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A Research Brief from STELAR

Translating Career Development Research to Practice in ITEST

Part 1: What Research Tells Us About Career Development

Joyce Malyn-Smith, Mary Beth Piecham, Georgia Bock

Introduction

Translating career development research into practice has long been a challenge for both the education and workforce development communities. It is exceedingly difficult for educators and training professionals to develop and implement curricula and programs that keep up with the rapid advances in technology and their workplace applications. Preparing a highly skilled, resilient workforce requires a collective focus on ensuring the largest number of students possible develop the interests, skills, knowledge, and dispositions needed to flourish in a rapidly evolving technological landscape.

The National Science Foundation's (NSF's) **Innovative Technology Experiences for Students and Teachers** (ITEST) program was established in 2003 to address this need. ITEST seeks to actualize a future-ready science, technology, engineering, and mathematics (STEM) and information and communication technologies (ICT) workforce that is prepared to meet pressing local, societal, and global challenges. Because STEM and ICT careers increasingly rely on technologies and computing, the ITEST program funds projects that engage youth, from pre-kindergarten through high school, and pre-K–12 educators in innovative technology learning and education experiences within and across STEM disciplines in formal and informal settings, all with a focus on emerging technology fields. For example, when artificial intelligence (AI) emerged as a future workforce priority, NSF funded several ITEST projects that focused on incorporating AI in K–12 education. These projects, described in *Artificial Intelligence and Learning: AI At-A-Glance in ITEST* (Malyn-Smith & MacGillivray, 2022), explored important research questions on the use and teaching of AI to support learning in STEM.

The ITEST program helps to prepare the next generation of scientists, technicians, engineers, and mathematicians by enabling them to apply their expertise across industry sectors and to use, modify, and create the technologies that drive innovation. As the resource center for the ITEST program, the STEM Learning and Research (STELAR) Center supports the program and its grantees by

synthesizing and disseminating findings surfaced by ITEST projects and developing materials to guide the broader STEM education field. Some of these efforts have been captured in STELAR's three-part series on critical issues in preparing youth for future work (see sidebar).

Considerable research supports how individuals develop career interests and capabilities and the importance of career development in helping individuals pursue pathways toward productive and rewarding careers (Robertson et al., 2021). Exposure to technological tools and learning processes that are essential for future STEM workplace success will also help to ensure that we have a workforce ready and able to meet the challenges our future will hold. This paper is the first of a two-part series entitled Translating Career Development Research to Practice in ITEST that examines the foundational theories of career development and the translation of this research into practice.

The second paper in this series, Part 2: The Career Development Continuum & ITEST At-a-Glance, examines the stages of career development—career awareness, career exploration, and career preparation (Malyn-Smith et al., 2021) — and shares practical applications of career education research within STEM and workforce education using examples of funded projects in the NSF's ITEST program.

Together, these papers shed light on the underpinnings of career education and its relevance to preparing youth for the innovation-driven technological workforce. With a deeper understanding of research in the field, educators and policymakers can

Critical Issues in Preparing Youth for Future Work

A series of three reports by STELAR.

1. *Building the Foundational Skills Needed for Success in Work at the Human-Technology Frontier* (Malyn-Smith et al., 2017), makes clear that dramatic and rapid developments in technology foster innovation at work, create new jobs, and change the very nature of how work is carried out. This paper examines the complex challenges related to workforce development, economics, education, equity, and ethics and highlights the significant impact of these developments on opportunities for employment, producing a high demand for people with specific STEM skill sets who can be nimble and flexible learners, adapting quickly to new roles and ways of working.

2. *K–8 STEM Career Competencies: Developing Foundational Skills for the Future of Work* (Malyn-Smith et al., 2021), focuses on helping educators understand how they can prepare students in the early grades for an ever-changing world of technology. It offers a framework for introducing K–8 students to a range of STEM learning experiences and career competencies that cultivate the art of "learning how to learn"—thereby giving students tools they can carry with them and practice as they explore options and form their own career identities over time. This paper also describes 10 foundational STEM career competencies and provides related classroom activities, curriculum resources, and background reading suggestions.

3. *Developing the Next Generation of Talent: Perspectives from the Field on Equity and the Future of Work* (Malyn-Smith et al, 2022). features interviews and research that led to our development of the Equity Systems Change Compass (the Compass), a tool designed by EDC to drive difficult conversations about equity. An accompanying guidebook is available that provides step-by-step guidance for facilitators.

make more informed decisions about what information and experiences might be introduced into pre-K–12 curriculum and out-of-school learning experiences to guide students onto paths leading to productive and rewarding careers.

What Research Tells Us About Career Development

The transition of youth into meaningful life roles has been the subject of study for centuries. Many of today's practices are rooted in institutional structures of the past and in theories that have evolved into current career development models and frameworks.

Medieval Apprenticeships

Today's union apprenticeships, a topic of great interest in the workforce development community, are based on institutional structures established in medieval times. Throughout history, individuals learned about work from their parents and significant others. Children of farmers became farmers, and children of builders became builders, as they observed, helped out, and practiced tasks. In the medieval times, youth apprentices aged 10–12 learned a trade by working under the tutelage of a master craftsman (Cartwright, 2018). As cities grew during these times, professional workers joined together forming guilds to protect their rights and the working conditions of members (e.g., millers, blacksmiths, builders, bakers, butchers, weavers). Apprenticeships lasted an average of seven years and culminated in a performance-based assessment when the apprentice produced a "masterpiece," demonstrating acquired skills and knowledge and qualifying them as a "master" worker able to open their own business and join the guild. Those who did not have the financial resources to start their own businesses became itinerant journeymen in master craftsmen's shops. Remnants of this model remain in today's union apprenticeship programs, youth apprenticeships, internships, and other work-based learning activities.

Important Career Development Theories

Today, various theories of career development shape our understanding of how and why individuals choose different careers and occupations. A review of career development research and practices from the early 20th century to present, as shown in Figure 1, can help us better understand society's evolving views on work, how these beliefs have changed over time, and which practices may no longer be relevant in today's technology-centered world of work. In the following section, we present a sampling of career development theories that have influenced the career education and career counseling fields.

Figure 1: Timeline of career development theories

Trait-Factor Theories (Early 20th Century)

For the first half of the 20th century, individuals were guided into jobs based on personal characteristics and abilities such as intelligence; mechanical and clerical aptitude; and the ability to manipulate words, numbers, and spatial relations. Early 20th century research was driven by rapid industrialization and the need for individuals to navigate a complex job market. This period was guided by trait-factor theorists (Proctor, 1920; Fryer, 1922; Patterson, 1949) who believed that certain "traits," such as intelligence and ability, were the best determinants of success in different jobs and that individuals gravitated toward occupations based on those traits (Katz, 1963). Large scale national initiatives placed people in jobs based on their scores on intelligence and ability tests.

During World War I, for example, the U.S. Army applied the theory that intelligence was the predictor of success by using intelligence testing to place men in occupations (Proctor, 1920). They believed that measurable attributes predicting educational and vocational success lay in the ways that individuals were different from each other. Based on intelligence scores, individuals were grouped into categories (i.e., professional, technical, skilled, semiskilled, and unskilled) where workers could expect success (Fryer, 1922).

For most of the 20th century, this model influenced vocational counselors as they advised individuals on which occupations they should pursue. Well into the 21st century, we still see remnants of this belief as high school counselors continue to advise students with lower grade point averages to pursue vocational rather than academic studies. This practice, however, has resulted in great stress within the vocational community as groups of vocational students enter programs unable to handle the technical rigor demanded of today's high-tech vocational and technical careers.

Aligning aptitudes with job families. As research progressed in the 1900s, researchers explored a variety of psychological measurements to predict workplace success (Patterson, 1949), including intelligence, mechanical ability, clerical aptitude, manipulative dexterities, vocational interest, and personalities. They determined that a large variety of occupations could be clustered into groups according to similarities in the abilities required (Bailey & Stadt, 1973. These abilities could then be compared with occupational aptitude patterns to determine the "fields of work" most suited to an individual's abilities and therefore the fields of work in which an individual might have the greatest chances of success. This translated into assessment tools used for career counseling and placement and helped to establish research into job families that we continue to see in more modern theories of occupational choice.

Matching abilities to jobs. This approach of matching interests and abilities to occupational requirements has been and continues to be used by career counselors to help individuals pursue broad career paths (Crites, 1965; Stead & Shartle, 1940; Super, 1954). The Army General Classification Test used during Word War II

introduced the ability to manipulate words, numbers, and spatial relations (Harrell & Harrell, 1945). The Army Airforce Classification Battery expanded assessment to include performance testing by using work sample tests representing components or features of a job to assign individuals to the role of pilot, bombardier, or navigator. Today, work sample tests might be a programming, management, or accounting task or perhaps a flight simulator experience. The military uses the Armed Forces Vocational Assessment Battery to determine what military careers are suited for applicants.

For decades, the United States Employment Services primarily used the General Aptitude Test Battery (GATB) to counsel individuals seeking jobs. The GATB has evolved into the Ability Profiler, a tool used today for career exploration by matching an individual's abilities to occupations through the U.S. Department of Labor's O*NET Resource Center.

In review—this "trait" or "trait-factor" approach, used most in the first half of the 20th century, posited that intelligence and abilities aligned with occupations were determinants of career success and that occupational goals identified through that process should remain constant over time.

Situated Career Development Research (Mid-20th Century Forward)

Alternative theories of career development began to emerge in the early 1950s. Some researchers focused mostly on a single determining factor shaping career development. Sociologists (Blau et al., 1956) believed that societal factors, including social class membership, home influences, school, community, pressure groups, and role perception, determined employment opportunities. Psychological theorists (Maslow (as cited in Singh & Behera, 2016); Holland, 1963; Rowe, 1976) believed that each individual has unique needs that direct them to occupations or environments that satisfy those needs. Maslow's hierarchy (Maslow & Lewis, 1987) describes levels of needs that can drive career choice (psychological, safety; belonging and love; importance, self-esteem, independence; information; understanding; and beauty and self-actualization). Roe (1976) raised the issue of unconscious parental influences on careers and through books such as *What Color is Your Parachute* (Bolles, 1971). Holland's (1959) personality types drove career development for decades by aligning career interests and skills to work environments where those interests and skills are valued.

Other theorists believed that environment heavily influences one's career choice. The environment in which we are born, particularly the socioeconomic class and opportunities we are exposed to, determines one's career direction. People may be free to make their own career choices; however, choices are limited to those of which we are aware. People and complex systems interact with and are influenced by a complex world environment and its chance events. Career development is socially situated, with context playing an important role. And a person's conceptualization of work and career is developed through relationships with others. Career development is a reflection of Bandura's social cognitive theory,

which emphasizes that human actions are influenced by one's environment and a result of observation, imitation, and modeling. Central to this theory is the concept of self-efficacy or belief in one's own capabilities, which is shaped by abilities, personal actors, and environment (Bandura & Walters, 1977).

Developmental Theories (Mid-20th Century Forward)

Today, career development specialists agree that moving along a career path is a developmental process that occurs over time and is influenced by personal and psychological factors, social factors, and environmental factors, including the career opportunity environment. For example, Ginzburg's Comprehensive Theory of Occupational Choice (Ginzburg et al., 1951) posited that career choice is not a single decision made at a specific time. It is a long-range, multi-year developmental process that is largely irreversible. By *irreversible*, it means, for example, that experiences in childhood that may influence your career direction cannot be unlearned. As individuals develop and experience the world, those experiences influence next steps and decisions.

It is widely recognized that career development begins early in life and proceeds along a continuum of experiences often occurring in stages; that personality development and career development are interdependent variables in the maturation process; and that occupational choice is part of the ongoing implementation of an individual's self-concept. Developmental theorists, notably Super (1955, 1980), posited that career processes occur in a series of life stages as described in Table 1. Super's *Theory of Vocational Development* (Super, 1980) emphasized that individuals are qualified for multiple occupations, each requiring characteristic patterns of abilities, interests, and traits; that career patterns develop continuously across the lifespan and are shaped by socioeconomic level, mental ability, personality characteristics, and opportunity; and that career and life satisfaction can be attained when one's career role aligns to one's abilities, interests, and values.

Stages	Age	Characteristics
Growth	Birth to 14–15	Forming self-concept, developing interests and capacities Developing an understanding of the world of work
Exploratory	15–24	Trial through classes, work experience, hobbies Collects information and makes choices related to skills development
Establishment	25–44	Skill building and stabilization through work experience
Maintenance	45–64	Continually adjusting skills to improve position
Decline	65+	Output reduces, prepares for retirement

Table 1: Super's (1980 life and career development stages

Integrated Theories (21st Century)

We have come to understand that career development is influenced by a multitude of factors interacting together—psychological, sociological, geographical, historical, political, physical, economic, and educational (Gunz, 2009). Developmentalists helped to set the stage for the integration of various approaches and theories as an individual engages in the career development process. Additional theories and frameworks have elevated our understanding of the complexities of the career development process and how those different factors come together to guide career development.

Social Cognitive Career Theory. Of late, social cognitive theorists have had a great influence on our understanding of how we move along our career path. We understand that individuals have agency in progressing along their own career paths, which are influenced both by personal factors, such as self-efficacy, outcome expectations, and personal goals, and external environmental factors, such as barriers, supports, and culture (e.g., financial resources, family, and cultural expectations). We better understand that an individual's progress along a chosen career path is a result of the dynamic interaction between those external environmental factors and the internal subjectivity factors. Social Cognitive Career Theory suggests that self-efficacy and outcome expectations (chances that one will succeed) influence career interests, decision-making, persistence, and job performance, and environmental factors influence career choice (Lent et al., 2002). This theory explains how individuals develop their career interests, make career decisions, and persist in their chosen careers.

Hope-Action Theory. One of the more thought-provoking career development theories to arise in recent years is the Hope-Action Theory (Niles et al., 2011, 2019). The central theme of this theory is that an individual's ability to envision a desired future and believe they can achieve it is what enables career planning and decision-making. Without hope, individuals lack self-motivation to engage in career planning and goal setting. This theory rests on the following key competencies:

- Hopefulness: The degree of hope one has about their future
- Self-reflection and self-clarity: Understanding one's values, strengths, and interests
- Visioning: Brainstorming potential career paths and desired outcomes
- Goal setting and planning: Defining specific goals and creating actionable steps to achieve them
- Implementation: Taking concrete actions toward goals
- Adapting: Adjusting plans and strategies based on new information or changing circumstances

As illustrated in Figure 2, the Hope-Action theory shows that individuals continuously learn from and interact with their environments as they construct their careers, with competencies as central elements and hope as the driving force.

Career counseling therapists can use Hope-Action Theory and the *Hope-Action*

Figure 2: Hope-Action Theory (Niles et al., 2011)

Inventory (Niles et al., 2010) to help clients identify their career goals, develop a sense of agency, and overcome obstacles by focusing on building hope and optimism. Educators implementing career development programs can incorporate elements of hope theory into curriculum to promote positive career attitudes and resilience among students.

Systems Theory. Most recently, the Systems Theory Framework (McMahon et al., 2004) describes a system of career influences that impact an individual's career development. Through reflecting on their position within each of three interconnected systems (the individual system, the social system, and the broader environmental/societal system), individuals construct their own system of career influences that describe their own career stories, which can lead them to the next steps in their career journeys.

The Trait-Factor and the situated and integrated theories and frameworks reviewed above illustrate our growing understanding of the career development process over the past century. It tells the story of how and why we, as a society, during the first half of the 1900s believed that only certain individuals were capable of succeeding in certain types of jobs and how that understanding changed as we learned more about the developmental nature of career development and the external factors that influence its growth. Over the years, this research has been translated into practice through various forms of career education in the public education sector and in government- and industry-supported training programs.

Conclusion

In this brief, we have highlighted the important role of career development theory in shaping our understanding of how individuals develop career interests, as well as the developmental, environmental, psychological, and social factors that influence one's career decisions and pathways throughout their lives. As education systems and policymakers provide opportunities for students to develop the critical knowledge, skills, and dispositions needed for success in the future workforce, it is essential that what we are learning through career development theory informs the design of educational programs, strategies, and interventions for informal and formal learning settings. Programs such as the NSF ITEST program exemplify how educators and practitioners can engage and inspire youth at critical stages in their career journey by providing developmentally and age-

appropriate experiences that support youth's awareness of and engagement in STEM and emerging technology career fields.

In Part 2 of this series, we will examine the career development continuum—career awareness, career exploration, and career preparation—and highlight how ITEST-funded projects apply research-informed strategies at critical stages across the pre-K–12 grade spectrum.

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