



Design of a web based career counselling information system: Türkiye case

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Abstract

This research presents the design of Career Counselling Information System (CCIS), a web-based career counselling information system. The research aims to reveal a design framework for a web-based career information system integrated with universities' labour market performance to support career guidance processes. This research is structured as a design-based research approach. This research presents the results of the first cycle of design-based research. The research follows a five-step process: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation. The analysis phase identifies indicators, universities/departments, and labour market profiles. The design phase configures the system architecture. The development phase creates the platform. A pilot study involved 30 career counsellors after CCIS development. The system was examined with 14884 career counsellors during implementation. Feedback from 40 career counsellors guided improvements. CCIS digitally transforms Türkiye's universities and departments labour market performance profiles. Career counsellors highlight CCIS indicators as essential for career decisions. The research's performance indicators and systems are expected to enrich career guidance, labour market information, and career information system literature.

Keywords Career guidance · Labour market information · Web-based career counselling information system · Higher education

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1 Introduction

Career guidance benefit from the advancements in emerging technologies. The widespread adoption of information technology and communication systems has dramatically facilitated providing student career guidance services (Gati & Asulin-Peretz, 2011; Pordelan & Hosseinian, 2022; Supriyanto et al., 2019). Online career services and career information systems are being developed to support students in the career decision process. These technological tools serve multiple purposes, including career decision-making, intervention, and planning (Sampson & Osborn, 2015; Zainudin et al., 2020). Career information systems becomes particularly crucial in countries with a significant young population, such as Türkiye. In Türkiye, the higher education entrance central system examination is administered by the Evaluation, Selection and Placement Centre (Ölçme, Seçme ve Yerleştirme Merkezi [ÖSYM]). Based on the examination results, students must make critical decisions about their future careers, including selecting a university and department. According to current statistics, 3 million 527 thousand candidates applied to the 2023 examination (ÖSYM, 2023). After the exams, face-to-face university preference counselling services are provided by career counsellors to support students in their transition to higher education institutions (Republic of Türkiye Ministry of National Education, 2023). The most critical mission expected from career counsellors is to carry out guidance activities for students' choices, decisions, and preparations for their future occupations and careers (Yeşilyaprak, 2019). The general purpose of this service is to guide students in transitioning to a higher education institution according to their abilities, interests, needs, personality traits, and living conditions. The services provided in this context are processed and recorded in the e-Guidance System. Consequently, students should receive career guidance services to select a department and university, a meaningful career step that aligns with their preferences and competencies. With the diversification of career choices, it has become more complex for each individual to determine their own path. Moreover, opting for a suitable university and department significantly influences an individual's career and job satisfaction, which, in turn, impacts the overall productivity level of society (Turan & Kayıkçı, 2019). This situation highlights the need for tailored and effective guidance services that enable students to make informed careers decisions and help them assess their career choices and abilities.

Moreover, emerging guidance practices yield significant benefits for individuals and public welfare (Barnes et al., 2020). As countries strive to promote evidence-based career guidance, the expanding use of data analytics and digital technologies for monitoring and evaluating the effectiveness of career guidance services becomes increasingly prevalent (Harrison et al., 2022). Career information systems are expected to enable evidence-based effective career development interventions. However, current systems prioritize accessibility for everyone rather than providing tailored applications for individualized career guidance, termed career guidance 1.0. Advancing from these resource-centric systems to personalized, counselor-involved designs is critical.

Career information systems are particularly important for bringing labour market information into career guidance processes (McKinlay, 1975). The labour market

is an important factor that shapes many career theories and influences an individual's career decision (Baruch & Sullivan, 2022; McKinlay, 1975). Students' earning expectations also play a crucial role in their preference for a university and department (Jiménez & Salas-Velasco, 2000). Soutar and Turner (2002) conducted research with 259 high school seniors, where students expressed a preference for good job opportunities over average ones, indicating that their satisfaction with university education depended on various factors such as career preparation, job opportunities, and employer interest (Alves & Raposo, 2007; Webb, 1993). These indicators are critical for making informed career decisions considering labour market performance (Baruch, 2015). Employment rates and job opportunities are crucial for students and parents to make conscious career choices (Tong, 2019). The use of labour market information as a basic resource for an effective career guidance process occurs through career information systems (Patton & McMahon, 2014; Pordehan & Hosseinian, 2022). Existing career information systems need proper alignment between labour market information and specific professions or higher education programs. It is essential to note that higher education plays a significant role as the first step toward a professional career. When individuals choose a university and department, they select a profession. For all countries, higher education institutions have a crucial impact on shaping labour market performance. Therefore, uncovering universities' labour market performance profiles and incorporating this data into career counselling processes to assess their effectiveness becomes essential. In line with, when current systems are examined in more depth, it is seen that they have a common design architecture. Navigation within the systems is primarily left to individuals in their career exploration. Understanding labour market information requires strong navigation skills, encompassing data on current labour market conditions, projections, job search duration, wages, occupational distribution, and sector knowledge. Career counsellors bridge labour market information and students, interpreting and using it to inform, advise, and guide learners. However, Individuals are expected to independently understand, combine, and make career decisions based on labour market information derived from indicator panels, demanding high data literacy and highlighting weak system designs.

Another noteworthy aspect is that the development of career information systems is typically supported by governments, indicating their policy-level consideration. Discrepancies in the organization, coordination, funding, delivery, and structure of career guidance have also been reported (Harrison et al., 2022). This indicates the need for a more consistent, effective, and comprehensive approach to career guidance. Additionally, having reliable evidence based on the scope and effectiveness of career guidance interventions is a prerequisite for justifying public investments in career guidance services (Harrison et al., 2022). Consequently, while there is a need for a robust experimental evidence base in career guidance, many countries require improvements in monitoring input, outcomes, and impact of career guidance processes (Barnes et al., 2020).

This research aims to design a web-based career information system integrated with the labour market performance of universities in the Turkish context. Digitizing universities' labour market profiles and utilizing them in career guidance processes is an innovative way to effectively place talent on a national scale. This research presents the results of the first cycle of design-based research (DBR).

1.1 Background and related works

A career is a life-long dynamic process that reflects progress along a career path (Baruch, 2015;

Esbroeck et al., 2005). A career decision is an important step on the career-planning path, which should be suitable for individuals (Bimrose & Mulvey, 2015; Lent & Brown, 2020). Making an appropriate career decision impacts an individual's life (Haneef et al., 2020). Individual's lifestyle, economic and social status, sense of productivity (Gati & Tal, 2008), career satisfaction (Gati et al., 2006), well-being (Creed et al., 2005), and living standards (Sabates et al., 2017) are influenced by their career choices. This progress encompasses several multidimensional concepts, including an individual's interests, attitudes, values, and professional decisions (Niles & Harris-Bowlsbey, 2013; Holt, 1989), all critical elements in the career development process. In addition, career development comprises a comprehensive range of psychological, educational, economic, and sociological factors (Herr, 2001; Song & Park, 2005) and includes interventions and practices to promote more effective career decision-making (Spokane, 1991).

Individuals require necessary guidance throughout their career journeys (Super, 1980). Career guidance is crucial in guiding individuals toward effective career planning and increasing awareness about their academic and professional careers (Eun et al., 2013; Gysbers, 2001), especially for students who need guidance in exploring job fields and opportunities (Haneef et al., 2020). Career guidance encompasses a comprehensive array of services designed to effectively bridge the divide between an individual's expectations, interests, qualifications, and skills and the broader societal or global expectations (European Center for the Development of Vocational Training (CEDEFOP) et al., 2019). In addition, previous research highlights the importance of career counselling in helping individuals access information about existing occupations and opportunities (Eun et al., 2013; Gati & Levin, 2015), especially for students who may face difficulties in making career decisions without sufficient knowledge (Ashari et al., 2019; Haneef et al., 2020). This process extends throughout a person's lifetime and is punctuated by significant milestones that influence the type of support provided at each stage. For example, career guidance involves.

- offering valuable assistance to individuals when making pivotal decisions, including educational planning or transitions,
- mapping out vocational education paths,
- aligning personal goals with the ever-evolving demands of the labour market.

Effective career guidance is paramount in enabling individuals to achieve their maximum potential, fostering enhanced productivity within national economies, and ensuring efficient management of human resources (CEDEFOP et al., 2019). The key figures responsible for career and academic counselling, such as guidance specialists, career counsellors, and psychological counsellors, play a pivotal role in this process (Zhang et al., 2018). When seeking career guidance and support from counsellors, practitioners need to utilize relevant data and statistical information about university and department options, occupations, and job fields. Such data should be employed judiciously and customized to cater to individual needs. The significance of up-to-date,

timely, personalized, and accurate career information and support is crucial due to the majority of individuals facing critical career decisions. Precisely tailored interventions in career guidance have far-reaching effects beyond the individual level; they hold the potential to advance society as a whole by aligning talent with contemporary demands and expectations, effectively matching human competencies with inherent capabilities.

Career information systems are among the most cost-effective approaches to providing current career information and supporting career exploration and planning (Garcia et al., 2021). These systems can potentially reach many participants, which is valuable when a career counselor must serve many students (Garcia et al., 2021). In such cases, addressing students' individual needs regarding career choices can become challenging. Therefore, digital career counselling tools can offer more comprehensive career guidance to individuals. Additionally, digitalization in career guidance can reduce geographical, psychological, physical, and financial barriers to accessing services, thus promoting equal opportunities (Mallen et al., 2005).

The pioneering research on career information systems was conducted by McKinlay (1975), and a career information system was developed to support individuals who were about to make career choices. In this system, occupational descriptions formed the core of the career information system. This initiative echoes continue today; many countries have moved towards digitalization in career guidance. Various career information systems have been developed and used by different countries. The government of Canada created an interactive tool presenting labour market outcomes for college and university graduates, including employment income based on age group, gender, education, geography, and field of study. In the U.S., the College Scorecard by the Department of Education lists universities and departments based on location and graduate earnings, providing information on graduation rates and student quotas. Other examples are Australia-the *National Career Information System*, Denmark-*eGuidance*, and Netherland-*Kiesmbo*. *O*NET OnLine* is an occupational information platform that provides information on around 1000 occupations. The platform was established under the coordination of the U.S. Department of Labor/Employment and Training Administration. The platform contains information on occupational salaries, future forecasts, job families, and job opportunities. The data is collected on a large population of workers from each occupation and updated frequently. Information is provided on job descriptions, technological skills required, work-related activities, work context (e.g., physical conditions, working hours), areas of interest, personality traits of people in this occupational group, hiring rates and wages, the level of education, experience, and training required to become a member of this occupational group, as well as internship opportunities. The platform's target audience is job seekers, students, and career seekers. *Bundesagentur für Arbeit* platform provides detailed information and guidance about job and education opportunities and the resources offered by the state for unemployed individuals, people with disabilities, migrants, parents, adolescents, and young adults by the German Federal Employment Agency. Individuals are guided according to the choices they make in the statements, "I know exactly what I want to be.", "I know roughly what I want to be.", "I'm leaning towards education, but I don't know which one." In this direction, information is provided about psychological tests, occupational lists, and types

of education so that individuals can discover their interests, strengths, and weaknesses. This information is also supported by videos. *Europass* was launched in 2018 in line with the European Union's policies to support lifelong learning and improve the quality and productivity of the workforce. It is managed by the European Commission. The old digital platform managed by CEDEFOP has been closed and the new Europass Platform is now available. The platform provides information on European work and learning opportunities, qualifications and qualifications systems, processes and procedures for lifelong learning in European countries, recognition and validation of diplomas and certificates, institutions and organizations providing guidance for international mobility and career management, information on skills needs in occupations and sectors, data, analysis and forecasts, information on living, studying, and finding a job in Europe (Europass, 2024). *eVejledning* In 2011, the Danish Ministry of Children and Education established "eVejledning", a digital national advice center hosted by the National Agency for ICT and Learning. Based on some feedback, the ministry created this platform with the aim of establishing an integrated tool for all age groups in the country to assess career possibilities. Apart from education and labour market information, the online platform provides individual career advice to individuals through phone calls and e-mails and group career advice through web-based seminars and live chats. The fact that the overwhelming majority of career information systems with active users are designed with a focus on occupations, that universities do not have labour market profiles, that they are open-access systems that only offer resources rather than personalized career guidance, that career decisions are left to the individual and individuals are bombarded with valuable but intensive information, that the systems demand high data literacy, and that there is no common design architecture are seen as aspects open to improvement. In addition, there are no reports on the effectiveness of current information systems. This situation points to the need for systematic design research context of career information systems.

Although studies on online career guidance have been conducted and widely used career information systems have been developed nationally, it is known that there is a need for new research on the effectiveness of online career guidance. Pordelan and Hosseinian (2022) designed a web-based career information system to support university students' entry into the labour market. The research contains valuable information about the positive impact of online career counselling on career guidance processes. In this study, it is stated that it is important for web-based career information systems to ensure data confidentiality for clients, to have digital literacy skills of career counsellors, and to produce outputs based on log data for the counselling process. In addition, useful features of career information systems, such as reaching more students, easy follow-up and ensuring continuity in support, are reported. According to the online career intervention study by Nota et al. (2016) with 200 secondary school students in Italy, the computer-assisted career advice system can effectively prepare for career objectives and enhance job flexibility. Additionally, research has shown that digital expert systems are valuable tools in career guidance and students' academic major selection (Nota et al., 2016). This information strengthens the research in designing more effective career information systems.

1.2 Current research

This research presents the design process of a career information systems, CCIS, designed to evaluate graduates' labour market performance and enable these evaluations to be used in career counselling activities in Türkiye. For this purpose: 1) to improve and expand labour market information in career guidance, 2) to provide career counsellors with a "single entry point" that gathers all labour market information in one centralized place, 3) to add and evaluate the impact of mentor support, which is lacking in existing systems, 4) to match complex labour market information with higher education and create profiles that can be integrated into career guidance services in the simplest form, 5) to develop a tool that makes career counselling processes more personalized.

Overall, this study is original and valuable for the community of human resources professionals, career counsellors, and policy-makers interested in digital technology (and strategy) and labour market information used in the context of career guidance and is motivated by the following question:

How should a web-based career information system, integrated with universities' labour market performances, be designed to support career guidance processes?

The main objectives of the research are:

- 1 Exploring the design features of a career information system for career counsellors providing labour market performance information
- 2 Design and develop an information system that incorporates the defined design features
- 3 Implementation to evaluate the use of career information systems in career guidance processes
- 4 Create a framework for the design of a web-based career information system integrated with labour market performance indicators and higher education to support career guidance processes

2 Methods

2.1 Research design

This research is structured as a DBR approach. This approach involves mixed research methods, emphasizes collaboration among researchers, and prioritizes the practical effects of the intervention (Anderson & Shattuck, 2012). DBR is a systematic and flexible methodology that aims to continuously improve real-world settings practices through iterative analysis, design, development, and implementation of educational practices (Wang & Hannafin, 2005). It is a real-world practical issue to explore how universities can innovatively design a career information system integrated with labour market performance indicators to support individuals' career choice processes. DBR guided a methodological framework for identifying design

features, development, implementation, and evaluation of the career information system. Due to the flexibility of the DBR, a contextually sensitive methodological framework was adopted to design a career information system. Figure 1 presents the design process and shows each sub-process's action steps and outputs. The output of each action is the input for the following action to optimize the design. Each process includes a unique method. A complex system design and diversity of procedures are other factors that make using DBR necessary. In accordance with the DBR approach, a dynamic and iterative cyclic design process has emerged. The design process is explained in detail in the following sections.

The research aims to reveal a design framework for a web-based career information system integrated with universities' labour market performance indicators to support career guidance processes. This design framework was shaped in an iterative process focused on career counsellors and implemented in the real world with 18,444 career counsellors. The research is not limited to this but also includes the interaction patterns of career counsellors in the system. Due to these patterns, DBR contributes to the advancement of theory in the career guidance processes. DBR is structured around five main steps: Analysis, Design, Development, Implementation, and Evaluation (Richey & Klein, 2005). Detailed information is presented in Table 1.

In the analysis stage, relevant literature, examples, and similar applications were reviewed, and expert opinions were solicited to determine expectations, needs, and indicators. In the design step, we decided and designed the CCIS prototype and its components. Experts stated opinions on these designs, and the system was optimized

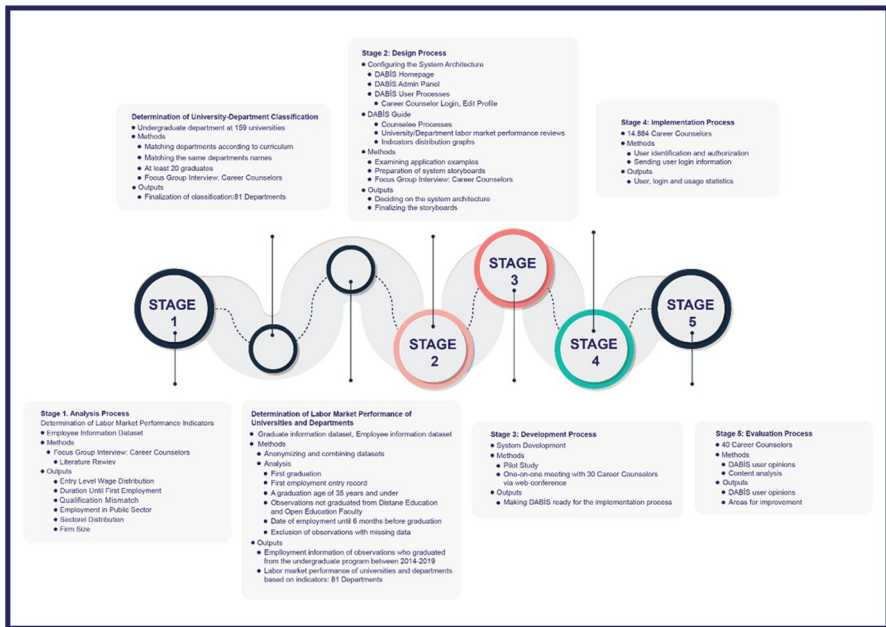


Fig. 1 CCIS design process

Table 1 Research Steps, Actions, and Outcomes

Step	Action	Outcome
Analysis	Literature review Review of best practices Expert opinion	Determining of the expectations, needs, and indicators
Design	Determining components of the CCIS Design of the CCIS Expert opinion about the CCIS Revising the CCIS	Design of the CCIS prototype
Development	Develop of CCIS components and prototype Expert opinion Revising the CCIS prototype	Developing of CCIS
Implementation	Pilot study	Implementation of CCIS
Evaluation	Revising and improvement of CCIS	Finalizing of CCIS for the first cycle

based on feedback. The development stage followed, leading to the implementation of the system for real users in the subsequent implementation stage. Finally, the evaluation stage was conducted, which involved examining the indicator tendencies and opinions of career counsellors, making further improvements and developments to the system, and optimizing it accordingly.

2.2 Participants

This study involves a collaborative effort with a diverse group of experts to facilitate the development of CCIS. Experts consist of instructional technologies, software development, guidance counselling, career advisement, measurement and assessment, statistics, and human resources (detailed information in Table 2).

Domain experts, guidance, career counsellors, and human resources experts, provided consultation to determine the system needs and indicators in the analysis phase. The design step added instructional technologies, measurement and assessment, statistics, and software developers. Experts in measurement, assessment, and statistics contributed to calculating and presenting the indicators. The instructional technologies and software developers worked on the design and develop of the system and its components. Career counsellors provided support in the implementation of the system. 14,884 career counsellors in the implementation step consist of people who actively use the system and work as career counsellors in public schools.

2.3 Data collection tools and data analysis

This research consists of different data collection processes and tools in accordance with the nature of DBR. Semi-structured interview forms and log data are the data collection tools. Semi-structured interview forms were used in the analysis, design, and evaluation stages. All interviews were conducted in person.

Table 2 Participants of the Research Process

Process	N	Experts
Analysis	5	Guidance
	1	Career Counsellors
	1	Human Resources
Design	1	Instructional Technologies
	1	Guidance
	3	Career Counsellors
	1	Human Resources
	1	Measurement and Assessment Statistics
	1	Software Developers
	1	Instructional Technologies
Development	30	Career Counsellors
	1	Guidance
	1	Human Resources
	1	Measurement and Assessment Statistics
	1	Software Developers
Implementation	14,884	Career Counsellors
Evaluation	1	Instructional Technologies
	1	Guidance
	40	Career Counsellors
	1	Human Resources
	1	Measurement and Assessment Statistics
	1	Software Development

The form used to define labour market performance indicators in the analysis process consists of six open-ended questions. These questions include 12 sub-questions in total. For example, *"Evaluate the functionality of the qualification mismatch indicator in career counselling processes."* and *"Evaluate the appropriateness of rating the qualification mismatch groups. These groups are (1) no qualification mismatch, (2) low-level qualification mismatch, (3) medium-level qualification mismatch, and (4) high-level qualification mismatch."*

During the design process, career counsellors were consulted about the design of CCIS components. The semi-structured form used in these interviews included ten open-ended questions about the design of CCIS components. For example, *"Are the graphs of the firm size indicator produced by the reporting module understandable?"* and *"Is the functionality of the criteria module design adequate?"* and *"How understandable is the information presented to you?"*

In the evaluation process, semi-structured interviews were conducted with 40 career counsellors using the system to examine the CCIS experiences of career counsellors and to enrich the log data. The interview form included seven questions aimed at understanding career counsellors' CCIS experiences, such as *"What are the benefits of CCIS for career guidance services?"*, *"What would be the most important reasons for continuing to use CCIS?"* *"What would you like to change in CCIS?"* and *"What aspects of CCIS need to be improved?"*. Additional

questions were posed to the career counsellors in accordance with the context of the interview.

In the evaluation process, log data obtained during the implementation process were used to determine the tendency of career counsellors to use the indicators. Log data refers to the digital traces of users who provide career guidance services using CCIS. The log data consists of the total number of logins, number of unique users, number of university-department profile clicks, number of university-department profile reviews, number of comparisons, number of registered students, and number of career counsellors that enrol students. A sample dataset with log data is presented in Fig. 2.

The PageName column in Fig. 2 shows the actions performed by career counsellors. These actions consist of University and department and compare. University and department actions refer to career counsellors' examining the labour market performance profile of a university and a department based on indicators. Compare action involves evaluating the labour market performance profile of different universities and departments based on indicators. FactorId reports the indicators used. Indicator coding is as follows: 1- employment in the public sector, 2- sectoral distribution, 3- firm size, 4- entry level wage distribution, 5- duration until first employment, and 6- qualification mismatch. UniverstyId and DepartmentId represent the universities and departments investigated. In addition, career counsellors' Session ID and Student ID information are kept by matching them with Advisor ID. This enabled the profiling studies presented in the rest of the study.

Descriptive findings were presented according to log data. In addition to descriptive statistics, adjusted residuals analysis and association rules were conducted to examine the associations with log data. On the other hand, content analysis is used for interviews. Detailed explanations about the analyses conducted within the scope of this research are given under this heading.

Residual approaches play an important role in assessing the significance of cell tests. These approaches are the standardized and adjusted residuals are handled in two ways. MacDonald and Gardner (2000) suggest using the adjusted residual approach instead of the standardized residual approach because it better meets the assumption of normal distribution in evaluating cell contribution to significance. In this study, adjusted residual analysis was used to determine the usage tendencies of indicators. On the other hand, association rules analysis revealed the joint of

PageName	StudentId	AdvisorId	FactorId	UniversityId	DepartmentId	UniversityId2	DepartmentId2	CreateDate	SessionId
Compare	ak010159-ak9-4968-9k46-481-7d70181198	ec008282-4d79-4172-3007-71439394819	5	81809053	31	89010008	31	7.12.2021 12:44:56c1884-48aa-4769-47b6-3370242a6c02	
Compare	ak010159-ak9-4968-9k46-481-7d70181198	ec008282-4d79-4172-3007-71439394819	5	81809053	31	18779581	31	7.12.2021 22:42:486c1884-48aa-4769-47b6-3370242a6c02	
UniversityandDepartment	ak010159-ak9-4968-9k46-481-7d70181198	ec008282-4d79-4172-3007-71439394819	5	53771667	31			7.12.2021 13:33:0e8b8a5-158e-44e5-a405-a881524a1d11	
UniversityandDepartment	ak010159-ak9-4968-9k46-481-7d70181198	ec008282-4d79-4172-3007-71439394819	5	53771667	31			7.12.2021 13:32:0e8b8a5-158e-44e5-a405-a881524a1d11	
UniversityandDepartment	ak010159-ak9-4968-9k46-481-7d70181198	ec008282-4d79-4172-3007-71439394819	5	53771667	31			7.12.2021 13:31:0e8b8a5-158e-44e5-a405-a881524a1d11	
UniversityandDepartment	ak010159-ak9-4968-9k46-481-7d70181198	ec008282-4d79-4172-3007-71439394819	5	53771667	31			7.12.2021 13:30:0e8b8a5-158e-44e5-a405-a881524a1d11	
UniversityandDepartment	8d34846-2bc-4d81-4ac1-1ba1215d64e6	411899e-0f8e-8e16-9b76-79a0a30f90ca	5	70157012	6			7.11.2021 23:28:0510808-714f-43a1-af0c-c5d403a089ff	
UniversityandDepartment	76c5e0a-af04-47b5-a05-119436-775fa	2af7202b-0164-414a-8a63-a409718a600c	5	23934413	7			7.11.2021 15:11:8541e04e-66d8-822a-9648-81279a176060	
UniversityandDepartment	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	2	92662996	29			7.10.2021 22:13:9d1501f5-af0c-4111-8f0c-6dad1-709d46	
UniversityandDepartment	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	4	92662996	29			7.10.2021 22:13:9d1501f5-af0c-4111-8f0c-6dad1-709d46	
UniversityandDepartment	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	5	92662996	29			7.10.2021 22:12:9d1501f5-af0c-4111-8f0c-6dad1-709d46	
UniversityandDepartment	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	2	53771667	15			7.10.2021 22:08:6a2e706a-0209-4486-8c78-a8117884b331	
UniversityandDepartment	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	4	53771667	15			7.10.2021 22:08:6a2e706a-0209-4486-8c78-a8117884b331	
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UniversityandDepartment	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	2	30889132	10			7.10.2021 13:16:4879c1eb-8f0c-4077-9188-0008436ac7e	
UniversityandDepartment	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	4	30889132	10			7.10.2021 13:16:4879c1eb-8f0c-4077-9188-0008436ac7e	
UniversityandDepartment	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	5	30889132	10			7.10.2021 13:15:4879c1eb-8f0c-4077-9188-0008436ac7e	
UniversityandDepartment	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	2	30889132	10			7.10.2021 13:15:4879c1eb-8f0c-4077-9188-0008436ac7e	
UniversityandDepartment	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	4	30889132	10			7.10.2021 13:15:4879c1eb-8f0c-4077-9188-0008436ac7e	
UniversityandDepartment	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	5	30889132	10			7.10.2021 13:15:4879c1eb-8f0c-4077-9188-0008436ac7e	
Compare	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	2	18779581	4	84914247	80	7.10.2021 13:11:4879c1eb-8f0c-4077-9188-0008436ac7e	
Compare	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	4	18779581	4	84914247	80	7.10.2021 13:11:4879c1eb-8f0c-4077-9188-0008436ac7e	
AdvisorReport	32549118-10k4-4339-1ac9-ba097299987	0f0-7d6-5524-4b0-Rd02-5564a1382d4c	5	18779581	4	84914247	80	7.10.2021 13:11:4879c1eb-8f0c-4077-9188-0008436ac7e	

Fig. 2 Overview of log data

indicators. Detailed information on adjusted residuals and association rules is provided in the findings section.

Content analysis creates a systematic picture based on qualitative data and answers research questions (Hsieh & Shannon, 2005). This research's six-stage model proposed by Creswell (2007) was as follows: 1) transcription, 2) selecting the reference interview for coding, 3) pre-processing, 4) coding, 5) theorizing and 6) analysis. First, transcripts of the interviews were created. Each researcher carefully read all the interviews and took notes where considered important. Then, with the joint decision of the researchers, the interview containing the richest data for the study was selected. Discussions were held on the selected interview, and explanatory words and/or phrases were placed on these statements. After the preprocessing stage, the coding process began. At this stage, the statements made by the participants were categorized meaningfully, and codes representing these statements were created. A list of codes was prepared, related codes were grouped, and unnecessary codes were removed. After the code list was created, the other interviews were analyzed according to the code list.

3 Findings

3.1 Findings of analysis phase

Labour market performance indicators, universities, departments, and the performance profiles of universities and departments were determined. Information on individuals who graduated from an undergraduate department between 2014 and 2019 was used. Departments were categorized based on their curriculum, resulting in 81 departments. The analysis outcome yielded indicators, university-department classifications, and labour market performance profiles of universities and departments, which served as inputs for the subsequent design process.

3.1.1 Determination of labour market performance indicators

The data set contained information such as employment and job leaving dates, employment sector, wage information, and firm size of active workers. Five indicators that provided the most information were selected and used as indicators in the study. In addition, a new indicator called qualification mismatch was developed after an extensive literature review. Three focus group interviews were conducted with career counsellors to validate the indicators further, resulting in a consensus on the accuracy of the selected indicators for the career determination process. The content of the indicators is as follows:

- i. **Entry Level Wage Distribution (ELWD):** This indicator depicts the distribution of individuals based on four income groups, determined by their first job after graduation.
- ii. **Duration Until First Employment (DUFE):** This indicator illustrates the duration between graduation and the commencement of an individual's first employ-

ment. The time between graduation and the start of the first job is categorized into four periods: (1) before graduation, (2) 0–6 months, (3) 6–12 months, (4) 12 months and above.

- iii. **Qualification Mismatch (QM):** This indicator assesses whether graduates are employed in jobs that are appropriate for their qualifications. A value close to or equal to zero indicates a good match between a graduate's qualifications and their employment. A value approaching three suggests that the individual is working in a job that requires significantly less qualifications than they possess. The International Labour Organization (ILO) has developed a methodology based on standard occupation and skill sets classification to calculate the qualification mismatch using the level of education and field of study (ILO, 2018). The qualification mismatch of graduates in their first job is reported in four groups: (1) no qualification mismatch, (2) low-level qualification mismatch, (3) medium-level qualification mismatch, and (4) high-level qualification mismatch.
- iv. **Employment in the Public Sector (EPS):** This indicator measures the percentage of graduates who enter their first job in the public sector.
- v. **Sectoral Distribution (SD):** This indicator displays the distribution of sectors in which graduates are employed in their first job. The sectoral distribution is determined using Nomenclature of Economic Activities (NACE) codes, which define and compare economic activities according to international standards. The NACE (2022) code includes 21 different sectors, but for this study, 19 sectors in the employee information data set were considered as references, including Manufacturing, Education, Construction, and others.
- vi. **Firm Size (FS):** This indicator displays the distribution of graduates' employment by firm size. Firm sizes are classified into four groups: micro (1–9 employees), small (10–49 employees), medium (50–249 employees), and large (250+ employees).

3.1.2 Determination of university-department classification

In order to assess the labour market performance of undergraduate departments across 159 universities, a classification process was conducted. University-department combinations with at least 20 employed graduates were included in the analysis. Departments were subsequently grouped based on their curriculum and focus group interviews were conducted with career counsellors to determine the suitability of the classification. Based on the experts' feedback, updates were made, and the classification was finalized, resulting in 81 departments. Statistical analyses were conducted to determine the labour market performance of these departments, which will be discussed in the next step.

3.2 Findings of design phase

The system architecture is presented in Fig. 3.

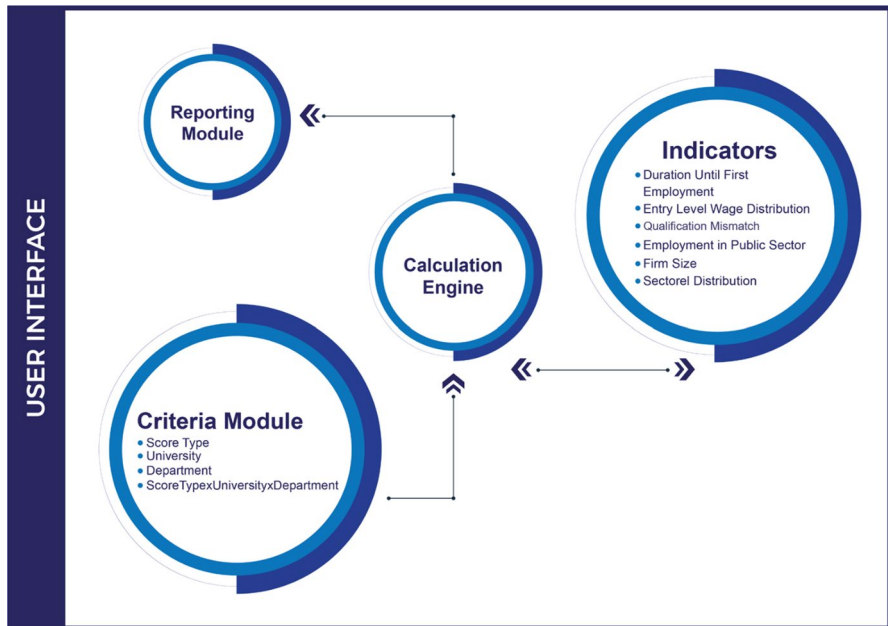


Fig. 3 System architecture

CCIS has five components: Reporting Module, Criteria Module, Calculation Engine, Indicators, and User Interface. Users can select the university and department based on specific criteria in the Criteria Module. The Calculation Engine receives the criteria from the Criteria Module, processes the data, and transmits it to the indicators for analysis. After the calculations are completed, the Calculation Engine sends the results to the Reporting Module, where the information is visualized and presented to the User Interface.

CCIS comprises two distinct processing centers: the Home Page and the CCIS Guide. The former serves as a platform for disseminating general information about CCIS to the public while containing a wealth of career resources for career counsellors. The Home Page is replete with various informative materials, including FAQs, tutoring resources, and contact details. Meanwhile, the CCIS Guide is dedicated to counselee registration and regulation procedures and reviews of universities and departments based on predefined indicators. Notably, access to this section is restricted to authorized career counsellors only.

3.3 Findings of development phase

CCIS is composed of two distinct panels, namely the Admin and User panels. Individuals with CCIS administrator authority have the ability to access CCIS usage statistics and generate reports based on these statistics. On the other hand, users who have been authorized as career counsellors can utilize the CCIS Guide to obtain

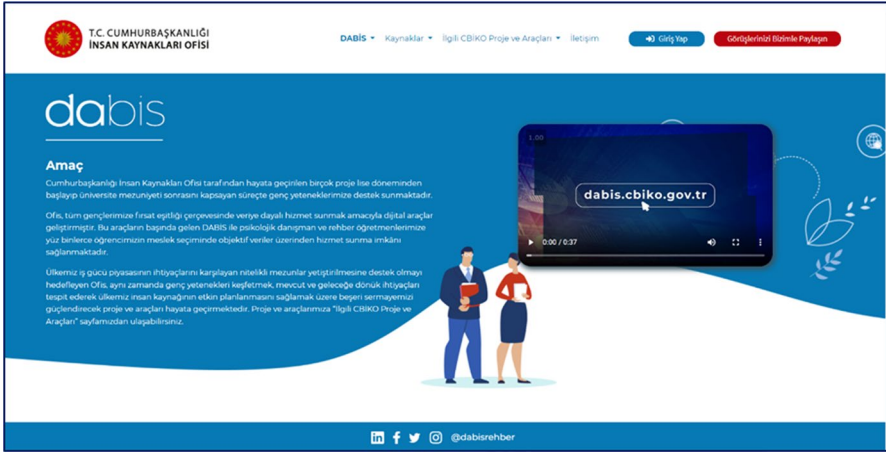


Fig. 4 CCIS home page

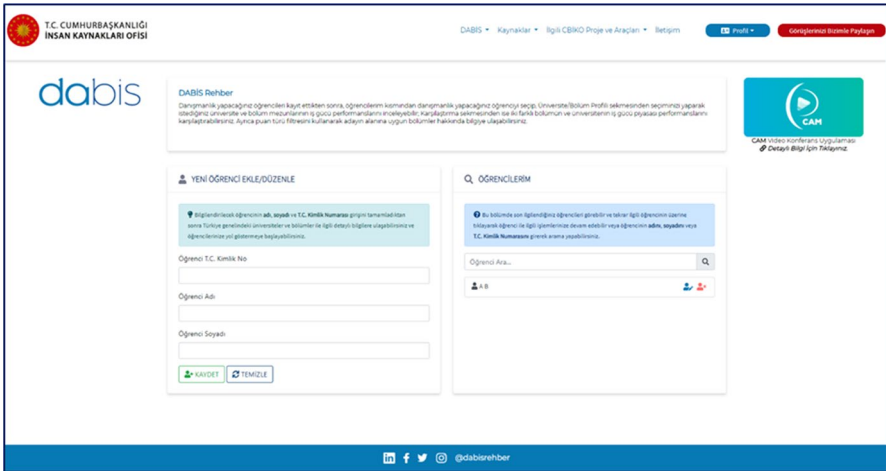


Fig. 5 CCIS Guide

in-depth information about the system. Figure 4 shows the CCIS Home Page (<http://dabis.cbiko.gov.tr>).

The home page provides general information about the system that is accessible to all individuals. Authorized users can access the CCIS Guide by logging in through this page.

Figure 5 illustrates the CCIS Guide, where career counsellors can perform various tasks.

One of its key features is that career counsellors can schedule online meetings with students through the CAM video conferencing application developed by the Human Resources Office of the Presidency of the Republic of Türkiye.

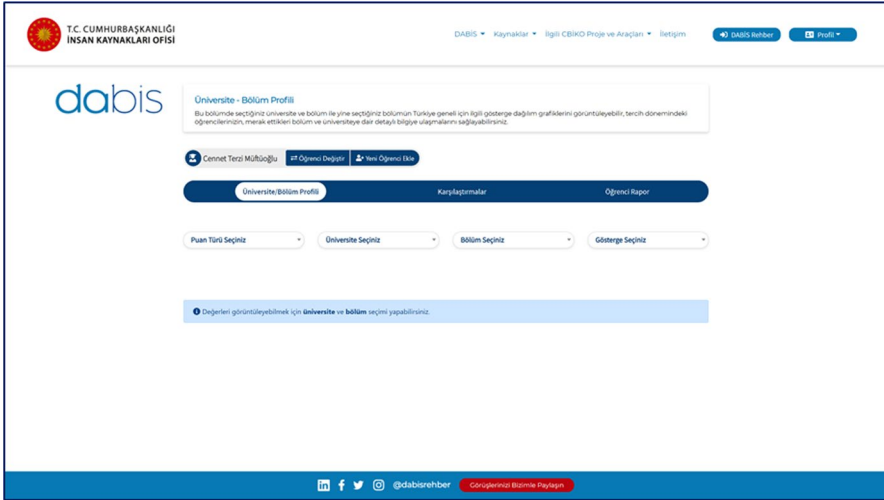


Fig. 6 CCIS Guide- university/department profile

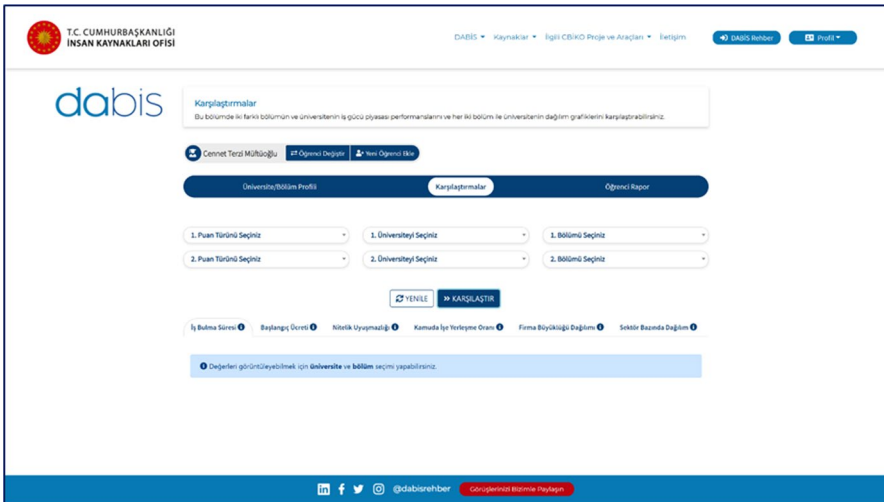


Fig. 7 CCIS Guide-comparisons

Figure 6 displays a screenshot of the University/Department profile, which is based on a filtering system that enables users to filter results based on score type, university, department, and indicator.

Figure 7 demonstrates the Comparisons section, where users have the ability to perform multi-criteria comparisons based on the type of score and combinations of universities and departments.

After the development of the CCIS platform, 30 career counsellors provided feedback. During the interview process, the system was presented in detail, and

Table 3 User and Login Statistics

Institution Type	Number of users	Number of login	Rate (%)
Secondary Education	6799	3703	54.46%
Counseling Centers	703	322	45.80%
Other*	100	23	23.00%
Not Specified	7052	1760	24.96%
Career Centers	201	109	54.23%
Total	14,884	5944	39.94%

*Center for Public Education, Vocational Education Center etc.

Table 4 Student enrollment statistics

Institution Type	Number of log in	Number of users registering students	Rate of users registering students (%)	Number of registered students
Total	5944	2773	46.65	13,129
Secondary Education	3703	1817	49.07	9129
Counseling Centers	322	176	54.66	600
Other	23	6	26.09	9
Not Specified	1760	728	41.36	3382
Career Centers	109	37	33.94	-

experts found it to be user-friendly, consistent, and highly informative, especially with regards to the indicators supporting career development. Upon careful consideration of the feedback received from the career counsellors, it was deemed appropriate to evaluate it at the end of the development process in the subsequent stages of the system development. During this evaluation, the suggestions were re-evaluated to determine their potential to enhance the system's suitability for its intended purpose and the quality of data it provides. As a result, the recommended improvements were implemented, and the system was thoroughly tested to ensure that it was error-free and ready for implementation.

3.4 Findings of implementation phase

During this phase, career counsellors and university career center managers were authorized, and their username and password information was sent via email. Table 3 displays the number of users and login statistics.

The group with the highest login rate was the guidance teachers working in secondary education institutions with a rate of 54.46%. Statistics on the number of students enrolled in CCIS are presented in Table 4 and usage statistics of career counsellors are presented in Table 5.

Table 5 System Usage Statistics

	Number of LOG	Total LOG	Rate (%)
University/Department profile view	32351	46481	70
Comparisons view	14130		30
University/department profile review	21424	38233	56
Comparisons review	16809		44

3.5 Findings of evaluation phase

The evaluation process played a crucial role in supporting all stages of the research. Experts were consulted at every stage, and real users accessing the CCIS provided feedback during the implementation process.

3.5.1 Career counsellors' tendencies to use indicators

The usage of indicators by career counsellors, according to the CCIS Guide navigations, has been reported. Out of the 13,000 individuals designated to provide counselling for students making university and department choices, 7889 accessed CCIS. The career counsellors who accessed CCIS performed 41,710 actions in the CCIS Guide. Of these actions, 38,233 (92%) were indicator usages, and the breakdown of these usages according to the university-department profiles and comparisons is provided in Table 6.

56% is attributed to university-department, while 44% is attributed to guide interactions in the comparisons section. The fact that indicator usage accounts for nearly all of the CCIS guide movements (92%) can be considered as a significant finding in terms of the effectiveness of this section. Indicator distributions regarding the frequency of each indicator's usage are presented in Table 7.

The research examined the movements of career counsellors' CCIS Guide in two distinct groups: University-Department (U-D) and Comparisons (C), as presented in Table 7. In the University-Department evaluations, the most frequently utilized indicators, in descending order, were the employment in the public sector (37%) and duration until first employment (29%). Subsequently, the indicators of entry level wage distribution (17%), qualification mismatch (9%), sector distribution (5%), and firm size (3%) followed this ranking. Similarly, a comparable pattern emerged when analysing indicator usage in the Comparisons section. In this section, the leading indicators were the employment in the public sector (32%) and duration until first

Table 6 CCIS Guide log data by indicator use

CCIS Guide	N	%
University-Department	21424	56
Comparisons	16809	44
Total	38233	100

Table 7 Indicator distributions according to CCIS Guide

CCIS Guide	U-D	U-D%	C	C%	Total	T%	Rank
EPS	41870	37%	26690	32%	68670	35%	4
DUFE	32990	29%	22435	27%	55485	28%	1
ELWD	19516	17%	14960	18%	34508	17%	2
QM	10218	9%	10512	12%	20742	10%	3
SD	5470	5%	4780	6%	10262	5%	6
FS	3846	3%	4974	6%	8826	4%	5
Total	113910	100%	84351	100%	198493	100%	

employment (27%), with entry level wage (18%), qualification mismatch (12%), sector distribution (6%), and firm size (6%) subsequently following suit. Comparing the two sections, it becomes apparent that the university-department reviews involved a higher number of indicator usages ($N=113,910$) compared to the comparisons section ($N=84,351$). Furthermore, Table 7 provides the presentation order of the indicators through the system order column. When analysing these findings in light of the sequence of indicator order, it becomes evident that a linear navigation is absent. Instead, a deliberate tendency towards specific indicators is apparent.

Table 8 presents a comprehensive analysis of the frequency of indicators used in both session-based university-department reviews and the comparisons section, independent of a specific indicator.

The findings from Table 8 reveal that in the University-Department reviews, the predominant usage of indicators was focused on a single indicator (26%). Subsequently, there was a decreasing trend in the use of indicators, with four indicators (19%), two indicators (17%), three and six indicators (14%), and five indicators (9%) following in sequence. Conversely, in the Comparisons section, the most prevalent usage was observed with six indicators (36%), followed by five indicators (17%), one indicator (15%), four indicators (14%), three indicators (10%), and two indicators (8%). These results highlight a notable disparity in the utilization of indicators between the University-Department evaluations and the Comparisons section. Specifically, it was noted that career counsellors tend to rely on a single indicator in the

Table 8 Use of indicators in combination

	U-D	U-D%	U-D% CUM	C	C%	C% CUM	T	T%	T% CUM
Single	730	26%	26%	215	15%	15%	945	23%	23%
2	469	17%	43%	108	8%	23%	577	14%	36%
3	401	14%	58%	141	10%	33%	542	13%	49%
4	512	19%	76%	205	14%	47%	717	17%	66%
5	256	9%	86%	243	17%	64%	499	12%	78%
6	399	14%	100%	513	36%	100%	912	22%	100%
Overall	2767	100%	100%	1425	100%	100%	4192	100%	100%

University-Department evaluations while favoring the utilization of six indicators in the Comparisons section. A corrected residual approach was employed to assess these tendencies' statistical significance. This approach compares the remaining cell values to the critical two-tailed z-value at the predetermined significance level, adjusted through Bonferroni correction. A statistically significant deviation is indicated when the absolute value of the residual exceeds the critical z-value, providing valuable insights for profiling purposes (Terzi et al., 2023). The results are presented in Table 9.

The analysis of Table 9 reveals significant deviations from expected values (α bonferroni = 0.00; z-value = 2.87) in six cells. These corrected residual values indicate observations that differ significantly from what was anticipated. The direction of the residuals, whether positive or negative, signifies whether the observations surpass or fall below expectations. Positive residuals indicate higher-than-expected values, while negative residuals indicate lower-than-expected values. Specifically, the findings from Table 4 demonstrate a stronger inclination toward the usage of 5 and 6 indicators in the Comparisons section, whereas in the University-Department evaluations, a greater tendency is observed for the usage of 1, 2, 3, and 4 indicators.

Further analyses were conducted to explore the relationships between these indicators using the apriori algorithm. Association rules are widely used in data mining to uncover non-linear patterns within a dataset. Evaluation metrics specific to the algorithm are employed to filter the rules, ensuring the selection of relevant rules based on specific criteria. This study filtered the association rules obtained using commonly used metrics such as support and confidence. A minimum confidence value of 0.8 and a minimum support value of 0.2 were set. The resulting rules may involve one or multiple antecedents and consequents. These rules are represented in the form of $x \rightarrow y$, where the confidence metric provides information about the likelihood of the items on the y side given the occurrence of the item or items on the x side, and the support metric indicates the occurrence probability of this relationship within the dataset. The items on the left side of the expression are referred to as antecedents (x), while the items on the right side are known as consequents (y). A total of 10 association rules were generated from the apriori algorithm, which is presented in Table 10.

Notably, the rules containing the duration until the first employment indicator attract immediate attention. Notably, the duration until first employment is not an antecedent for other indicators. This finding implies that, despite being ranked first

Table 9 Users' indicator tendencies (z-values)

Chi-Square	C	U-D
Single indicator	-8.29	8.29
Two indicators	-8.34	8.34
Three indicators	-4.20	4.20
Four indicators	-3.35	3.35
Five indicators	7.39	-7.39
Six indicators	16.04	-16.04

Table 10 A set of association rules in the use of indicators

Rules	Support	Confidence
1. SD, ELWD, EPS- > DUFE	45%	100%
2. SD, ELWD, NU, EPS- > DUFE	30%	100%
3. SD, FS, ELWD, EPS = > DUFE	30%	100%
4. SD, FS, ELWD, NU, EPS = > İBS	26%	100%
5. ELWD, EPS = > DUFE	58%	99%
6. ELWD = > DUFE	71%	97%
7. SD = > DUFE	52%	97%
8. EPS = > DUFE	66%	96%
9. FS, ELWD, DUFE, EPS = > SD	30%	91%
10. EPS = > ELWD	59%	85%

in the system, the utilization of the duration until the first employment indicator is contingent upon using other indicators. It becomes evident that various combinations exist. For instance, examining the first rule reveals that individuals utilizing the industry distribution, entry-level wage, and employment in the public sector indicators all include the duration until the first employment indicator (confidence value).

Additionally, this rule covers 45% of the dataset (support value). Similarly, it is observed that the rate of public employment indicator solely acts as an antecedent for the duration until first employment and entry-level wage indicators. Notably, except for the sixth and seventh rules, the employment in the public sector indicator is an antecedent for all other rules. This finding suggests that employment in the public sector holds a critical position among the indicators. The fourth rule indicates a pattern of combined indicator usage, as individuals incorporating the sector distribution, firm size, entry-level wage, qualification mismatch, and employment in the public sector indicators also include the duration until the first employment indicator (confidence value). This rule encompasses 30% of the dataset. In conjunction with the sector distribution, entry-level wage, and employment in the public sector indicators, the qualification mismatch indicator exclusively serves as an antecedent in the second and fourth rules.

3.5.2 Results of content analysis

The analysis findings indicated that the counsellors emphasized the significance of CCIS in the career counselling process and provided valuable recommendations for its further development. They commended the system for its ability to enhance the effectiveness of counselling services by incorporating the performance of universities in the labour market as a new parameter. Furthermore, the counsellors underscored the value of CCIS in empowering students to make informed decisions about their career paths based on reliable data.

The statements of career counsellors regarding the contribution of CCIS are presented below:

P1: “CCIS provides the opportunity to guide students based on data in the career selection process.”

P2 : “CCIS is a good example of caring about the future, youth and employment...”

P3 : “A nice, well-equipped system; if the data is kept up-to-date, it will be a guide for us and the students in the counselling process.”

Based on the feedback provided by the career counsellors who actively use CCIS, it was identified that there were certain areas for improvement. In addition to highlighting the positive impact of CCIS on the career counselling process, the counsellors emphasized the need for certain features to be added to the system. The opinions of the counsellors on the areas for improvement were analysed, and the results were presented in Table 6 along with sample statements.

4 Discussion and conclusion

This research involves the process of designing a web-based career information system. DBR methodology was used for the research problem. Interface design, information design (data visualisation, etc.) and interaction design were handled holistically and systematically to reveal a career information system design model suitable for the needs. The research has enabled universities to identify design features for developing career information systems integrated with labour market performance indicators. CCIS can be used on a national scale with a high level of real users and provides a basis as a best practice for developing career information systems based on labour market performance indicators, especially for developing countries and countries in digitalization. One of the strengths of the research is that it has been tested in a real-world setting and in a real context (career guidance processes) and with a wide range of users, which the DBR also emphasizes. An important limitation of DBR research is that the implementation process is carried out with limited participants and in a controlled setting (Dermentzi et al., 2022; Sandanayake et al., 2021). As a result, CCIS has a database that allows the 4000+ universities and departments' profiles reviews and 17 million comparisons based on six indicators. This database continues to enrich with log data from user interactions. CCIS, which aims to support young people to make more informed career choices with labour market data, was cited as a best practice in the OECD, 2023 Türkiye Economic Survey for contributing to Türkiye's human resources reforms (OECD, 2023).

Ginzberg (1952) characterizes career choice as a largely irreversible decision. To create an ideal career path, individuals must balance career decisions with labour market information (Parsons, 1909). CCIS was conceived to support young people's decision-making processes with objective data, aligning with Parsons' call for timely, accurate, up-to-date, and easily accessible guidance. Unlike other career information systems, CCIS includes mentor support and underscores the role of career counsellors in decision-making.

In order to create an ideal career path, it is important for individuals to be able to find a balance in career decisions by supporting their self-knowledge with

labour market information (Parsons, 1909). At this point, the idea of CCIS, which is the subject of this research, was born in order to support the decision processes of young people with objective data. As Parsons (1909) stated, every individual needs help in making the most important decision of his/her life and this help should be timely, accurate, up to date and easily accessible. In this direction, unlike other existing career information systems, mentor support was added to CCIS and the necessity of career counsellors to take an active role in career planning processes were once again revealed in the resulting decision table.

Labour market information is central in the delivery of effective career guidance (Gysbers et al., 2014) therefore in every career information system. Parsons (1909) described it as “*a knowledge of the requirements and conditions of success, advantages and disadvantages, compensation, opportunities, and prospects in different lines of work*” (p. 5). Defining labour market indicators remains uncertain (Kumar & Arulmani, 2014), but our research demonstrates how six indicators enhance career guidance. CCIS’s usage statistics show its effectiveness in facilitating career decisions and university and department selection. Moreover, usage statistics demonstrate a steady increase in the number of users, students, university-department profile reviews, and comparisons within the CCIS. This suggests that CCIS is meeting a need in the field of career guidance, particularly in terms of the use of labour market information in the university and department selection process. Using labour market information in selecting higher education programs is crucial in promoting effective employment management and individual’s career growth.

Prior research underscores guided career decision-making’s significance (Eun et al., 2013). Choosing a university and department is critical career decision in an individual’s career path and career counsellor assistance is vital in facilitating and improving individuals’ decision-making process for a career choice that aligns well with their aptitudes, interests, personality traits and labour market (Eun et al., 2013). CCIS is only accessible to professionals in the field, such as career counsellors, due to the critical nature of career decision-making and the potential risks associated with misinterpreting labour market performances. CCIS aims to support students in this process by providing career counsellors with relevant labour market data to guide students in making informed decisions. The integrated presentation of information, such as employment in the public sector and firm size of universities and departments, helps facilitate effective career management.

On the other hand, system interactions show that there is no linear movement between indicators and that there is a deliberate tendency towards indicators. According to the research results, it is seen that employability is important in career determination processes. Another striking point is that there is a statistically significant trend in the use of five and six indicators in the comparisons section. This reveals the need for comprehensive labour market indicators when there is more than one career choice. In addition to this result, based on the system interactions, questions such as what the ideal number of indicators should be in a career information system and which indicators should be included, what are the factors affecting the use of indicators (indicator use according to universities and departments, etc.) and what are the decision-making indicators will be interesting research topics.

CCIS is a system continuously undergoing development and improvements based on feedback from stakeholders. We present the initial results from the DBR first cycle and invite researchers to explore the potential of career information systems. The main areas identified for improvement include for second cycle: a) adding of career counsellor sign-up feature, b) incorporating associate degree programs into the system, c) adding a reporting function, d) adding of student sign-up feature, and e) diversifying the range of universities and departments. In addition, usage statistics have highlighted the need to ensure that users effectively utilize the system's indicators and comparison sections.

The career counsellors have recognized CCIS as a tool that facilitates effective employment and human resource management, going beyond its function as a career choice facilitator. The development and evaluation of CCIS involved input from experts who emphasized the importance of the indicators in supporting the career decision-making process. Especially, based on log data, research findings suggest that considering multiple parameters, such as those presented in CCIS, is more appropriate to make informed career choices than relying solely on a single factor, such as duration until first employment. By incorporating a multidimensional decision-making process that includes six indicators, CCIS strengthens the career decision process, ultimately benefiting individuals and promoting better employment outcomes.

Staunton and Rogosic (2021) argue that career information systems developed without a scientific basis cannot support career decision-making processes. In accordance with the iterative and formative nature of DBR, the output of each cycle provides a source for the following design research, in other words, new cycles. Therefore, the first cycle outputs obtained in this study have a robust scientific base as input for subsequent research. CCIS is also a precursor to a human resources ecosystem that recognizes the importance of early career intervention in career decision-making. CCIS has the potential to provide valuable information for top stakeholders such as policymakers, career counsellors, curriculum developers, and university administrators. The most important milestones of this DBR are that the universities have reached a sufficient number of graduates who have entered employment (a limit of 20 graduates was for this research), employment information is digitally recorded, universities and programs are classified in a way that overlaps with employment, data preprocessing processes are carefully carried out to combine data from different institutions, it is long-term and dynamic process, and since a national scale digital transformation is aimed in the context of career guidance, it is necessary to work with large masses and an interdisciplinary team. In this research, the career information system was developed in collaboration with experts, career counsellors and researchers. In future research, individuals at the career decision-making stage can be included. Moreover, the following research should examine the specific role of these indicators in the career determination process in detail. The findings of this study are expected to open up new avenues for further research in the field of career guidance.

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Data availability The data that supports the findings of this study is available from the corresponding author upon reasonable request.

Declarations

Conflict of interest No potential conflict of interest was reported by the authors.

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References

- Alves, H., & Raposo, M. (2007). Conceptual model of student satisfaction in higher education. *Total Quality Management*, 18(5), 571–588. <https://doi.org/10.1080/14783360601074315>
- Anderson, T., & Shattuck, J. (2012). Design-based research: A decade of progress in education research? *Educational Researcher*, 41(1), 16–25. <https://doi.org/10.3102/0013189X11428813>
- Ashari, Z. H. M., Azman, N., & Rasul, M. S. (2019). Factors predicting career choice among Malaysian students in skills-based training institutions. *International Journal for Educational and Vocational Guidance*, 19, 19–39. <https://doi.org/10.1007/s10775-018-9366-5>
- Barnes, S., Bimrose, J., Brown, A., Gough, J., & Wright, S. (2020). *The role of parents and carers in providing careers guidance and how they can be better supported*. Warwick Institute for Employment Research.
- Baruch, Y. (2015). Organizational and labor markets as career ecosystem. In A. De Vos & B. I. J. M. Van der Heijden (Eds.), *Handbook of research on sustainable careers* (pp. 364–380). Edward Elgar.
- Baruch, Y., & Sullivan, S. E. (2022). The why, what and how of career research: A review and recommendations for future study. *Career Development International*, 27(1), 135–159. <https://doi.org/10.1108/CDI-10-2021-0251>
- Bimrose, J., & Mulvey, R. (2015). Exploring career decision-making styles across three European countries. *British Journal of Guidance & Counselling*, 43(3), 337–350. <https://doi.org/10.1080/03069885.2015.1017803>
- CEDEFOP; ETF; European Commission (2019). *Investing in career guidance*. Inter-agency working group on career guidance WGCG. Retrieved April 13, 2024 from <https://www.cedefop.europa.eu/en/publications/2227>
- Creed, P., Prideaux, L. A., & Patton, W. (2005). Antecedents and consequences of career decisional states in adolescence. *Journal of Vocational Behavior*, 67(3), 397–412. <https://doi.org/10.1016/j.jvb.2004.08.008>
- Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches* (2nd ed.). Sage.
- Dermentzi, E., Zotou, M., & Tambouris, E. (2022). *Ve diğerleri*. Açık verileri öğretmek için probleme dayalı öğrenme yöntemini ve eğitim teknolojilerini kullanmak: Tasarım temelli bir araştırma yaklaşımı. *Educ Inf Technol*, 27, 8859–8882. <https://doi.org/10.1007/s10639-022-10995-9>
- Esbroeck, R. V., Tibos, K. I. M., & Zaman, M. (2005). A dynamic model of career choice development. *International Journal for Educational and Vocational Guidance*, 5(1), 5–18. <https://doi.org/10.1007/s10775-005-2122-7>
- Eun, H., Sohn, Y. W., & Lee, S. (2013). The effect of self-regulated decision making on career path and major-related career choice satisfaction. *Journal of Employment Counselling*, 50(3), 98–109. <https://doi.org/10.1002/j.2161-1920.2013.00029.x>
- Evaluation, Selection and Placement Centre (ÖSYM) (2023, December 29). *ÖSYM provided exam services to over 11 million candidates in 2023*. Retrieved January 18, 2024, from <https://www.osym.gov.tr/TR,29079/osym-2023te-11-milyonun-uzerinde-adaya-sinav-hizmeti-verdi-29122023.html>

- Garcia, E. A., McWhirter, E. H., & Cendejas, C. (2021). Outcomes of Career Information System Utilization Among First-Year High School Students. *Journal of Career Development, 48*(5), 767–780. <https://doi.org/10.1177/0894845319890930>
- Gati, I., & Asulin-Peretz, L. (2011). Internet-based self-help career assessments and interventions: Challenges and implications for evidence-based career counselling. *Journal of Career Assessment, 19*(3), 259–273. <https://doi.org/10.1177/1069072710395533>
- Gati, I., & Levin, N. (2015). Making better career decisions. In P. J. Hartung, M. L. Savickas, & W. B. Walsh (Eds.), *APA handbook of career intervention*, Vol. 2. Applications (pp. 193–207). American Psychological Association. <https://doi.org/10.1037/14439-015>
- Gati, I., & Tal, S. (2008). Decision-making models and career guidance. In J. Athanasou & R. Van Esbroeck (Eds.), *International handbook of career guidance* (pp. 157–185). Springer.
- Gati, I., Gadassi, R., & Shemesh, N. (2006). The predictive validity of a computer-assisted career decision-making system: A six-year follow-up. *Journal of Vocational Behavior, 68*(2), 205–219. <https://doi.org/10.1016/j.jvb.2005.08.002>
- Ginzberg, E. (1952). Toward a theory of occupational choice. *Occupations: The Vocational Guidance Journal, 30*(7), 491–494. <https://doi.org/10.1002/j.2164-5892.1952.tb02708.x>
- Gysbers, N. C. (2001). School guidance and counselling in the 21st century: Remember the past into the future. *Professional School Counselling, 5*(2), 96–105.
- Gysbers, N. C., Heppner, M. J., & Johnston, J. A. (2014). *Career counselling: Holism, diversity, and strengths* (4th ed.). American Counselling Association.
- Haneef, F., Abbasi, R. A., Noor, M. N., Daud, A., & Sindhu, M. A. (2020). A review of career selection models. *Researchpedia Journal of Computing, 1*(1), 30–38.
- Harrison, C., Villalba-Garcia, E. & Alan Brown, A. (2022). *Towards European standards for monitoring and evaluation of lifelong guidance systems and services: Vol. 1*. Luxembourg: Publications Office. Cedefop working paper, No 9. Retrieved April 13, 2024 from <http://data.europa.eu/doi/10.2801/422672>
- Herr, E. L. (2001). Career development and its practice: A historical perspective. *The Career Development Quarterly, 49*(3), 196–211. <https://doi.org/10.1002/j.2161-0045.2001.tb00562.x>
- Hsieh, H., & Shannon, E. S. (2005). Three Approaches to qualitative content analysis. *Qualitative Health Research, 15*(9), 1277–1288. <https://doi.org/10.1177/1049732305276687doi:10.1186/s41239-018-0100-7>
- Holt, P. A. (1989). Differential effect of status and interest in the process of compromise. *Journal of Counselling Psychology, 36*(1), 42–47. <https://doi.org/10.1037/0022-0167.36.1.42>
- International Labour Organization (ILO), (2018). Measurement of qualifications and skills mismatches of persons in employment. 20th International conference of labour statisticians (ICLS), Geneva.
- Jiménez, J. D. D., & Salas-Velasco, M. (2000). Modeling educational choices. A binomial logit model applied to the demand for higher education. *Higher Education, 40*(3), 293–311. <https://doi.org/10.1023/A:1004098300436>
- Kumar, S., & Arulmani, G. (2014). Understanding the Labour Market: Implications for Career Counselling. In G. Arulmani, A. Bakshi, F. Leong, & A. Watts (Eds.), *Handbook of Career Development. International and Cultural Psychology*. Springer. https://doi.org/10.1007/978-1-4614-9460-7_12
- Lent, R. W., & Brown, S. D. (2020). Career decision making, fast and slow: Toward an integrative model of intervention for sustainable career choice. *Journal of Vocational Behavior, 120*, 103448. <https://doi.org/10.1016/j.jvb.2020.103448>
- MacDonald, P. L., & Gardner, R. C. (2000). Type I error rate comparisons of post-hoc procedures for I J chi-square tables. *Educational and Psychological Measurement, 60*(5), 735–754. <https://doi.org/10.1177/0013164403251280>
- Mallen, M. J., Vogel, D. L., & Rochlen, A. B. (2005). The practical aspects of online counselling: Ethics, training, technology, and competency. *The Counselling Psychologist, 33*(6), 776–818. <https://doi.org/10.1177/0011000005278625>
- McKinlay, B. (1975, March). *Developing a career information system: Final report* (DLMA-82-41-72-03-2). Oregon University, Eugene Career Information System. Retrieved April 13, 2024 from <https://eric.ed.gov/?id=ED109375>
- NACE. (2022). Complete list of all NACE Code. Retrieved August 24, 2022, from <https://nacev2.com/tr>
- Niles, S. G., & Harris-Bowsbey, J. (2013). *Career development interventions in the 21st century* (4th ed.). Columbus, OH: Merrill Prentice Hall.

- Nota, L., Santilli, S., & Soresi, S. (2016). A life-design-based online career intervention for early adolescents: Description and initial analysis. *The Career Development Quarterly*, 64(1), 4–19. <https://doi.org/10.1002/cdq.12037>
- OECD. (2023). OECD Economic Surveys: Türkiye 2023. *OECD Publishing, Paris*. <https://doi.org/10.1787/864ab2ba-en>
- Parsons, F. (1909). *Choosing a vocation*. Houghton Mifflin.
- Patton, W., & McMahon, M. (2014). *Career development and systems theory: Connecting theory and practice* (Vol. 2). Springer.
- Pordelan, N., & Hosseinian, S. (2022). Design and development of the online career counselling: A tool for better career decision-making. *Behaviour & Information Technology*, 41(1), 118–138. <https://doi.org/10.1080/0144929X.2020.1795262>
- Republic of Türkiye Ministry of National Education (2023, July 4). *2023 Preference counseling units implementation guide published*. MEB. Retrieved January 18, 2024, from <https://orgm.meb.gov.tr/www/2023-tercih-danismanligi-birimleri-uygulama-kilavuzu-yayimlandi/icerik/2398>
- Richey, R. C., & Klein, J. D. (2005). Developmental research methods: Creating knowledge from instructional design and development practice. *Journal of Computing in Higher Education*, 16, 23–38. <https://doi.org/10.1007/BF02961473>
- Sabates, R., Gutman, L. M., & Schoon, I. (2017). Is there a wage penalty associated with degree of indecision in career aspirations? Evidence from the BCS70. *Longitudinal and Life Course Studies*, 8(3), 290–301. <https://doi.org/10.14301/lfcs.v8i3.470>
- Sampson, J. P., Jr., & Osborn, D. S. (2015). Using information and communication technology in delivering career interventions. In P. J. Hartung, M. L. Savickas, & W. B. Walsh (Eds.), *APA handbook of career intervention*, Vol. 2. Applications (pp. 57–70). American Psychological Association. <https://doi.org/10.1037/14439-005>
- Sandanayake, T. C., Karunanayaka, S. P., & Madurapperuma, A. P. (2021). A framework to design open educational resources-integrated online courses for undergraduate learning: A design-based research approach. *Education and Information Technologies*, 26, 3135–3154. <https://doi.org/10.1007/s10639-020-10393-z>
- Song, B. I., & Park, Y. J. (2005). *Career planning and employment strategy*. Hakjisa.
- Soutar, G. N., & Turner, J. P. (2002). Students' preferences for university: A conjoint analysis. *International Journal of Educational Management*, 16(1), 40–45. <https://doi.org/10.1108/09513540210415523>
- Spokane, A. R. (1991). *Career intervention*. Prentice-Hall, Inc.
- Staunton, T., & Rogosic, K. (2021). Labour market information and social justice: A critical examination. *International Journal for Educational and Vocational Guidance*, 21, 697–715. <https://doi.org/10.1007/s10775-021-09466-3>
- Super, D. E. (1980). A life-span, life-space approach to career development. *Journal of Vocational Behavior*, 16(3), 282–298. [https://doi.org/10.1016/0001-8791\(80\)90056-1](https://doi.org/10.1016/0001-8791(80)90056-1)
- Supriyanto, G., Widiaty, I., Abdullah, A. G., & Yustiana, Y. R. (2019). Application expert system career guidance for students. In *Journal of Physics: Conference Series*, 1402(6). <https://doi.org/10.1088/1742-6596/1402/6/066031>
- Terzi, C., Şahin, M., & Yurdugül, H. (2023). Cell-wise residual testing in two-way contingency tables: Post-hoc tests for chi-square analysis. *Educational Technology Theory and Practice*, 13(1), 304–328. <https://doi.org/10.17943/etku.1075830>
- Tong, L. (2019). Graduate employment in Vietnam. *International Higher Education*, 97, 22–23. <https://doi.org/10.6017/ihe.2019.97.10948>
- Turan, Ü., & Kayıkçı, K. (2019). The role of school guidance services in the occupational choice of senior high school students. *E-International Journal of Educational Research*, 10(1), 15–33.
- Wang, F., & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development*, 53(4), 5–23. <https://doi.org/10.1007/BF02504682>
- Webb, M. S. (1993). Variables influencing graduate business students' college selections. *College and University*, 68(1), 38–46.
- Yeşilyaprak, B. (2019). Vocational guidance and career counselling services in Türkiye: Recent advances and future prospects. *Kariyer Psikolojik Danışmanlığı Dergisi*, 2(2), 73–102.
- Zainudin, Z. N., Hassan, S. A., Talib, M. A., Ahmad, A., Yusop, Y. M., & Asri, A. S. (2020). 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), 67–93. <https://doi.org/10.6007/IJARBS/v10-i11/8047>
- Zhang, J., Yuen, M., & Chen, G. (2018). Teacher support for career development: An integrative review and research agenda. *Career Development International*, 23(2), 122–144. <https://doi.org/10.1108/CDI-09-2016-0155>

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