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Symmetrical and Asymmetrical Modeling: Applying Vitae Researchers' Development Framework through the Lens of Web 2.0 Technologies for Vocational-Health Education Researchers

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Abstract: Background and Purpose: The development of research knowledge, skills, and attitudes among postgraduate vocational-health education students is a crucial outcome of their degree program. This study focuses on the research competences of vocational-health education students and their use of web 2.0 technologies to enhance research productivity. The study employs the Vitae Researcher Development Framework (RDF) and examines the use of web 2.0 technologies. Method: The study surveyed 390 postgraduate vocational-health education students enrolled in universities in Pakistan. Of the participants, 50.5% were male, 49.5% were female, 45.1% were from private universities, and 54.9% were from public sector universities. Moreover, 68.2% were Master's students, while 31.8% were doctoral students. The data were analyzed through both symmetrical and asymmetrical modeling techniques, including Partial least square equation modeling (PLS-SEM) and fuzzy set Qualitative Comparative Analysis (fsQCA), to measure the direct and indirect specific relationships among the constructs. Results: The results confirmed that research competences and web 2.0 technologies have a direct effect on research productivity. Furthermore, the results revealed that web 2.0 technologies mediate in the relationship between research competences and research productivity. Conclusions: The study concludes that research competences and web 2.0 technologies predict research productivity. Additionally, web 2.0 technologies have an intervening role in the relationship between research competences and research productivity during the COVID-19 pandemic emergency. Implications: This study highlights the broader implications for health education policymakers and institutions to include web 2.0 technologies in their development plans. Future studies can develop web 2.0-based instructional strategies for the professional development of advanced vocational-health education researchers. Originality: This study contributes to the knowledge of research competences, web 2.0 technologies, and research productivity for vocational-health education researchers.

Keywords: research competences; research productivity; vocational-health education; web 2.0 technologies

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1. Introduction

The exploration, integration, and exploitation of Information and Communication Technologies (ICT) have become the norm in the health sciences industry in the current era [1] with no exception, ranging from health service-providing companies to the products development industry and academia [2]. Researchers have applied the term "digital

transformation" to highlight the transformation of the business world and society through digital technology [2]. This concept is not limited to high-tech firms and digital startups in the medical sciences, but it is also equally applicable to vocational-health sciences research and development organizations and academia. Digital transformation is a continuous process that firms of all sizes from different health sectors need to embrace [2,3].

Research and knowledge production are the backbone of health sciences academia and the health sciences entrepreneurship process [4]. Vocational-health education institutions prepare researchers for continuing knowledge production for the benefit of society, but vocational-health education organizations also consume their products. Researchers' development and knowledge management are the lifeblood of health education organizations and society [5]. Using innovative technologies for the professional development of researchers, knowledge management, and knowledge sharing according to the changing context, culture, and environment is the hallmark of health education institutions. This situation has prompted researchers to investigate the influence of research competences on the use of technologies for their research productivity at a higher education level in vocational-health sciences. Therefore, the present study explores how research competences enhance research productivity through web 2.0 technologies among vocational-health education novice researchers during the COVID-19 pandemic.

Several models [6] and standards are available for the development of researchers [7]. The Vitae Researcher Development Framework (RDF) has gained significance because of its adaptability for different lenses, such as leadership, employability, early researchers, and so forth [8]. Researchers have also used Vitae RDF to study researchers' knowledge, skills, and attitude development in different contexts. The Society of College, National, and University Libraries (SCONUL) introduced information literacy and its seven pillars. According to [9], information literacy is "an umbrella term which encompasses concepts such as digital, visual and media literacies, academic literacy, information handling, information skills, data curation, and data management." A working paper published in 1999 [9] on the seven pillars of information literacy has described the seven aspects of information-literate persons: "Identity, Scope, Plan, Gather, Evaluate, Manage, and Present." Although experts have suggested viewing Vitae RDF through SCONUL's information literacy lens, there is a scarcity of research on health sciences' novice researcher development through an information literacy lens, especially with a focus on web 2.0 technologies, which saw an increased use by academics during the pandemic. Therefore, research is needed to view researcher development through an information literacy lens with a focus on web 2.0 technologies.

This study addressed the research gaps mentioned above by shedding light on the influence of research competences on research productivity through web 2.0 technologies usage during the COVID-19 pandemic. To understand the phenomenon, web 2.0 technologies were divided into five sub-scales, such as general use of social media, communication technologies, collaborative technologies, information management technologies, and multimedia technologies. We later analyzed them using a second-order technique. This study used a survey approach to collect data from postgraduate vocational-health education students enrolled in a developing country in Pakistan. Partial least square structural equation modeling was used for symmetrical data analysis to measure the relationships used in the research model, while fuzzy set Qualitative Comparative Analysis (fsQCA) helped in asymmetrical data analysis. The research questions of the study were formulated based on the rationale mentioned above:

RQ1. What is the impact of research competences on the use of web 2.0 technologies and research productivity?

RQ2. Does the use of web 2.0 technologies mediate the relationship between research competences and research productivity?

This research contributes to knowledge in four ways. First, it adds to the literature on web 2.0 technologies, research competences, and research productivity for novice researchers in vocational-health education. Second, it provides empirical evidence of the use

of web 2.0 technologies to enhance the research productivity of vocational-health education learners during emergencies such as the COVID-19 pandemic. Third, it presents empirical evidence and a robust statistical analysis of the mediating role of web 2.0 technologies in the relationship between research competences and research productivity during the COVID-19 pandemic. Fourth, it introduces a methodological addition by combining symmetrical and asymmetrical approaches for data analysis. Overall, this study is valuable for vocational-health education institutions, and policymakers can use it to develop research policies and social media strategies to improve researchers' productivity and process efficiency.

2. Literature Review

Web 2.0 is the second version of the worldwide web that enables user collaboration, networking, and content generation. Examples of web 2.0 include YouTube, wikis, blogs, social media, and online networks [10,11]. Web 2.0 has the ability to share information, facilitate user collaboration, and enhance communication. It is also useful for research [12]. For example, web 2.0 technologies such as social networking sites facilitate researchers in collecting data from mass populations and can also provide new insights and ideas from individuals [13,14]. Web 2.0 is also extensively used to share data through blogs and wikis, which enhances the validity and transparency of research [14]. Due to web 2.0 technologies, researchers [12] are collaborating more, promoting interdisciplinary research and knowledge sharing. Web 2.0 platforms such as ResearchGate are also being used by researchers for the dissemination of knowledge [15].

Different researchers define web 2.0 in various ways. Ellison et al. [16] defined web 2.0 technologies as platforms to develop online profiles to connect with others. Kietzmann et al. defined it as building blocks that comprise a set of functionalities [17]. Kaplan et al. presented the taxonomy of web 2.0 into six major categories: online gaming sites, online shared spaces, content-based shared sites, collaborative networks, social network sites, and blogs [11]. Duman [18] used the classification of web 2.0 usage as a tool for research into five broader categories: social media networks such as Facebook and Twitter, web 2.0 for collaboration such as Wikipedia and Statpedia, information management technologies such as Endnote and Mendeley, multimedia services such as audio, video, and file transfer services, and communication technologies such as WhatsApp, Zoom, and Skype [18]. This study has used Duman's [18] classification of web 2.0 technologies among postgraduate students.

Before the pandemic, higher education students spent an average of 10–60 min on social media websites such as Facebook and Twitter to improve their language skills, conduct research, and enhance their research profiles [19]. A pre-pandemic analysis of postgraduate vocational-health education students' web 2.0 technologies such as Facebook, Twitter, wikis, and blogs showed their engagement in virtual environments for research writing as an outcome of social media activity [20]. During the COVID-19 pandemic, postgraduate vocational-health education students faced new challenges and prioritized web 2.0 technologies such as Zoom for research communication [21].

The use of web 2.0 technologies for research among novice vocational-health education researchers depends on their training and research competences in using technology. Previous research suggests that novice researchers use web 2.0 technologies not only for leisure and social networking, but also for sharing opinions [22], online learning [23], information exchange [24], personal promotion, submitting assignments [25], and disseminating research outputs [26].

However, some scholars have a negative view of web 2.0 usage [27,28]. Many scholars believe that web 2.0 use can have a negative impact on students' mental well-being, leading to addiction [28]. Attitudes towards public and scholarly engagement with web 2.0 vary globally, depending on language, cultural, and political paradigms [29]. Some countries prioritize their local web 2.0 platforms by blocking selective international web 2.0 technologies to prevent the spread of undesired political information in their society. For instance, China has banned WhatsApp and Facebook nationwide [30]. The Chinese gov-

ernment recommends WeChat for social, public, and scholarly information dissemination and communication purposes [19]. The use of web 2.0 for academic and other purposes also depends on the circumstances of the users. For example, social isolation during the pandemic has changed the social media usage behavior of students.

One of the objectives of the vocational-health education postgraduate program is to develop students as future knowledge producers. Developing research competences and conducting research work are part of the postgraduate program's coursework. Various frameworks and models are available for researchers' development [7]. Bent et al. proposed a model called the "Seven Ages of Researchers", which describes researchers' development in seven stages: masters-level students, doctoral students, post-doctoral researchers, adjunct researchers, senior research fellows, and expert-level researchers [9]. Another model introduced by a pan-European research network is known as EURAXESS, which categorizes researchers into three developmental stages: R1 is the first postgraduate student stage, R2 is the post-doctorate student stage, and R3 is the professional researcher stage [31]. This research uses Bent et al.'s [31] first level for Master's and PhD students and EURAXESS's R1 level for postgraduate students to define research competences.

Another comprehensive model, the Vitae Researcher Development Framework (RDF), aims to produce professional researchers in the UK [7]. The Vitae RDF was introduced in 2011 [8] and is flexible to use with different lenses, such as leadership and information literacy. Researchers define information literacy as an umbrella term covering key concepts such as data management, information handling, academic literacy, online and web 2.0, and social media literacies [9]. In this research, information literacy is limited to the use of web 2.0 technologies for research productivity. The information literacy or web 2.0 lens of the Vitae RDF is used, connecting the Vitae RDF with the web 2.0 landscape of SCONUL. This lens provides knowledge, skills, and attitudes for researchers' development to use information technology such as web 2.0 and social media for research activities. The web 2.0 lens on Vitae RDF measures how researchers can practically use research competences to use information technologies in their research work. It also enables academicians to realize the use of their information literacy to highlight transferability and their abilities through two-way information technologies for knowledge creation and dissemination.

2.1. Conceptual Framework and Hypotheses Development

The Researcher Development Framework (RDF) is widely adopted by researchers [9], as it helps them develop their skill sets across various domains. This framework emphasizes the importance of information literacy skills for scholars, which are highly effective in helping researchers find, assess, and use information to solve problems and generate new knowledge. Additionally, the RDF is a useful tool for supporting researchers in developing their information literacy skills, including information seeking, data management, and knowledge dissemination. By focusing on specific RDF domains relevant to information literacy, scholars can develop the skills needed to effectively utilize information throughout the research process. In this study, we utilized the RDF through the lens of information literacy, specifically with a focus on web 2.0 and its effect on research productivity. We have also formulated our study hypothesis based on the RDF through the lens of web 2.0 learning technologies.

2.1.1. Research Competences Influence the Research Productivity

In this study, research competences are defined as the knowledge and abilities required to effectively manage research activities for knowledge dissemination. According to Tahsildar and Hasani [32], research productivity is influenced by research skills gained through research competence. Numerous studies in the field of medical science have emphasized the role of professional training and career exploration programs in building research competence. A recent study by [33] on doctoral students in the biomedical field highlighted that researchers invested in training and development, were more aware of their research competences, and observed productive outcomes in their research work and

career. Research competences gained during postgraduate programs help vocational-health education students become expert researchers [9]. Researchers [32] identified a positive role of research competences in enhancing the research productivity of vocational-health education researchers. Another study showed [34] that inferior quality research competences of vocational-health education students result in low-quality research outcomes. Based on the above discussion, we have developed a hypothesis, as follows.

H1. *Research competences have a positive influence on research productivity.*

2.1.2. Research Competences and Web 2.0 Technologies Usage

Research competences are an exogenous construct in this research that affects the usage of web 2.0 technologies, an endogenous variable of the study. According to research findings [35], research competences developed during coursework help students use new media, web 2.0, and social media for collaboration, planning, and research management. Web 2.0 technologies can prove to be a valuable platform for knowledge sharing and collaboration, as they can help transcend geographical boundaries [36]. Furthermore, a study conducted in India [37] found that healthcare professionals who are confident about their knowledge are more likely to engage in knowledge-sharing platforms provided by web 2.0 technologies. Researchers have identified that the research competences of novice vocational-health education researchers influence their ability to access quality research material, develop and share ideas in shared areas of interest, and enhance academic writing skills through the use of social media [38]. According to [39], postgraduate level vocational-health education students use their research abilities to exploit web 2.0 resources to update their information, engage with research activities, access new resources, and enhance their abilities for innovation and creativity. We base the following hypothesis on the above discussion.

H2. *Research competences have a positive influence on the use of web 2.0 technologies.*

2.1.3. Web 2.0 Technologies and Research Productivity

This study defines social media technologies as communication tools, collaborative tools, multimedia tools, management tools, and general technologies that enhance research productivity [40]. Usage of social media platforms such as Zoom, Google Docs, WhatsApp, and Facebook has skyrocketed among postgraduate-level health sciences researchers [41]. Social media technologies provide unique and cost-effective opportunities for novice health sciences researchers to recruit and execute studies [42,43]. Health sciences researchers have used Facebook, Twitter, and other social media networking sites to maintain social distancing [44]. During the COVID-19 pandemic, web 2.0 became an essential communication tool for health sciences research organizations to spread their research work as a public message in society [45,46]. This included maintaining social distancing and accessing hard-to-reach audiences such as colleague researchers, target populations and samples, research networks review meetings, conferences, and journals for the dissemination and sharing of newly constructed knowledge.

When used as a workplace tool, social media has a significant impact on work efficiency. Even the social-oriented use of social media has been found to be helpful for work efficiency as it leads to smoother social interactions, increased awareness of social capital, and more opportunities to explore new clients [47]. Social media also improves social capital formation among employees to build knowledge and enhance work performance [48].

Based on the above discussion, we propose the following hypothesis.

H3. *Social media technologies have a positive influence on research productivity.*

2.1.4. Mediation of Web 2.0 Technologies

Researchers have identified that research competences (RC) positively influence the research productivity (RP) of postgraduate health sciences students [49]. It is also a part of the postgraduate vocational-health education students' learning process to gain research

competences to effectively use web 2.0 technologies, which can enhance their research productivity [50]. Researchers have suggested that novice vocational-health education researchers' RC enable them to gain knowledge, abilities, and attitudes for the use of web 2.0 technologies, such as e-resources and social media, which facilitate research planning, management, organization, and dissemination [51]. The use of social media, in particular, has been found to aid postgraduate students in compiling their research tasks and connecting with their peers [50,52]. Therefore, we propose the following hypothesis based on the above discussion.

H4. *Web 2.0 technologies mediate the relationship between research competences and research productivity.*

3. Research Method

3.1. Research Approach

This study employed a cross-sectional survey research approach. The survey method was beneficial for three reasons. Firstly, to explore the impact of research competences on the use of web 2.0 technologies and research productivity, it was necessary to gather personal insights from postgraduate students. Secondly, collecting data from a large sample size would produce results that are generalizable to the target population of the study. Finally, researchers had connections in the field that enabled them to collect data from postgraduate vocational-health education students.

3.2. Instrumentation

Duman [18] developed a questionnaire to measure the usage of web 2.0 technologies. The instrument was divided into four parts. The first section collected participants' demographic information. The second part asked about the use of different web 2.0 technologies. The third part was related to research competences, and the fourth part was about research productivity. We used a Likert-type scale ranging from 1 = strongly disagree to 5 = strongly agree. Please refer to supplementary file A for information on the constructs, sub-constructs, and relevant indicators. To improve the face validity and content validity of the instrument, 20 PhD students and ten researchers filled out the pilot survey, and ten experts provided feedback. The pilot survey resulted in Cronbach alpha values for all constructs being above the threshold of 0.7. Below, we provide detailed explanations of the scales used in the instrument.

3.2.1. Measures

Research Competences

The scale used 32 items related to research competences, which were adapted from the work of [8]. Sample items included "I can analyze issues related to research" and "I am able to solve research problems during the research process". The Cronbach alpha values were above the threshold of 0.70, indicating that the research competences scale was reliable.

Web 2.0 Technologies Usage

The web 2.0 technologies scale has 25 items adapted from previous studies [18]. Sample items included "Academic and social network sites such as Academia.edu and ResearchGate are helpful for research activities" and "Social media has become a part of my academic routine". The Cronbach alpha values were above the threshold of 0.70, indicating that the web 2.0 technologies scale was reliable.

Research Productivity

The eight items related to research productivity were adapted from the work of Duman [18]. Sample items included "I am able to prepare, organize, and collect data" and "I am able to generate ideas". The Cronbach alpha values were above the threshold of 0.70, indicating that the research productivity scale was reliable.

3.3. Data Collection

This study collected data from postgraduate vocational-health education students enrolled at universities in Pakistan. An online website [53] was used to determine the necessary sample size for the study. Structural equation modeling (SEM) was used with three second-order variables, three observed constructs, eight latent constructs, and eight latent indicators, with an expected effect size of 0.2, a statistical power of 0.8, and a significance level of 95%. The online website calculated a minimum sample size of 276 respondents (Westland, 2010). The research plan was approved by an ethical research committee. The stratified random sampling technique was used to select five public and five private Pakistani universities that offer postgraduate vocational-health education programs. Informed consent was obtained from the students prior to data collection. The sample included 45% private students and 55% students from public universities, based on the proportion of students enrolled in public and private institutions. In this sample, 68% of students were enrolled in a Master's program and 32% were doctoral students, based on the enrollment of students in Master's and doctoral programs in public and private sector universities. The survey was distributed via email to randomly selected email addresses of Master's and PhD students based on the strata outlined above. Out of 400 questionnaires distributed, 10 were discarded due to missing values, resulting in a data analysis of a 97.50% (n = 390) response rate.

3.4. Data Analysis Procedure

We analyzed the data using SmartPLS 3.3.3 for symmetrical data analysis and fsQCA software for asymmetrical data analysis. For symmetrical data analysis, we used the measurement modeling approach, including assessing the indicator loading, Cronbach alpha, composite reliability, and average variance extracted to ensure reliability. Additionally, we ensured convergent and discriminant validity and tested the coefficient of determination, Q^2 Fit indices, f square, and VIF among dimensions. For asymmetrical data analysis, we applied the QCA approach using fsQCA software and measured the consistency level of the configuration. Depending on the research question and data interpretation, various studies have used symmetrical and asymmetrical data analysis techniques simultaneously. Symmetrical data analysis techniques, such as linear regression analysis and structural equation modeling, are used when the factors have a normal distribution and cause—effect relationships need to be measured. These techniques are widely used in tourism studies, psychology, sociology, and business to analyze large-scale surveys. Asymmetrical data analysis techniques are used when the association between factors is non-linear. These techniques include the use of fuzzy set Qualitative Comparative Analysis (fsQCA), which helps to find different combinations of relationships between variables. These techniques are commonly used in health sciences and organizational management. We employed both symmetrical and asymmetrical data analysis techniques to identify both linear and non-linear relationships among the variables, providing us with all possible combinations of research analysis output.

3.5. Demographic Profile

A total of 390 postgraduate vocational-health education students participated in the survey, comprising 197 (50.5%) males and 193 (49.5%) females. Based on the strata shared earlier, 176 (45.1%) research participants were from private higher education institutions, and 214 (54.9%) were from public higher education institutions. Among the participants, 266 (68%) were Master's students, while 124 (31.8%) were doctoral students. In terms of age, 174 (44.6%) participants were under 25 years old, 152 (39%) were between 25–30 years old, 39 (10%) were between 30–35 years old, 9 (2.3%) were between 35–40 years old, 11 (2.8%) were between 40–45 years old, and 5 (1.3%) were over 45 years old.

4. Data Analysis

SmartPLS 3.3.3 was used for symmetrical data analysis, while fsQCA software was used for asymmetrical data analysis.

4.1. Symmetrical Data Analysis

The analysis comprised of two techniques: measurement analysis and partial least square structural equation modeling (PLS-SEM) analysis [54]. The construct of web 2.0 technologies was a second-order factor of the repeated reflective indicators of communication technologies, collaborative technologies, information management technologies, and general social media use. We conducted a two-step analysis following the researchers' guidelines [55].

4.1.1. Outer Model

The reliability and convergent validity of the constructs were assessed by factor loading (FL), Cronbach's alpha, composite reliability (CR), and Average Variance Extracted (AVE) [56]. The threshold values for FL > 0.60, CA > 0.7, AVE > 0.5, and CR > 0.7 [56]. Table 1 showed that the values for FL, CA, CR, and AVE exceeded the respective threshold values. Therefore, the data analysis concluded that the instrument is reliable and valid, as given in Table 1.

Table 1. Reliability and Validity.

Constructs	Loadings	CA	CR	AVE
Collaborative				
CO1	0.86			
CO2	0.936	0.927	0.948	0.821
CO3	0.932			
CO4	0.894			
Communication				
C1	0.778			
C2	0.851			
C3	0.7			
C4	0.893	0.943	0.953	0.716
C5	0.87			
C6	0.894			
C7	0.89			
C8	0.876			
Multimedia				
M1	0.901			
M2	0.928	0.956	0.966	0.85
M3	0.937			
M4	0.931			
M5	0.911			
Management				
I1	0.886			
I2	0.923			
I3	0.907	0.959	0.967	0.832
I4	0.922			
I5	0.938			
I6	0.894			
I7	0.886			

Table 1. *Cont.*

Constructs	Loadings	CA	CR	AVE
General				
G1	0.76			
G2	0.843			
G3	0.836	0.902	0.925	0.672
G4	0.848			
G5	0.798			
G6	0.83			
Engagement				
E1	0.842			
E2	0.794			
E3	0.799			
E4	0.8	0.923	0.937	0.649
E5	0.812			
E6	0.748			
E7	0.845			
E8	0.803			
Governance				
GR1	0.683			
GR2	0.866			
GR3	0.736	0.89	0.917	0.649
GR4	0.847			
GR5	0.854			
GR6	0.831			
Knowledge				
F1	0.651			
F2	0.773			
F3	0.709			
F4	0.77	0.93	0.944	0.706
F5	0.838			
F6	0.787			
F7	0.832			
Effectiveness				
K1	0.768			
K2	0.867			
K3	0.803	0.883	0.909	0.59
K4	0.867			
K5	0.835			
K6	0.907			
K7	0.826			
Research productivity				
RP1	0.844			
RP2	0.911			
RP3	0.93			
RP4	0.935	0.972	0.976	0.838
RP5	0.924			
RP6	0.927			
RP7	0.934			
RP8	0.914			
Web 2.0 technologies				
Multimedia	0.91			
Information management	0.886	0.972	0.974	0.566
Collaborative	0.869			
Communication	0.861			
Social media in general	0.734			

Table 1. *Cont.*

Constructs	Loadings	CA	CR	AVE
Research competences				
Research governance	0.864			
Knowledge and intellectual abilities	0.85	0.956	0.96	0.562
Personal effectiveness	0.849			
Engagement and influence	0.813			

Abbreviations: Average Variance Extracted = AVE; Composite Reliability = CR; Cronbach Alpha = CA.

Researchers [57] suggested using Heterotrait—Monotrait correlation ratios (HTMT) to assess the discriminant validity of the constructs. An HTMT index below the threshold of 1 indicates a satisfactory level of discriminant validity. In our study, we developed a second-order factor for research competences from the sub-factors of research governance, knowledge and intellectual abilities, personal effectiveness and engagement, and influence. Another construct we examined was web 2.0 technologies, which was a second-order factor of communication, collaboration, information management, and multimedia technologies. We found that the discriminant validity for the second-order factors was satisfactory, as shown in Table 2.

Table 2. Factors' Discriminant Validity (HTMT) at second-order.

	Research Productivity	Research Competences
Research productivity		
Research competences	0.705	
Web 2.0 technologies	0.792	0.838

We assessed the quality of the structural equation model through the coefficient of determination R^2, Geisser's Q^2, effect size f^2, fit indices such as SRMR and NFI, and VIF values, and exogenous constructs' direct and indirect effects on endogenous constructs after assessing the outer and inner models.

4.1.2. Quality Measures of SEM

The coefficient of determination R^2 indicates weak, moderate, and strong explanatory power when its values are 0.25, 0.50, and 0.75, respectively. In our study, we measured R-square values for research productivity (0.58) and web 2.0 technologies (0.55). In addition to R-square values, we used the Q-square index to evaluate the criterion prediction of endogenous constructs [58]. To assess the cross-validation redundancy analysis, we used blindfolding in Smartpls software. The Q^2 index (which is calculated as 1-SSE/SSO) reflects the quality of the path model, with all endogenous constructs above the zero thresholds, as shown in Table 3.

Table 3. Coefficient of Determination and Q^2.

Constructs	R^2	Q^2
Research productivity	0.582	0.483
Web 2.0 technologies	0.552	0.400

The fitness of the model was evaluated using the Standardized Root Mean Squared Residual (SRMR) and Bentler—Bonett Normed Fit Index (NFI). According to researchers [59], a model is considered to have a good fit if the SRMR values are below the threshold of 0.05 and the NFI is greater than 0.9. In our SEM analysis, we found SRMR = 0.049 and NFI > 0.90, indicating good fit indices. Additionally, the RMS_Theta value was used as another indicator to measure the model fit, and the ideal threshold value is below 0.12. The value of RMS_Theta, which was 0.127 in Table 4, indicates that the model fit was appropriate.

Table 4. Fit indices, f-square, and VIF.

Constructs	Research Productivity		Web 2.0 Technologies		Fit Indices
	f^2	VIF	f^2	VIF	
Research Ccompetences	0.046	2.234	1.234	1	SRMR = 0.049 NFI = 0.90
Web 2.0 technologies	0.382	2.234			RMS_Theta = 0.127

A principal component factor was constructed using factor analysis. According to [60], the unrotated factor analysis results should be below 50%. Harman's one-factor analysis yielded a result of 31.7%. In addition, we measured the VIF values to assess multicollinearity issues among the constructs. VIF values should be below the threshold of 0.5 [61]. All constructs showed VIF values less than 0.5, indicating no multicollinearity problem, as given in Table 4.

Next, we measured the f-square values that reflect the effect of exogenous constructs on endogenous constructs in a measurement model; an f-square value below 0.02 is weak, between 0.02 and 0.15 is moderate, and above 0.15 is substantial [62]. All constructs have shown a satisfactory effect size of exogenous constructs on endogenous constructs, as given in Table 4.

4.2. Descriptive Statistics

All constructs exhibited a general inclination towards agreement on a scale of 1 (strongly disagree) to 5 (strongly agree), as demonstrated by the following means and standard deviations: research competences (M = 4.029, SD = 0.524), web 2.0 technologies (M = 3.776, SD = 0.922), and research productivity (M = 3.604, SD = 1.28).

4.3. Direct Path

Researchers [63] have suggested measuring the β coefficient; to assess the effect of exogenous constructs on endogenous constructs in hypothesis testing. Research also [64] recommends measuring the probability level and t-stats; to endorse the β coefficient for hypothesis testing at the bootstrapping level of 5000 sub-samples. We performed a bootstrap at 5000 level to get the β coefficient, significance level, and t-statistics.

We verified a positive and significant relation of RC with RP (β = 0.207, t = 4.526, p = 0.000). Hence, it does not reject H1. Data analysis shows that the influence of RC with the use of web 2.0 technologies was significant and positive (β = 0.745, t = 30.66, p = 0.000). Hence, it robustly accepts H2. Web 2.0 technologies have shown a positive and significant relation with RP (β = 0.596, t = 12.324, p = 0.000). Hence, it accepts H3. Data analysis showed the mediation of RC between web 2.0 technologies and RP. Web 2.0 technologies showed a positive mediation between research competences and research productivity (β = 0.444, t = 11.343, p = 0.00). Hence, it accepts H4, as given in Table 5. Figure 1 also shows overall relations among the constructs.

Table 5. Direct and indirect Paths.

Direct and Indirect Relationships	Coefficients	Mean	T Statistics	*p* Values
Research competences → research productivity	0.207	0.206	4.526	0.000
Research competences → web 2.0 technologies	0.745	0.744	30.663	0.000
Web 2.0 technologies → research productivity	0.596	0.598	12.324	0.000
Research competences → web 2.0 technologies → research productivity	0.444	0.445	11.343	0.000

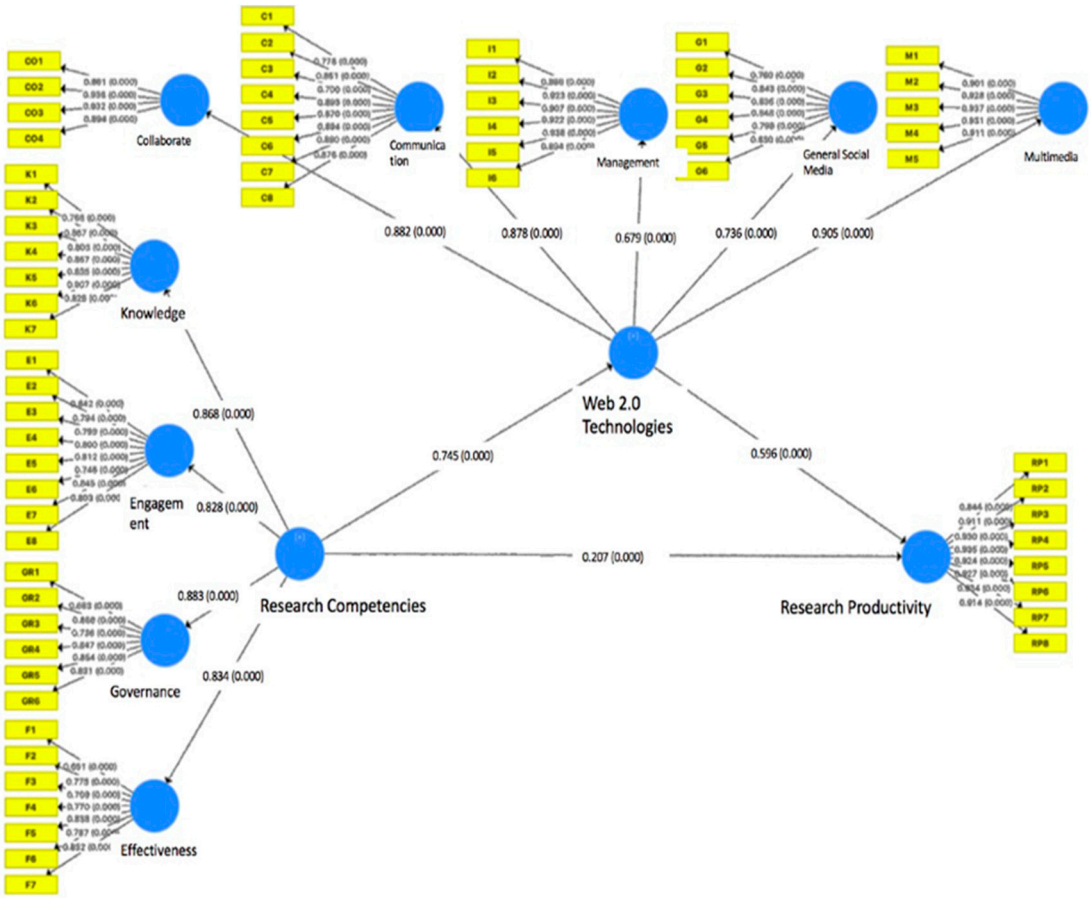

Figure 1. Direct relations.

Figure 1 shows the overall direct relation among the variables.

Asymmetrical Data Analysis

The qualitative comparative analysis (QCA) technique was initially introduced in the 1980s in various fields, including political science and sociology, to investigate complex conditions with small sample sizes [65]. However, QCA's applicability is not restricted to small sample studies, and it can be used in various disciplines to analyze large datasets [66]. QCA is used to determine the necessary and sufficient conditions for achieving an outcome through the combination of various exogenous constructs.

To analyze our data, we converted the Excel data file into a CSV file and standardized the item scores, which ranged from −3 to 3. The first step involved calibrating the scores, such as 3 to 1, 0 to 0.05, and −3 to 0 [67]. The second step generated a truth table [68], which presented the possible configurations of conditions necessary to obtain the study's outcome. Researchers [69] recommended setting the consistency level to 3 for samples larger than 150, which reduced the rows with fewer than two cases. The final step was to identify the configuration with a consistency level > 0.8 and coverage level > 0.2 [67].

The fsQCA technique provides three types of solutions: simple and complex solutions, parsimonious solutions, and intermediate solutions. Researchers [67,70] suggest choosing intermediate solutions as an adequate option for analyzing fsQCA results. This is the reason we selected intermediate solutions for interpreting the results.

The fsQCA outcomes show a linear and mono combinations of the dimensions of RC and SMT, which generate an outcome of RP. It also shows a sufficient configuration to produce a high level of RP. The configuration table for RP presents two configurations: configuration 1 (RC) and configuration 2 (SMT), as given in the Table 6.

Table 6. Configurations for RP.

Configurations	Raw Coverage	Unique Coverage	Consistency
	Model: research productivity = f (RS, SMT)		
RC	0.85	0.040	0.90
SMT	0.90	0.082	0.90
Solution coverage: 0.940638;			
Solution consistency: 0.848767			

Regression graphs also endorsed a positive relation of RC with RP as well as web 2.0 technologies with RP as given in the Figure 2.

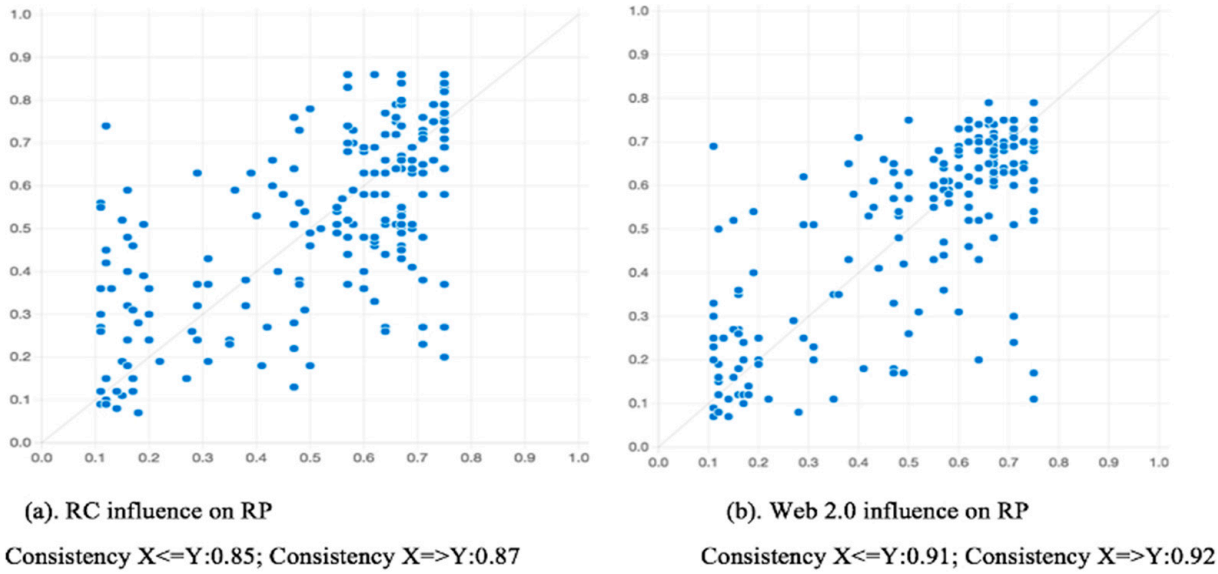

Figure 2. (**a**) RC influence on RP, (**b**) Web 2.0 inlfuence on RP.

5. Discussion

The purpose of this research was to measure the influence of research competences on the use of web 2.0 technologies to enhance the research productivity of students during the COVID-19 pandemic. To the best of the researchers' knowledge, this is among the first studies to measure the influence of research competences with the mediation of web 2.0 technologies to enhance research productivity during an emergency. The COVID-19 pandemic has proved disastrous for almost all sectors of society worldwide, including education [71]. The COVID-19 lockdown restricted many people to working from home through telework, which potentially affected work productivity [72]. There is competition among health, educational, and pharmaceutical research institutions to invent vaccines, revolutionary medicines, and scientific breakthroughs to sustain a healthier world for all. Health sciences vocational, educational, and research institutions need to compete in a transforming world [73]. During the last two decades and especially during and after the post-COVID-19 context, competition has increased among the health sciences' vocational and educational institutions that need continuous innovation adoption to sustain in the market [74]. Vocational-health education institutions cannot survive without adopting innovative technologies to enhance their performance and research productivity, like other business organizations [2,74]. Therefore, the Higher Education Commission (HEC) of Pakistan directed vocational-health education institutions' teachers and postgraduate students to use information communication and technology (ICT) resources [73,75]. Vocational-health education institutions tried their best to expedite disruptive innovation technologies during the COVID-19 pandemic. The basic purpose of these efforts was to maintain re-

search productivity among students, such as thesis and paper writing and research project development, and students' graduation [76]. Unfortunately, vocational-health education institutions were not ready to adopt e-learning systems because they did not train enough teachers to use e-learning systems in the case of emergency [77]. Sufficient infrastructure was also not available to use e-learning systems. However, the internet, mobile phones, and social media networks were accessible to vocational-health education students. Researchers assumed that the research competences imparted to novice vocational-health sciences researchers also developed their information literacy, which helped them use web 2.0 technologies for learning and research during the pandemic [78].

Our study followed the Researcher Development Framework (RDF) by Vitae to find out the research competences of the researchers. First, the current study explored the influence of research competences on research productivity among postgraduate vocational health education students. The study outcomes revealed a positive and significant influence of research competences on research productivity; hence, H1 was accepted. The current study results match with previous studies that early researchers' research competences based on RDF, such as "engagement and influence", "personal effectiveness", "research management", and "research knowledge" correlate with research productivity [76,79]. Researchers [80] also suggested that higher education aims to impart research competences among postgraduate vocational health education students that help them produce research effectively. Therefore, it is derived that research competences may play a positive role in a crisis to increase research productivity.

Second, current research assessed the influence of research competences on the use of web 2.0 technologies. The results supported H2: research competences significantly and positively impacted postgraduate vocational-health education students' research productivity during COVID-19. Previous studies also supported the results of our study that research competences influence the use of web 2.0 technologies among postgraduate vocational-health education students for research [81]. Gleason et al. [82] viewed the influence of research skills on the use of web 2.0 for research communication. The study concluded that postgraduate vocational-health education students' research competences, such as research management, effectiveness, and governance, help them use web 2.0 for research. Novice vocational-health sciences researchers used web 2.0 technologies for updating literature, data collection, and storage. Web 2.0 technologies also helped novice researchers in collaboration, communication, and sharing of ideas. However, barriers to adopting web 2.0 technologies for research include misinformation, quality of information, and restrictions. According to researchers [19], the COVID-19 pandemic has led to the active use of web 2.0 technologies to disseminate pandemic statistics, global health issues, and vaccine development [83]. Health sciences publishers have also shifted towards web 2.0 platforms to enhance their research output. ICT technologies and web 2.0 technologies were already used in e-health, telemedicine, and other popular forms of digital healthcare [84]. A survey in health sciences research has revealed that peer review, social media promotion, and open access are key factors in producing impactful research publications [85]. It shows that web 2.0 technologies are becoming a trend in health sciences academia, like other business sectors. For example, if traditional health education institutions were not ready to use classical e-learning systems for researchers' development and research production during the COVID-19 emergency, it does not mean that health sciences institutions stopped their function. Astonishingly, advanced health sciences institutions worldwide exploited the readily available new technologies and web 2.0 technologies under practice for their researchers' development and research productivity, which resulted in the development of vaccines for COVID-19 in record time, such as Pfizer-BioNTech, Oxford-AstraZeneca, Sinopharm BIBP, Moderna, Janssen, CoronaVac, Covaxin, and Novavax. The health sciences industry did not only use new technologies for innovation and research, but higher education vocational-health sciences institutions also used new technologies to continue the education and research process.

Third, this research found the influence of web 2.0 technologies usage on research productivity. The results supported H3: web 2.0 technologies significantly and positively influenced postgraduate vocational-health education students' research productivity during COVID-19. The results of the research coincide with prior studies [86]. Rapid use of surveys enabled researchers to gain knowledge about the pandemic's effects. Video conferencing technologies such as Skype and Zoom helped postgraduate researchers conduct qualitative interviews [13]. Collaborative technologies, such as Wikipedia and Statpedia, helped early-career researchers gain basic knowledge [87,88]. Researchers shared audio, video, and data files through social media [88,89]. Overall, we concluded that using web 2.0 technologies is essential to enhance postgraduate vocational-health education students' research productivity during emergencies.

Fourth, our study measured a mediating role of web 2.0 technologies usage in the relationship between RC of the vocational-health education students and RP during the COVID-19 pandemic. Results showed web 2.0 technologies positively and significantly mediate the relationship between research competences and research productivity, supporting H4. The previous research findings also confirmed the relationship between RC and RP through web 2.0 technologies [33] among vocational-health education students [90]. Similarly, results showed that research skills help enhance research productivity among vocational-health education students through web 2.0 technologies [91]. The plausible reason for the positive influence of research competences on research productivity through web 2.0 technologies is because the rapid use of social networking sites improves the research productivity during the COVID-19.

6. Conclusions

This study makes a theoretical contribution by introducing an RDF competence framework through the lens of information literacy, with a focus on the use of web 2.0 technologies. This research has broader theoretical implications in terms of linking research competences with the research productivity of postgraduate students, through the use of web 2.0 tools. The development of postgraduate students' research competences may include research governance, knowledge and intellectual abilities, personal effectiveness, and engagement and influence, which are linked with the use of web 2.0 technologies such as communication tools, media tools, management tools, and collaboration tools. Finally, this study adds to the understanding of the mediating role of web 2.0 technologies between RDF-based competences and research productivity.

7. Practical Implications

Web 2.0 technologies and research competences were key predictors of research productivity among postgraduate vocational-health education students during the COVID-19 pandemic. There are multiple implications for various stakeholders, such as supervisors, researchers, and vocational-health education policymakers. We have viewed RDF through the lens of information literacy with focus on web 2.0 technologies. First, universities should devise a research competence development policy of the early researchers for the utilization of web 2.0 for research purposes. Second, the research supervisors should encourage and guide the students on using web 2.0 technologies to improve their research productivity. Third, vocational-health education policymakers at the university should revise their policies and allow their research supervisors to supervise their students using various web 2.0 technologies, which ultimately improve research productivity among the students. Vocational-health education institutions may devise their instructional designs to train novice researchers; collect data through information management tools such as Monkey surveys, Google docs, and Qualtrics; use information management tools such as Mendeley and Endnote; communicate with researchers and other relevant persons through communication management tools such as Google meet, Zoom and Skype; collaborate for knowledge seeking through collaborative tools such as Wikipedia and Statepedia; share the research tasks through multimedia tools such as audio, video and images. Finally,

the setting research competences frameworks through the lens of information literacy for the use of web 2.0 technologies would enhance the research productivity of the novice researchers during or post pandemic crisis.

8. Limitations and Future Research Direction

Limitations of this study include focusing only on postgraduate vocational-health education students in Pakistan. To better understand the phenomena under study, we suggest conducting further research that includes different disciplines from higher education. Additionally, the study relied on a cross-sectional and self-report method to collect data. Future studies could use a mixed-methods approach and interview techniques to gain a more in-depth understanding. Experimental studies could also be conducted by designing different web 2.0 interventions for developing research competences among early career researchers. This study explored the mediating role of web 2.0 technologies in the relationship between research competences and research productivity. Future studies could consider factors such as research attitudes, research facilities, and the role of mentors in enhancing research productivity in vocational-health education.

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References

1. Selvi, K.S.; Ganesan, P. Exploring the university research scholars' information literacy competency: A focus on the knowledge and skills. *Inf. Discov. Deliv.* **2022**, *50*, 365–373. [CrossRef]
2. Jafari-Sadeghi, V.; Garcia-Perez, A.; Candelo, E.; Couturier, J. Exploring the impact of digital transformation on technology entrepreneurship and technological market expansion: The role of technology readiness, exploration and exploitation. *J. Bus. Res.* **2020**, *124*, 100–111. [CrossRef]
3. Sadeghi, V.J.; Biancone, P.P.; Anderson, R.B.; Bakenda, J.M.N. International entrepreneurship by particular people 'on their own terms': A study on the universal characteristics of entrepreneurs in evolving economies. *Int. J. Entrep. Small Bus.* **2019**, *37*, 288. [CrossRef]
4. de Noronha, M.E.S.; Bento, L.F.; Rufino, J.P.F.; Rocha, T.V. Research overview about competences of startups. *Int. J. Prof. Bus. Rev.* **2022**, *7*. [CrossRef]
5. Iovu, M.-B.; Bărbuță, A. Research Competencies of Social Work Students during Remote Learning. *Rev. Rom. pentru Educ. Multidimens.* **2022**, *14*, 203–222. [CrossRef]
6. Vuong, Q.H. *Mindsponge Theory*; Walter de Gruyter GmbH: Berlin, Germany, 2023; ISBN 9783111186092.
7. Fazal, F.A.; Chakravarty, R. Researcher development models and library research support. *Libr. Hi. Tech. News* **2021**, *38*, 18–22. [CrossRef]

8. VITAE. Researcher's Development Framework. 2010. Available online: https://www.vitae.ac.uk/researchers-professional-development/about-the-vitae-researcher-development-framework/developing-the-vitae-researcher-development-framework (accessed on 28 October 2020).
9. Bent, M.; Stubbings, R. *The SCONUL Seven Pillars of Information Literacy: Core Model For Higher Education*; SCONUL Working Group on Information Literacy: London, UK, 2011.
10. Fuchs-Kittowski, F.; Köhler, A. Knowledge creating communities in the context of work processes. *ACM SIGGROUP Bull.* **2002**, *23*, 8–13. [CrossRef]
11. Kaplan, A.M.; Haenlein, M. Users of the world, unite! The challenges and opportunities of Social Media. *Bus. Horizons* **2010**, *53*, 59–68. [CrossRef]
12. Liu, C.; Ma, J.-L. Adult Attachment Style, Emotion Regulation, and Social Networking Sites Addiction. *Front. Psychol.* **2019**, *10*, 2352. [CrossRef]
13. Boland, J.; Banks, S.; Krabbe, R.; Lawrence, S.; Murray, T.; Henning, T.; Vandenberg, M. A COVID-19-era rapid review: Using Zoom and Skype for qualitative group research. *Public Health Res. Pract.* **2021**, *32*. [CrossRef]
14. Jason, P.; Bradely, H.H. Scientometrics 2.0: New metrics of scholarly impact on the social Web. *First Monday* **2010**, *15*. [CrossRef]
15. Wolf, M.; Sims, J.; Yang, H. Social Media? What Social Media? *UK Acad. Inf. Syst. Conf. Proc.* **2018**, *3*.
16. Ellison, N.B.; Boyd, D.M. Sociality through Social Network Sites. In *The Oxford Handbook of Internet Studies*; Oxford University Press: Oxford, UK, 2013.
17. Kietzmann, J.H.; Hermkens, K.; McCarthy, I.P.; Silvestre, B.S. Social media? Get serious! Understanding the functional building blocks of social media. *Bus. Horiz.* **2011**, *54*, 241–251. [CrossRef]
18. Murat, D. Graduate Students' Use of Social Media Tools for Thesis/Dissertation Research. Ph.D. Thesis, Middle East Technical University, Ankara, Turkey, 2015.
19. Zimba, O.; Gasparyan, A.Y. Social media platforms: A primer for researchers. *Rheumatology* **2021**, *59*, 68–72. [CrossRef]
20. Cheston, C.C.; Flickinger, T.E.; Chisolm, M.S. Social Media Use in Medical Education: A Systematic Review. *Acad. Med.* **2013**, *88*, 893–901. [CrossRef]
21. Dedeilia, A.; Sotiropoulos, M.; Hanrahan, J.G.; Janga, D.; Dedeilias, P.; Sideris, M. Medical and Surgical Education Challenges and Innovations in the COVID-19 Era: A Systematic Review. *In Vivo* **2020**, *34* (Suppl. 3), 1603–1611. [CrossRef]
22. Wiid, J.A.; Cant, M.C.; Nell, C.E. Perceptions And Uses Of Social Media Networking Systems By South African Students. *Int. Bus. Econ. Res. J.* **2014**, *13*, 715. [CrossRef]
23. Salmon, G.; Ross, B.; Pechenkina, E.; Chase, A.-M. The space for social media in structured online learning. *Res. Learn. Technol.* **2015**, *23*. [CrossRef]
24. Al-Sharqi, L.; Hashim, K. University Students' Perceptions of Social Media as a Learning Tool. *J. Soc. Media Soc.* **2016**, *5*, 65–88.
25. Subramani, R. The Academic Usage of Social Networking Sites by the University Students of Tamil Nadu. *Online J. Commun. Media Technol.* **2015**, *5*, 162–175. [CrossRef]
26. van Noorden, R. Online Collaboration: Scientists and the Social Network. *Nature* **2014**, *512*, 126–129. [CrossRef] [PubMed]
27. Iqbal, J.; Asghar, M.Z.; Ashraf, M.A.; Rafiq, M. Social Media Networking Sites Usage and Depression Among University Students During the COVID-19 Pandemic: The Mediating Roles of Social Anxiety and Loneliness. *Soc. Media + Soc.* **2022**, *8*, 20563051221107633. [CrossRef]
28. Cann, A.; Dimitriou, K.; Hooley, T. *Social Media: A Guide for Researchers*; Research Information Network: London, UK, 2011; p. 89.
29. Zeng, R.; Li, M. Social Media Use for Health Communication by the CDC in Mainland China: National Survey Study 2009–2020. *J. Med. Internet Res.* **2020**, *22*, e19470. [CrossRef]
30. Lien, C.H.; Cao, Y. Examining WeChat users' motivations, trust, attitudes, and positive word-of-mouth: Evidence from China. *Comput. Hum. Behav.* **2014**, *41*, 104–111. [CrossRef]
31. Yurdakul, I.K.; Ursavas, F.; Işçitürk, G.B. An Integrated Approach for Preservice Teachers' Acceptance and Use of Technology: UTAUT-PST Scale. *Eurasian J. Educ. Res.* **2014**, 21–36. [CrossRef]
32. Nasim Tahsildar Faculty-Perceived Research Skills and Research Productivity: A Case Study at a Public University in Af-ghanistan. *Indian J. Sci. Technol.* **2021**, *2*, 11–36.
33. Brandt, P.D.; Varvayanis, S.S.; Baas, T.; Bolgioni, A.F.; Alder, J.; Petrie, K.A.; Dominguez, I.; Brown, A.M.; Stayart, C.A.; Singh, H.; et al. Measuring Effects of Trainee Professional Development on Research Productivity: A Cross-Institutional Me-ta-Analysis. *bioRxiv* **2020**, 1–59. [CrossRef]
34. Iqbal, M.Z.; Mahmood, A. Factors Related to Low Research Productivity at Higher Education Level. *Asian Soc. Sci.* **2011**, *7*, 188. [CrossRef]
35. Nikolaieva, S.Y.; Koval, T.I. Use of Information and Communication Technologies for Research Competency Formation of Future Doctors of Philosophy. *Inf. Technol. Learn. Tools* **2019**, *1*, 237–256. [CrossRef]
36. Singh, J.B.; Chandwani, R.; Kumar, M. Factors affecting Web 2.0 adoption: Exploring the knowledge sharing and knowledge seeking aspects in health care professionals. *J. Knowl. Manag.* **2018**, *22*, 21–43. [CrossRef]
37. Maheshwari, B.; Sarrion, M.; Motiani, M.; O'Sullivan, S.; Chandwani, R. Exploration of factors affecting the use of Web 2.0 for knowledge sharing among healthcare professionals: An Indian perspective. *J. Knowl. Manag.* **2020**, *25*, 545–558. [CrossRef]
38. Nwangwa, K.C.; Yonlonfoun, E.; Omotere, T. Undergraduates and Their Use of Social Media: Assessing Influence on Research Skills. *Univers. J. Educ. Res.* **2014**, *2*, 446–453. [CrossRef]

39. Rajeh, M.T.; Sembawa, S.N.; Nassar, A.A.; Al Hebshi, S.A.; Aboalshamat, K.T.; Badri, M.K. Social media as a learning tool: Dental students' perspectives. *J. Dent. Educ.* **2020**, *85*, 513–520. [CrossRef]
40. Gruzd, A.; Staves, K.; Wilk, A. Connected scholars: Examining the role of social media in research practices of faculty using the UTAUT model. *Comput. Hum. Behav.* **2012**, *28*, 2340–2350. [CrossRef]
41. Lowenthal, P.R.; Borup, J.; West, R.E.; Archambault, L. Thinking Beyond Zoom: Using Asynchronous Video to Maintain Connection and Engagement During the COVID-19 Pandemic. *J. Technol. Teach. Educ.* **2020**, *28*, 383–391.
42. Arigo, D.; Pagoto, S.; Carter-Harris, L.; Lillie, S.E.; Nebeker, C. Using social media for health research: Methodological and ethical considerations for recruitment and intervention delivery. *Digit. Health* **2018**, *4*, 2055207618771757. [CrossRef]
43. Brown, J.; Kotz, D.; Michie, S.; Stapleton, J.; Walmsley, M.; West, R. How effective and cost-effective was the national mass media smoking cessation campaign 'Stoptober'? *Drug Alcohol Depend.* **2014**, *135*, 52–58. [CrossRef]
44. Ni, M.Y.; Yang, L.; Leung, C.M.C.; Li, N.; Yao, X.I.; Wang, Y.; Leung, G.M.; Cowling, B.J.; Liao, Q. Mental Health, Risk Factors, and Social Media Use During the COVID-19 Epidemic and Cordon Sanitaire Among the Community and Health Professionals in Wuhan, China: Cross-Sectional Survey. *JMIR Ment. Health* **2020**, *7*, e19009. [CrossRef]
45. Cuello-Garcia, C.; Pérez-Gaxiola, G.; van Amelsvoort, L. Social Media Can Have an Impact on How We Manage and Inves-tigate the COVID-19 Pandemic. *J. Clin. Epidemiol.* **2020**, *127*, 198–201. [CrossRef]
46. Ali, S.H.; Foreman, J.; Capasso, A.; Jones, A.M.; Tozan, Y.; DiClemente, R.J. Social media as a recruitment platform for a nationwide online survey of COVID-19 knowledge, beliefs, and practices in the United States: Methodology and feasibility analysis. *BMC Med. Res. Methodol.* **2020**, *20*, 116. [CrossRef]
47. Jong, D.; Chen, S.-C.; Ruangkanjanases, A.; Chang, Y.-H. The Impact of Social Media Usage on Work Efficiency: The Perspectives of Media Synchronicity and Gratifications. *Front. Psychol.* **2021**, *12*, 693183. [CrossRef] [PubMed]
48. Babu, S.; Vr, H.; Subramoniam, S. Impact of Social Media on Work Performance at a Technopark in India. *Metamorph. A J. Manag. Res.* **2020**, *19*, 59–71. [CrossRef]
49. Asghar, M.Z.; Arif, S.; Iqbal, J.; Seitamaa-Hakkarainen, P. Social Media Tools for the Development of Pre-Service Health Sciences Researchers during COVID-19 in Pakistan. *Int. J. Environ. Res. Public Health* **2022**, *19*, 581. [CrossRef]
50. O'Connor, S.; Jolliffe, S.; Stanmore, E.; Renwick, L.; Booth, R. Social media in nursing and midwifery education: A mixed study systematic review. *J. Adv. Nurs.* **2018**, *74*, 2273–2289. [CrossRef]
51. Leshchenko, M.P.; Kolomiiets, A.M.; Iatsyshyn, A.V.; Kovalenko, V.V.; Dakal, A.V.; Radchenko, O.O. Development of Informational and Research Competence of Postgraduate and Doctoral Students in Conditions of Digital Transformation of Science and Education. *J. Phys. Conf. Ser.* **2021**, *1840*, 012057. [CrossRef]
52. Korzynski, P. How does online social networking help leaders communicate? evidence from the Fortune 500. *Asia Pac. J. Hum. Resour.* **2014**, *52*, 460–475. [CrossRef]
53. Soper, D.S. A-Priori Sample Size Calculator for Structural Equation Models [Software]. 2017. Available online: www.danielsoper.com/statcalc (accessed on 28 October 2020).
54. Hair, J.F.; Hult, G.T.M.; Ringle, C.M.; Sarstedt, M. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*; Sage: Thousand Oaks, CA, USA, 2017.
55. Wang, B.; Rasool, S.F.; Zhao, Y.; Samma, M.; Iqbal, J. Investigating the nexus between critical success factors, despotic leadership, and success of renewable energy projects. *Environ. Sci. Pollut. Res.* **2021**, *29*, 10388–10398. [CrossRef]
56. Iqbal, J.; Asghar, A.; Asghar, M.Z. Effect of Despotic Leadership on Employee Turnover Intention: Mediating Toxic Workplace Environment and Cognitive Distraction in Academic Institutions. *Behav. Sci.* **2022**, *12*, 125. [CrossRef]
57. Henseler, J.; Ringle, C.M.; Sarstedt, M. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J. Acad. Mark. Sci.* **2015**, *43*, 115–135. [CrossRef]
58. Geisser, S. A predictive approach to the random effect model. *Biometrika* **1974**, *61*, 101–107. [CrossRef]
59. Hu, L.T.; Bentler, P.M. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct. Equ. Model. Multidiscip. J.* **1999**, *6*, 1–55. [CrossRef]
60. Baumgartner, H.; Weijters, B.; Pieters, R. The biasing effect of common method variance: Some clarifications. *J. Acad. Mark. Sci.* **2021**, *49*, 221–235. [CrossRef]
61. Hair, J.F.; Ringle, C.M.; Sarstedt, M. PLS-SEM: Indeed a Silver Bullet. *J. Mark. Theory Pract.* **2011**, *19*, 139–152. [CrossRef]
62. Cohen, J. *Statistical Power Analysis Jbr the Behavioral Sciences*; Lawrence Erlbaum Associates: Hillsdale, NJ, USA, 1988; pp. 18–74.
63. Grimsey, D.; Lewis, M.K. Evaluating the risks of public private partnerships for infrastructure projects. *Int. J. Proj. Manag.* **2002**, *20*, 107–118. [CrossRef]
64. Information, M.; Chin, W.W. Commentary Issues and Opinion on Structural Equation Modeling. *MIS Q.* **2013**, *22*, vii–xvi.
65. Timberlake, M.; Ragin, C.C. The Comparative Method: Moving beyond Qualitative and Quantitative Strategies. *Soc. Forces* **1989**, *67*, 827. [CrossRef]
66. Kadile, V.; Biraglia, A. From hobby to business: Exploring environmental antecedents of entrepreneurial alertness using fsQCA. *J. Small Bus. Manag.* **2020**, *60*, 580–615. [CrossRef]
67. Rasoolimanesh, S.M.; Ringle, C.M.; Sarstedt, M.; Olya, H. The combined use of symmetric and asymmetric approaches: Partial least squares-structural equation modeling and fuzzy-set qualitative comparative analysis. *Int. J. Contemp. Hosp. Manag.* **2021**, *33*, 1571–1592. [CrossRef]

68. Rubinson, C. Presenting qualitative comparative analysis: Notation, tabular layout, and visualization. *Methodol. Innov.* **2019**, *12*, 2059799119862110. [CrossRef]
69. Fiss, P.C. Building Better Causal Theories: A Fuzzy Set Approach to Typologies in Organization Research. *Acad. Manag. J.* **2011**, *54*, 393–420. [CrossRef]
70. Olya, H.; Jung, T.H.; Dieck, M.C.T.; Ryu, K. Engaging visitors of science festivals using augmented reality: Asymmetrical modelling. *Int. J. Contemp. Hosp. Manag.* **2020**, *32*, 769–796. [CrossRef]
71. Iqbal, J.; Qureshi, N.; Ashraf, M.A.; Rasool, S.F.; Asghar, M.Z. The Effect of Emotional Intelligence and Academic Social Networking Sites on Academic Performance During the COVID-19 Pandemic. *Psychol. Res. Behav. Manag.* **2021**, *14*, 905–920. [CrossRef] [PubMed]
72. Ashraf, M.A.; Iqbal, J.; Arif, M.I.; Asghar, M.Z. Fostering ICT Competencies in Blended Learning: Role of Curriculum Content, Material, and Teaching Strategies. *Front. Psychol.* **2022**, *13*, 758016. [CrossRef] [PubMed]
73. Karnes, J.H.; Asempa, T.; Barreto, J.N.; Belcher, R.M.; Bissell, B.D.; Gammal, R.S.; Kier, K.L.; Lee, C.R.; Liu, L.; McCune, J.S.; et al. The essential research curriculum for doctor of pharmacy degree programs—2021. *JACCP J. Am. Coll. Clin. Pharm.* **2022**, *5*, 358–365. [CrossRef]
74. Mokhtarzadedeh, N.G.; Mahdiraji, H.A.; Jafari-Sadeghi, V.; Soltani, A.; Kamardi, A.A. A product-technology portfolio alignment approach for food industry: A multi-criteria decision making with z-numbers. *Br. Food J.* **2020**, *122*, 3947–3967. [CrossRef]
75. Iqbal, J.; Asghar, M.Z.; Ashraf, M.A.; Yi, X. The Impacts of Emotional Intelligence on Students' Study Habits in Blended Learning Environments: The Mediating Role of Cognitive Engagement during COVID-19. *Behav. Sci.* **2022**, *12*, 14. [CrossRef]
76. Mobile learning technology readiness and acceptance among pre-service teachers in Pakistan during the COVID-19 pandemic. *Knowl. Manag. E Learn. Int. J.* **2021**, *13*, 83–101. [CrossRef]
77. Asghar, M.Z.; Arif, S.; Barbera, E.; Seitamaa-Hakkarainen, P.; Kocayoruk, E. Support through Social Media and Online Class Participation to Enhance Psychological Resilience. *Int. J. Environ. Res. Public Health* **2021**, *18*, 11962. [CrossRef]
78. Asghar, M.Z.; Iqbal, A.; Seitamaa-Hakkarainen, P.; Barbera, E. Breaching Learners' Social Distancing through Social Media during the COVID-19 Pandemic. *Int. J. Environ. Res. Public Health* **2021**, *18*, 11012. [CrossRef]
79. Spronken-smith, R. Reforming Doctoral Education: There Is a Better Way. *Cent. Stud. High. Educ.* **2018**. Available online: https://escholarship.org/uc/item/4s08b4jx (accessed on 28 October 2020).
80. Kozhakhmet, S.; Moldashev, K.; Yenikeyeva, A.; Nurgabdeshov, A. How training and development practices contribute to research productivity: A moderated mediation model. *Stud. High. Educ.* **2020**, *47*, 437–449. [CrossRef]
81. Yilmaz, Y.; Ruan, B.; Thomas, P.; Tran, V.; Chan, T.M. Reframing organizations in the digital age: A qualitative study exploring institutional social media adoption. *F1000Research* **2021**, *10*, 1048. [CrossRef]
82. Gleason, B.; von Gillern, S. Digital Citizenship with Social Media: Participatory Practices of Teaching and Learning in Sec-ondary Education. *Educ. Technol. Soc.* **2018**, *21*, 200–212.
83. Wang, J.; Zhou, Y.; Zhang, W.; Evans, R.; Zhu, C. Concerns Expressed by Chinese Social Media Users During the COVID-19 Pandemic: Content Analysis of Sina Weibo Microblogging Data. *J. Med. Internet Res.* **2020**, *22*, e22152. [CrossRef] [PubMed]
84. Rezaei, M.; Jafari-Sadeghi, V.; Cao, D.; Mahdiraji, H.A. Key indicators of ethical challenges in digital healthcare: A combined Delphi exploration and confirmative factor analysis approach with evidence from Khorasan province in Iran. *Technol. Forecast. Soc. Chang.* **2021**, *167*, 120724. [CrossRef]
85. Gupta, L.; Gasparyan, A.Y.; Zimba, O.; Misra, D.P. Scholarly publishing and journal targeting in the time of the Coronavirus Disease 2019 (COVID-19) pandemic: A cross-sectional survey of rheumatologists and other specialists. *Rheumatol. Int.* **2020**, *40*, 2023–2030. [CrossRef]
86. Geldsetzer, P. Use of Rapid Online Surveys to Assess People's Perceptions During Infectious Disease Outbreaks: A Cross-sectional Survey on COVID-19. *J. Med. Internet Res.* **2020**, *22*, e18790. [CrossRef]
87. Smith, D.A. Situating Wikipedia as a health information resource in various contexts: A scoping review. *PLoS ONE* **2020**, *15*, e0228786. [CrossRef]
88. Vuong, Q.-H.; Le, T.-T.; La, V.-P.; Nguyen, H.T.T.; Ho, M.-T.; Van Khuc, Q.; Nguyen, M.-H. Covid-19 vaccines production and societal immunization under the serendipity-mindsponge-3D knowledge management theory and conceptual framework. *Humanit. Soc. Sci. Commun.* **2022**, *9*, 22. [CrossRef]
89. Zhu, Y. Open-access policy and data-sharing practice in UK academia. *J. Inf. Sci.* **2019**, *46*, 41–52. [CrossRef]
90. Al Sharqi, L.M.; Hashim, K.; Ahmed, H.A. Perceptions of social media as a learning tool: A comparison between arts and science students. *Int. J. Soc. Media Interact. Learn. Environ.* **2016**, *4*, 92. [CrossRef]
91. Golovchun, A.; Zhumabekova, G.; Turlybekova, A.; Muktarova, E.; Zhusupbekov, A. The Development of Research Com-petence Through Digital Resources. *Talent. Dev. Excell.* **2020**, *12*, 633–641.