Unveiling Patterns: Exploring Factor Analysis in Career Interest Exploration

Tahira Zakir[1]*, Nadia Jahan[2], Tahira Anwar Lashari[2]

National University of Sciences and Technology, Islamabad, Pakistan

Abstract

The established relationship between one's successful career choices and career interests drives increased adoption of interest assessment tools in career guidance. The use of technology can significantly improve this process. While there are existing international career assessment tools, there needs to be more tools tailored to Pakistani students. More research is needed on how effective digital career assessment tools are, primarily within the Pakistani context. Therefore, this research centers on developing a digital career interest assessment tool for Pakistan's secondary school students. The study included two phases: developing the career interest assessment tool based on John Holland's theory of Occupational Interest, DOTS Framework and Cognitive Information Processing in Career Services (CIP), and developing the web portal. The study adopted the Design and Development Research - Type 1 method. A purposive sampling technique was employed where the sample consisted of 230 Pakistani secondary school students from nine cities of Pakistan. Quantitative data were analyzed using Exploratory Factor Analysis (EFA) using SPSS 23. Before extracting the factors, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used to assess the factorability of the data. The obtained data revealed five extracted factors with 35 measurable items. The highest factor, 0.759, was found on item 61, whereas the factor of 0.427 was found on item 62. The internal consistency was confirmed by calculating Cronbach's alpha coefficient. The results revealed that in tool development, factor analysis plays a decisive role in extracting valuable factors from a dataset and filtering out irrelevant items, making the process more efficient. Moreover, results also provide insights that digital career assessments tailored for students have the potential to empower them to delve into prospects and make well-informed career decisions.

Keywords: e-career assessment, factor analysis, career guidance, secondary school students, Pakistan, technology integration

1. Introduction

In the field of academic and career guidance, technological advancements have steadily grown in popularity since the 1960s (Sampson et al., 2020; Woo et al., 2020; National Board for Certified Counselors, 2016; Harris-Bowlsbey, 2013; Vuorinen et el., 2011; Fowkes & McWhirter, 2007; Offer & Chiru, 2006; Gati et al., 2001; Watts, 2001). The goal is to improve the delivery of career planning services and simplify the career exploration process. Esteemed career development organizations, like the American Counseling Association and the National Career Development Association, have supported incorporating technology into counselor training and practice, acknowledging its accessibility, utility, and diverse applications (ACA, 2014 & NCDA, 2019). Studies suggest that technology can complement the work of career professionals, improving their effectiveness (Sampson, 2020; Zainuddin, 2019; Golden, 2017; Watts, 2005). As individual interests start taking shape during the "Exploration Stage" of life (Abidi & Malik, 2020; Bilal & Malik, 2014; Super, 1973), assessment of interest becomes an integral ingredient in the career guidance journey (Brown & Lent, 2019). Career assessments link career development principles and their practical application, helping young people explore career options using technology-driven guidance tools (Whitfield et al., 2009; referenced by Harrington & Long, 2012). Technology-based tools for career assessment also necessitate evaluation by guidance counselors to ensure comprehensive content coverage, user-friendly interaction, and technical functionality (NCDA, 2022). The rationale behind this research stems from the need for students to make decisions about their education and careers based on their abilities rather than succumbing to parental influence or traditional career paths (Abidi & Malik, 2020; Khatri, 2019; Bilal & Malik, 2014; Wasif, 2010; Khan, 2010). In the context of the post-COVID-19 era where digital technologies play a significant role in education services, integrating technology-based career guidance is crucial to meet the diverse needs of Generation Alpha, who are adept at digital skills. The use of technology in career services is increasing day by day. However, there is still a lack of research on how effective computer-assisted career guidance tools are, especially in secondary schools (Moore & Czerwinska, 2019; Sampson & Lumsden, 2015) Additionally, there is a need for e-career interest assessment tools tailored to the local context of secondary school students in Pakistan. Professionals see the potential of tools but feel unsure about choosing and using online career assessment tools (Abidi & Malik, 2020). That is why this study aimed to develop an e-career interest assessment tool for secondary school students in Pakistan to help them explore career options and make informed decisions.

Career Assessment: Career assessment is a method of measuring theoretical constructs (e.g., interests, abilities, aptitudes, etc.) by incorporating them into career interventions, particularly tests and other measurements.
E-Career Assessment Tool: E-career assessment tools are designed to guide users' career exploration using digital platforms.
*Career Interest Inventories**:*** Career Interest Inventories link an individual's vocational interests to educational majors and occupations, facilitating career exploration and planning.

Career assessments offer insights into self-awareness, career awareness, and skills required for career planning, all of which are crucial for advancing in one's career and achieving success. Studies indicate that individuals who undergo career assessments tend to have outcomes in terms of their career development compared to those who do not receive such guidance (Hussain, et al., 2014). By undergoing these assessments, individuals can gain an understanding of how they make decisions about their careers, improve their certainty in choosing a path, and enhance their belief in themselves (Ikram et. al., 2023). These assessments have been associated with aligning a person with their environment, clearing one's ambiguities about their career prospects, and encouraging proactive behavior toward one's career goals (Jahan, et al., 2023) However, the accuracy and dependability of these assessments may be affected by factors including the type of assessment used, the quality of interpretation and feedback given, as well as the individual's level of involvement and introspection during the assessment process.

2. Theoretical Foundations

This study utilizes known theoretical models in career guidance to shape the development of the e-career assessment tool. John Holland's theory of occupational interest (1997) highlights the significance of aligning individuals' personalities with career environments (Holland, 1997). This theoretical model provides a solid foundation for the development of the e-career assessment tool. The DOTS framework, developed by Bill Law and A.G. Watts, emphasizes the importance of self-awareness and recognizing opportunities in career development, which is crucial for individuals to make informed decisions. Similarly, Sampson et al.'s Cognitive Information Processing Model in Career Services (CIP) focuses on the role of knowledge areas,

such as self-awareness and understanding occupations, in exploring careers. By integrating these models, the e-career assessment tool aims to provide a comprehensive and effective platform for students to explore their career interests and make informed decisions.

Holland's Theory of Occupational Interest (1997)

John Holland's theory of occupational interests, also known as the RIASEC model, suggests that individuals can be grouped into six personality categories: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. Each personality type is linked to career fields that match their interests and skills. According to Holland, people tend to seek out professions that align with their personality traits, leading to job satisfaction and career success.

Key Aspects:

Realistic: Realistic personality types prefer hands-on activities requiring abilities like engineering, farming, and construction.

Investigative: Investigative personality types enjoy working with ideas and information in roles such as scientists or researchers.

Artistic: Artistic personality types value creativity in fields like artistry, writing, or music.

Social: Social personality types enjoy helping others and thrive in settings such as teaching, counseling, human resources, or helping professions.

Enterprising: Enterprising personality types enjoy leadership roles in business environments like management or sales.

Conventional: Conventional personality types appreciate structure and organization while working with data in careers such as accounting or administration.

DOTS Framework (1996)

The DOTS framework, created by Bill Law and A.G. Watts, presents an approach to career education and guidance emphasizing four components: decision-making, opportunity awareness, transitioning skills, and self-awareness. This model sheds light on the journey of career development, underscoring the importance of acquiring the skills and knowledge to navigate one's path effectively. It promotes self-awareness and opportunity awareness, enlightening individuals about their strengths and the potential career opportunities that align with their attributes.

Key Aspects:

Decision Making (D): The capacity to make informed and successful career choices by comprehending and applying the decision-making process to career decisions.

Opportunity Awareness (O): Recognizing career opportunities by understanding the job market, industries, and specific job roles.

Transition Learning (T): Involves equipping oneself with the skills needed to move from one employment stage to another. This includes preparing for job applications and interviews and adapting to work environments.

Self-awareness (S): Understanding one's strengths, weaknesses, interests, and values. This self-awareness aids individuals in selecting careers that resonate with their attributes.

This research focuses on the DOTS Model's two aspects, i.e., self-awareness and opportunity awareness.

Cognitive Information Processing in Career Services (1992)

Gary Peterson, James Sampson, and Robert Reardon's Cognitive Information Processing (CIP) model in career services focuses on the processes involved in making career decisions. The model highlights the significance of understanding oneself and knowing about career paths, supported by a systematic approach to decision-making.

Key Components:

Knowledge Domain: This includes self-awareness (knowing one's interests, values, and abilities) and occupational knowledge (information regarding professions and the working environment).

Decision-making Skills Domain: This involves the CASVE cycle (communication, analysis, synthesis, valuation, and execution). This cycle aids individuals in approaching career decisions.

Executive Processing Domain: This encompasses meta cognitions like self-talk, self-awareness, and control over the decision-making process.

This research focuses on the knowledge domain (Self-Knowledge and Occupational Knowledge) of CIP's model.

Connecting Theoretical Models:

The three theoretical models—Holland's RIASEC model, the DOTS framework, and the CIP model—complement each other by offering an approach to career guidance and exploration.

1. Self-Awareness:

Holland's Theory: Identifies personality types. Aligns them with career environments.

DOTS Framework: Focuses on self-awareness as an aspect of career growth.

CIP Model: Highlights self-knowledge as an element in making career choices.

2. Occupational Knowledge:

Holland's Theory: Explores work settings that suit people with different personality types.

DOTS Framework: Encourages awareness of opportunities to help individuals grasp the career options available.

CIP Model: Knowing job roles is crucial for making informed career choices.

Map for the E-Career Assessment Tool

This section's detailed examination of existing studies lays the theoretical and empirical groundwork for developing an e-career interest assessment tool customized for the requirements of Pakistani secondary school students.

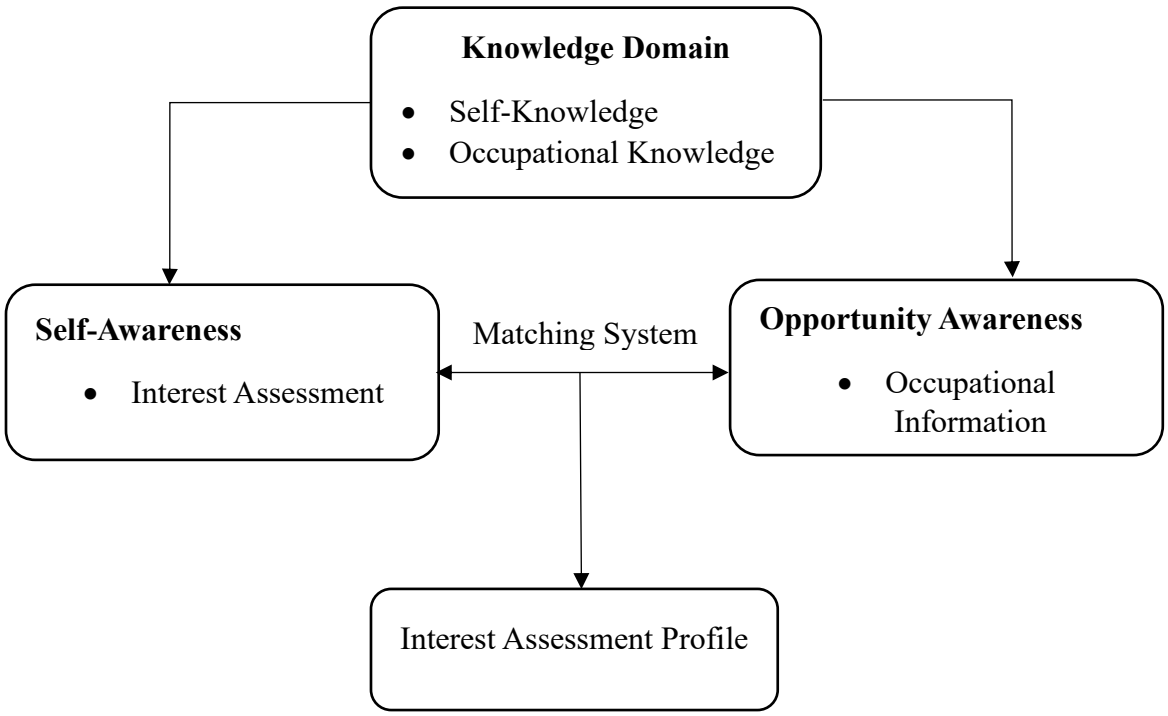

Figure 1: E-career assessment tool mapped on Holland's theory of occupational interest (1997), DOTS framework (1996) & CIP in career services (1992)

3. Research Methodology

This study adopted Design and Development Research—Type 1 (Richey et al., 2004), which focuses on developing and improving educational products, programs, or processes.

3.1 Population and Sample

A purposive sampling technique was employed to select participants. This ensured that the data gathered in the study represented the target audience, improving the results' applicability. The study focused on secondary school students in grades 8, 9, and 10 from public and private schools in Pakistan. This specific population is chosen to tailor the e-career assessment tool to meet adolescents' career exploration needs effectively. In addition, the goal was to gather insights from students attending public and private schools in different cities of Pakistan, considering the diverse socio-economic and cultural backgrounds in the city environment. This inclusive approach ensures that the observations can be applied across contexts and represent the broad spectrum of students in the area. The sampling technique used was to create a representative sample from the student population. The sample group comprised 230 students, including males and females, and was selected to reflect a range of schools and demographic characteristics for the generalizability of results. By employing sampling, the researchers focused on individuals with ICT skills to ensure their effective use of the e-career assessment tool.

3.2 Data Collection Procedure

Students were invited to take part in the study after providing their consent. They were guided through the assessment process, with the option to withdraw at any stage. To streamline data collection, participants were directed to the developed web portal's registration link for easy access. This online platform made it easier for students from both public and private schools to register and access resources. Utilizing technology improves efficiency and reduces the challenges typically faced with traditional paper-based methods.

3.3 Content Validity and Reliability of the Instrumentation

In this phase, experienced professionals in the field of career assessment conducted a review to ensure that the items were adequately designed to evaluate the intended aspects. Seven experts

from different fields, including career advisors and psychometricians, reviewed the tool's face and content validity to validate its validity. They provided feedback to improve the relevance and clarity of the content. Furthermore, a trial run involving fifteen students was carried out to assess the clarity and suitability of the items. This initial test with a group of students offered insights that helped refine the tool. To guarantee that the e-career assessment tool was reliable, an internal consistency measure was utilized. This included calculating Cronbach's Alpha coefficient to evaluate how consistently participants responded across items in the tool. A Cronbach's Alpha value of 0.943 indicated internal consistency, confirming that it reliably measured career-related aspects.

3.4 Development Phases of the Tool

The tool's developmental phase comprised two stages: **career interest assessment tool development** and **web portal development**.

Career Interest Assessment Tool Development:

In the *development of the assessment tool*, the focus was on laying the groundwork for the e-career assessment tool by combining theoretical concepts with empirical research to ensure its effectiveness and relevance. In this stage, a pool of items was generated. A deductive approach was used to generate the item pool, drawing items from existing literature and already available tools to cover various career assessment aspects. Ninety items were developed for the e-career assessment tool through a literature review and existing career interest inventories. Cognitive interviews were conducted to guarantee clarity and understanding of these items. Interviews with six students in grades 9 and 10 helped identify issues with item responses. The cognitive interviews were instrumental in refining these items to make them more transparent and applicable to the target audience. Moreover, expert reviews and sample tryouts were carried out to ensure the validity of the tool.

Web Portal Development:

The second stage was *web portal development.* During this phase of the study, the prototype was created for a web portal. Feedback from experts was incorporated to improve its features and user experience. This stage was important for converting the assessment material into a to-use platform guaranteeing that the tool would be useful and efficient in real-world scenarios.

The web portal prototype development was carried out in three major stages namely, the design process, development process, and testing and deployment (See Figure 2).

1. Design Process:

The process of designing the web prototype went through further stages such as:

- Goal Identification & Strategy
- Information Architecture (IA) & Sitemap Creation
- Wireframing & Prototyping
- Visual Design and Content Creation
- Usability Testing & Refinement

2. Development Process:

This process included several stages including:

- Developing Environment Setup
- Front-end development
- Back-end development
- Integration and Functionality Implementation

3. Testing and Deployment Process:

Testing and deployment included stages like:

- Quality Assurance (QA) & Testing
- Performance Testing
- Pre-Launch Testing
- Domain Name Setup & Hosting Configuration

- Website Launch & Monitoring

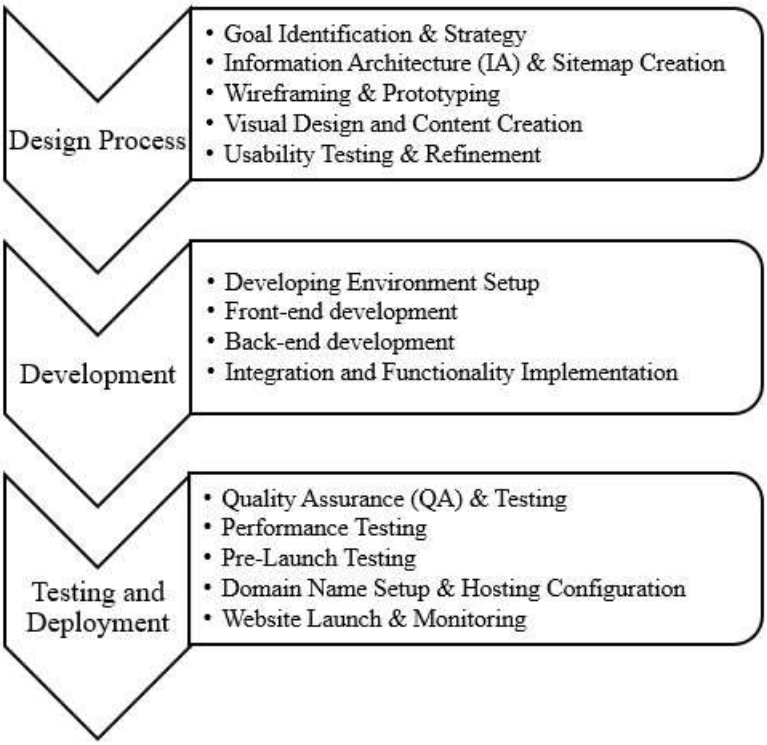

Figure 2: Phases of web-portal prototype development

3.5 **Tools and Technologies used:**

Creating a web portal involved front-end and back-end development. The front-end was built based on wireframes and mockups using HTML (Hypertext Markup Language), CSS (Cascading Style Sheets), JavaScript, and Bootstrap within Laravel to ensure responsiveness across devices and browsers. For the back-end, PHP (Hypertext Preprocessor) was used. For the development of back-end, models were set up using the Laravel framework. Laravel was chosen as the framework for its features and support of MVC (Model-View-Controller) architecture. SQL (Structured Query Language) was selected for managing the database to handle student data and survey responses effectively. Git and GitHub were utilized for version control and collaboration during code changes. Figma was employed to design wireframes and prototypes streamlining the design process. Website implementation included setting up the development environment with

tools like Bootstrap CDN (Content Delivery Network) and jQuery CDN (Content Delivery Network) and configuring libraries and plugins. Features, like authentication and authorization, were incorporated as well and a PDF library was integrated for generating assessment reports. The production environment was prepared, the web server was configured, and the website was deployed using a web hosting service that included phpMyAdmin for managing the database.

4. Results and Discussion

4.1 Testing and Deployment

Thorough testing and deployment were crucial for ensuring the success of the portal. Testing included unit tests, integration tests, and user acceptance tests (UAT) to verify that all functionalities operated correctly and that the portal met performance and security requirements. Bug fixes that deal with any issues discovered during testing were promptly addressed as part of the process to improve stability and performance based on testing feedback. The final version of the web portal was launched in the production environment with attention to ensuring a successful transition from development to production. After the portal was launched it was regularly checked for any problems. Updates and enhancements were made in response to user feedback and evolving needs.

4.2 Factor Analysis

Subsequently, the study was undertaken with 230 students to evaluate the characteristics of the e-career assessment tool. Exploratory factor analysis (EFA) was utilized to ascertain the tool's construct validity. By employing exploratory factor analysis (EFA) in SPSS software insights were gained into the structure of the tool.

Exploratory Factor Analysis (EFA): The data from the study underwent analysis using exploratory factor analysis (EFA) with SPSS 23 software. This statistical method helped unveil the underlying patterns within the data revealing connections and correlations among components of the assessment tool. Through EFA the research aimed to validate that the items in the tool aligned with expected constructs further solidifying its construct validity.

Table 1: Five identified clusters of career interest assessment tool

Sr. No.	Items	Categories of Scale
1	16, 18, 20, 23, 22, 17	Realistic
2	65, 68, 67, 66, 63, 62	Investigative
3	81, 85, 82, 86, 64, 83, 77	Artistic
4	40, 35, 31, 39, 32, 36, 38	Enterprising
5	15, 10, 11, 4, 3, 78, 79	Conventional

Kaiser-Mayer-Olkin (KMO) Measure of Sampling Adequacy: The pivotal assumption of factor analysis is the KMO model to determine sampling adequacy. In this study, the KMO statistics value was found to be 0.781, which suggests that the factor analysis is suitable for the data at hand and indicates that the sample size is adequate.

Table 2: The Kaiser-Maye- Olkin in measure estimation

Kaiser-Mayer-Olkin Measure of Sampling Adequacy		0.781
Bartlett's Test of Sphericity	Approx. Chi-Square	9431.932
	df	4005
	Sig.	.000

Table 3: The rotated component/ factor matrix of career interest assessment tool

Rotated Component Matrix

		Component				
		1	2	3	4	5
1	q16	.722				
2	q18	.717				
3	q20	.668				
4	q23	.662				
5	q24	.655				
6	q22	.651				
7	q17	.584				
8	q61		.759			
9	q65		.658			
10	q68		.648			
11	q67		.611			
12	q66		.535			
13	q63		.535			
14	q62		.427			
15	q81			.702		
16	q85			.632		
17	q82			.622		
18	q86			.587		
19	q64			.560		
20	q83			.548		
21	q77			.473		
22	q40				.671	
23	q35				.641	
24	q31				.627	
25	q39				.590	
26	q32				.582	
27	q36				.547	
28	q38				.536	
29	q15					.585
30	q10					.582
31	q11					.560

32	q4					.553
33	q3					.551
34	q78					.492
35	q79					.465

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

The main goal of the exploratory factor analysis (EFA) was to uncover the factor structure of the e-career interest assessment tool created for high school students, in Pakistan. Based on Holland's model it was expected that there would be six factors corresponding to the six personality types (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional). Principal Component Analysis (PCA) with Varimax rotation was used as the extraction method to make the factor structure clearer and more understandable. The criteria for determining the number of factors included eigenvalues greater than 1 and an examination of the plot. Interestingly it was observed that the social personality type did not align with any factor. This suggests that the items meant to assess the type did not have enough correlations to form a separate factor. Instead, these items displayed scattered loadings across factors indicating a potential overlap with other personality types or an issue, with how these specific items measured this particular trait.

5. Conclusion

The research developed a career assessment tool to help high school students navigate their career paths better. By incorporating technology and adhering to robust psychometric principles, the tool is valuable for guiding students in exploring and deciding on their careers. The findings support the tool's overall reliability and validity, suggesting that further adjustments are necessary to encompass all aspects of Holland's model. Developing a culturally contextualized e-career assessment tool significantly contributes to Pakistan's career counseling field. This tool's ability to enhance students' self-awareness and opportunity awareness can empower them to make informed career decisions aiding their professional growth.

References

Abidi, S. M., & Malik, A. A. (2020). Career assessment in Pakistan: Current scenario. *New Horizons*, 14(2), 255.

American Counseling Association. (2014).

Bilal, A., & Malik, R. K. (2014). Career Counseling in Pakistan. 4(16). Retrieved from http://www.iiste.org

Brown, P. (2020a). Some observations on the race to higher education, digital technologies and the future of work. *Journal of Education and Work*, 33(7–8), 491–499. https://doi.org/10.1080/13639080.2020.1852500

Brown, P. (2020b). Some observations on the race to higher education, digital technologies and the future of work. *Journal of Education and Work*, 33(7–8), 491–499. https://doi.org/10.1080/13639080.2020.1852500

Golden, S. H. (n.d.). Factors that Influence School Counselors' Intent to Use Online Counseling. Retrieved from https://scholarworks.waldenu.edu/dissertations

Harrington, T., & Long, J. (2013a). The history of interest inventories and career assessments in career counseling. *Career Development Quarterly*, 61(1), 83–92. https://doi.org/10.1002/j.2161-0045.2013.00039.x

Harrington, T., & Long, J. (2013b). The history of interest inventories and career assessments in career counseling. *The Career Development Quarterly*, 61(1), 83–92. https://doi.org/10.1002/J.2161-0045.2013.00039.X

Harris-Bowlsbey, J., & Sampson, J. P. (2005). Use of technology in delivering career services worldwide. *Career Development Quarterly*, 54(1), 48–56. https://doi.org/10.1002/j.2161-0045.2005.tb00140.x

Holland, J. L. (1997). *Exploring careers with a typology of persons and environments* (3rd ed.). Psychological Assessment Resources.

Hussain, S., Fouad, N., Munaf, S., Khan, M. A., & University of Karachi. (2014). Adaptation of the Career Key into Urdu. *Pakistan Journal of Psychological Research*, 29(2).

Ikram, A., Anwar Lashari, S., & Anwar Lashari, T. (2023). Professional quality of life, empathy, and coping strategies of young clinical psychologists in Lahore, Pakistan. *Iranian Journal of Psychiatry and Clinical Psychology*, 29(2), 216–235. https://doi.org/10.32598/ijpcp.29.2.4594.1

Jahan, N., Khan, D. S. N., & Qureshi, D. H. (2023). Professional development and training of careers educators: A practitioner's model for in-service school teachers. *Journal of*

Contemporary Trends and Issues in Education, 2(3), 72–95. https://doi.org/10.55628/jctie.v3i1.81

Khan, S. (1992). Translation and adaptation of a vocational interest inventory aap ki dilchaspian. (n.d.).

Khan, S. (1995). Job knowledge test. (n.d.).

Khatri, P., Raina, K., Wilson, C., & Kickmeier-Rust, M. (2020). Towards mapping competencies through learning analytics: Real-time competency assessment for career direction through interactive simulation. *Assessment and Evaluation in Higher Education*, 45(6), 875–887. https://doi.org/10.1080/02602938.2019.1689382

Moore, N., & Czerwinska, K. (2019a). Understanding the use of digital technology in the career development sector. Retrieved from http://derby.openrepository.com/derby/handle/10545/602116

National Career Development Association. (2022). National career development guidelines framework. Retrieved from https://www.ncda.org/aws/NCDA/pt/sp/compentencies_ncd_guidelines

Peterson, G. W., Sampson, J. P., Reardon, R. C., Lenz, J. G., & Lenz All, J. G. (2003). Core concepts of a cognitive approach to career development and services. Retrieved from http://www.career.fsu.edu/techcenter

Richey, R. C., Klein, J. D., & Nelson, W. S. (2004). *Design and development research in education* (2nd ed.). Lawrence Erlbaum Associates.

Sampson, J. P., Woo, H. K., National Board for Certified Counselors, Harris-Bowlsbey, J., Vuorinen, R., Fowkes, R., McWhirter, E., Offer, M., Chiru, C., Gati, I., & Watts, T. (2020).

Super, D. E., & Jordaan, P. (1973). Career development theory. *British Journal of Guidance & Counselling*, 1(1), 3–16. https://doi.org/10.1080/03069887308259333

U.S. Department of Labor. (1996). *Dictionary of Occupational Titles* (4th ed.).

U.S. Department of Education. (1992). *Classification of instructional programs*.

Zainudin, Z. N., Hassan, S. A., Abu Talib, M., Ahmad, A., Yusop, Y. M., & Asri, A. S. (2020a). Technology-assisted career counselling: Application, advantages and challenges as career counselling services and resources. *International Journal of Academic Research in Business and Social Sciences*, 10(11). https://doi.org/10.6007/ijarbss/v10-i11/8047