001	Strong
Improvement	IMP1	0.65	0.04	17.91	<0.001	Strong
	IMP2	0.63	0.05	15.62	<0.001	Strong

Influence on the use of social media in professional activities, the use of AR masks in the classroom as an assessment tool in the context of age, gender, subject area, period of use, and perceived confidence.

4.2. MANOVA Analysis

A preliminary check of assumptions was conducted to test for multivariate normality and equality of variance. No violations of multivariate normality were found. Regarding the equality of variance, a violation of the dependent variable "behaviour" was identified. Pallant [26] suggested that if this assumption is violated, a more conservative alpha level should be established to determine the significance of this variable. In this study, an alpha value of $p < 0.001$ will be used. A multivariate analysis of variance was conducted on the effect of social media use as a function of age, gender, subject area, years of use, and confidence. Risk groups were identified (men over 45 years old (β = -0.30); science teachers with low confidence). For men, age more strongly reduces AR acceptance (*p* = 0.019). For high seniority, confidence increases positive attitudes (*p* = 0.007). Table 5.

Table 5.
Influence of individual factors.

Factor	Dependent variable	*F*	*p*	Private η²	Interpretation
Age	AR masks	6.21	0.013	0.04	The older, the more skeptical (β = -0.22).
	Social media	3.45	0.064	0.02	Insignificant
Paul	AR masks	8.73	0.003	0.06	Women are more positive (M = 3.8 vs 3.2)
	Social media	12.54	<0.001	0.09	Women are more active (M = 4.1 vs 3.5)
Subject area	AR masks	4.56	0.004	0.07	Humanitarians > Naturalists (*p* = 0.002)
	Social media	2.98	0.032	0.05	Language Educators > Mathematicians
Age of use	AR masks	15.32	<0.001	0.12	The greater the length of service, the higher the acceptance (β = 0.38)
	Social media	9.87	<0.001	0.08	Direct relationship (β = 0.29)
Confidence	AR masks	25.41	<0.001	0.21	Strong effect (β = 0.45)
	Social media	18.76	<0.001	0.16	Key predictor (β = 0.51)

The results of multivariate analysis of variance (MANOVA) indicate a statistically significant effect of a set of independent variables (gender, age, subject area, years of digital technology use, and confidence level) on the dependent variables reflecting educators' attitudes towards the use of social media and AR masks in professional activities (Pillai's Trace = 0.28, $F(12, 450) = 5.67$, $p < 0.001$; Wilks' Lambda = 0.72, $F(12, 448) = 4.89$, $p < 0.001$).

The effect size estimated through the partial eta-square ($\eta^2 = 0.18$) indicates a moderate degree of influence of the investigated factors on the variability of educators' attitudes towards digital technologies. This means that the predictors included in the model explain approximately 18-28% of the total variance of the dependent variables, indicating that there is a significant contribution of other factors not considered in the study, such as individual experience with technology, access to digital resources, or organizational conditions.

The high level of statistical significance ($p < 0.001$) confirms the reliability of the results obtained and allows us to draw reasonable conclusions about the presence of stable relationships between the variables in question. It should be noted that, despite the statistical significance, the moderate effect size indicates the need for further research to identify additional factors influencing the digital activity of teachers.

5. Discussion

The results of this study allow us to draw several important conclusions about the factors influencing the readiness of Kazakhstani educators to use AR masks and social networks in their professional activities. The conducted MANOVA analysis confirmed a statistically significant influence of the set of considered factors (gender, age, subject area, years of technology use and confidence level) on the dependent variables ($p < 0.001$), which is consistent with the data of previous studies [27, 28].

The findings demonstrate several key patterns:

1. Gender differences were found to be a significant predictor: female teachers showed more positive attitudes towards technology, especially in the context of social media use ($M = 4.1$ vs 3.5 for males). This result is consistent with Markauskaite [29] findings but contradicts Brosnan and Lee [30] findings, which may be due to changing gender stereotypes in the digital age.
2. The age factor showed the expected negative correlation with AR technology adoption ($\beta = -0.22$), which supports the theory of the 'digital divide' between generations [31]. However, the lack of a significant effect of age on attitudes towards social media ($p = 0.064$) indicates a more universal adaptation.
3. Subject specialization proved to be a significant factor, with humanities and language educators showing a higher willingness to innovate compared to science teachers ($p = 0.002$). This may be due to differences in pedagogical approaches and subject content.
4. Seniority of technology use and confidence level showed the strongest influence ($\eta^2 = 0.12$ and 0.21 respectively), which fully supports the TAM model's [31] statements about the key role of perceived usefulness and ease of use.

Despite the statistical significance of the results, their moderate explanatory power ($\eta^2 = 0.18$) should be noted. This indicates the presence of other significant factors not taken into account in this study, such as organisational support, access to technological infrastructure, personal characteristics (innovativeness, tolerance to uncertainty), cultural and institutional characteristics.

Based on the results of the study, it is possible to identify practical recommendations, namely the development of targeted programmes for improving digital competence for teachers of older age groups to overcome the age barrier. When introducing AR technologies, it is necessary to take into account subject specificity, offering differentiated approaches for different disciplines. Developing teachers' digital confidence through practice-oriented training can be a key factor for the successful integration of new technologies.

However, there are limitations to the study in the form of a cross-sectional design that does not allow for causal relationships, the use of only self-reported data, and the limited sample. The study could be made more comprehensive by including additional predictors (organisational culture, teaching style) and qualitative research on motivational barriers. The findings contribute to the theory of technological acceptance in education and offer practical guidelines for the development of digital transformation programmes for pedagogy.

6. Conclusion

The conducted research revealed a complex relationship between professional and demographic characteristics of teachers and their level of digital activity. The results indicate a significant influence of gender and age factors on the adoption of innovative tools, with women and younger teachers showing greater openness to the use of social media and AR masks in the educational process. The influence of professional experience with digital technologies and the level of confidence in their use was particularly significant, which confirms the need for targeted development of relevant competences.

The findings emphasize the importance of taking subject specificity into account when introducing technological innovations, as teachers of humanities and language disciplines show a noticeably greater willingness to innovate than their colleagues from the natural sciences. At the same time, the revealed moderate explanatory power of the model indicates the presence of additional factors, not taken into account in the study, related to both individual characteristics of teachers and organizational conditions of their professional activity.

The results of the study have important practical significance for the development of targeted programmes of digitalisation of education, which should take into account the identified patterns. A promising direction for further research is the in-depth study of the role of institutional and cultural factors in the adoption of digital technologies by the teaching community, as well as the development of comprehensive models that combine individual, professional, and organisational determinants of technological adaptation.

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