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Evolving Dynamics of 21st Century Skills: A Bibliometric Analysis

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Abstract: The aim of this study was to analyze recent topics discussed regarding 21st century skills. One of the approaches to defining a study's subject is to examine research studies related to that field. The journal titled "Thinking Skills and Creativity," which publishes research aligned with the purpose of this study, was used as the main data source. Bibliometric analysis was employed to scrutinize the data (972 publications) obtained from this journal. The collected data were analyzed using descriptive statistics via the Web of Science (WOS) system initially. Subsequently, the VOSviewer software was employed for bibliometric analyses. The findings pertaining to research topics covered in this journal highlighted nine themes, which have been designated as follows: Enhancing Creativity and Learning in Education, Promoting Creativity and Problem-Solving in STEM Education, Nurturing Creativity and Development in Adolescent Education, Fostering Holistic Learning and Success in Education, Fostering Creativity and Critical Thinking in 21st Century Education, Nurturing Creativity and Learning in Children, Exploring Creative Thinking and Individual Differences, Promoting Critical Thinking and Creativity in Education, Fostering Creativity and Collaboration in Secondary Education.

Keywords: Bibliometric analysis, creativity, critical thinking, research trends, thinking skills, 21st century skills

21. Yüzyıl Becerilerinin Gelişen Dinamikleri: Bibliyometrik Bir Analiz

Öz: Bu çalışmanın amacı, 21. yüzyıl becerileri ile ilgili olarak son dönemlerde tartışılan konuları analiz etmektir. Bir çalışmanın konusunu tanımlama yaklaşımlarından biri, o alanla ilgili araştırma çalışmalarını incelemektir. Bu çalışmanın amacına uygun araştırmalar yayımlayan "Thinking Skills and Creativity" adlı dergi, ana veri kaynağı olarak kullanılmıştır. Bu dergiden elde edilen verileri (972 yayın) incelemek için bibliyometrik analiz yöntemi uygulanmıştır. Toplanan veriler, başlangıçta Web of Science (WOS) sistemi aracılığıyla tanımlayıcı istatistikler kullanılarak analiz edilmiştir. Daha sonra, bibliyometrik analizler için VOSviewer yazılımı kullanılmıştır. Bu dergide ele alınan araştırma konularına ilişkin bulgular, şu şekilde belirlenen dokuz temayı öne çıkarmaktadır: Eğitimde Yaratıcılığı ve Öğrenmeyi Geliştirme, STEM Eğitiminde Yaratıcılığı ve Problem Çözmeyi Teşvik Etme, Ergen Eğitiminde Yaratıcılığı ve Gelişimi Destekleme, Eğitimde Bütünsel Öğrenme ve Başarıyı Teşvik Etme, 21. Yüzyıl Eğitiminde Yaratıcılığı ve Eleştirel Düşünmeyi Güçlendirme, Çocuklarda Yaratıcılığı ve Öğrenmeyi Destekleme, Yaratıcı Düşünme ve Bireysel Farklılıkları Keşfetme, Eğitimde Eleştirel Düşünme ve Yaratıcılığı Teşvik Etme, Ortaöğretimde Yaratıcılığı ve İşbirliğini Güçlendirme.

Anahtar kelimeler: Bibliyometrik analiz, yaratıcılık, eleştirel düşünme, araştırma eğilimleri, düşünme becerileri, 21. yüzyıl becerileri

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Introduction

Thinking, a subject of discourse across diverse conceptual frameworks since the era of Ancient Greece, remains the fundamental characteristic that sets humans apart from other entities. At the essence of human existence resides an innate inclination towards cognitive reflection, as individuals endeavor to comprehend and elucidate the intricacies of the world through a persistent quest for questioning and inquiry (Aktoprak & Hursen, 2022). The cognitive abilities individuals employ to address challenges are referred to as thinking skills (Li, 2016). The terminology of "thinking skills" and its associated concepts, such as "learning to learn," are employed to express the intention of instructing cognitive and learning processes that possess practical applicability across various real-world situations (Wegerif, 2006).

When we juxtapose the elements that define the concepts of "learning" and "knowledge" in the present era with those of two decades ago, it becomes apparent that ascertaining the precise meaning of "knowing" has become a more challenging task in contemporary times due to especially advancement of technology and education technology (Li, 2016). These progressions have given rise to employment opportunities that were nonexistent merely a decade ago, compelling the need to educate young individuals for careers that have yet to materialize (Dede, 2011), necessitating new proficiencies from individuals (Chen et al., 2022). Consequently, international organizations and numerous countries have devised frameworks for "21st century skills" commonly known as "lifelong learning competences" (González-Pérez & Ramírez-Montoya, 2022; Tight, 2021b). These frameworks encompass global competencies and higher-order thinking skills, which individuals must possess to adapt to the fast-paced development of this era (Geisinger, 2016; Voogt & Roblin, 2012). These skills represent essential elements within standardized assessments including "the Programme for International Student Assessment (PISA), the Progress in International Reading Literacy Study (PIRLS), the Trends in International Mathematics and Science Study (TIMMS), and the Programme for the International Assessment of Adult Competencies (PIAAC)" (Akcaoğlu et al., 2023, p.1).

The future society is characterized by competition based on people, experience, and wisdom (Powell, 2020; Schmidt, 2022), so it is imperative for students, who represent our future citizens, to transcend mere accumulation of knowledge and focus on cultivating their advanced cognitive abilities, including critical thinking, decision making, and problem-solving (Miri et al., 2007). Consequently, there is a growing demand for higher-order thinkers and lifelong learners who possess the ability to connect old and new knowledge, reorganize and process information, creatively analyze problems, effectively solve complex issues, collaborate within teams to achieve mutually beneficial outcomes, and critically observe the world (Kroth et al., 2022). These transformative developments pose fresh challenges to educators, necessitating substantial modifications in the content of learning as well as the methodologies employed to facilitate this learning process (Voogt et al., 2013), which will produce human resources that are responsive to societal progress and possess the capacity to compete effectively (Tight, 2021a; Tijsma et al., 2020). As a result of these developments, there has been a notable upsurge in the scholarly attention dedicated to the cultivation of cognitive and learning capabilities among learners in recent times (Wegerif et al., 2015; cited in Li, 2016).

The most appropriate approach to defining a field of study involves an examination of research studies pertaining to that field, and it is the responsibility of each discipline to periodically evaluate its own scholarly output (Staton-Spicer & Wulff, 1984). In addition, analyzing research

conducted within a specific discipline provides valuable guidance for researchers interested in pursuing studies in the same area (Cohen et al., 2007). This research, in this context, presents a comprehensive investigation of the existing body of literature concerning 21st century skills by employing a bibliometric analysis approach. The analysis primarily centers on the examination of the temporal progression of scholarly publications and citations, the identification of influential articles, authors, and institutions, the exploration of keywords associated with the domain. The overarching objective of this study is to facilitate the identification of trends and propose potential directions for future research in the broad field of 21st century skills. To achieve this objective, the search was refined to include publications in the journal titled *Thinking Skills and Creativity* (*TS&C*), which aims to publish issues related to thinking skills. Launched in 2006, TS&C uniquely involves research dealing with creativity and thinking skills including teaching of thinking (TS&C, 2023). In this sense, this bibliometric analysis was refined to find answers for the following research questions:

1. What is the distribution of the studies published in the selected journal with respect to year, countries, authors, and institutions?
2. What are the research trends dealing with 21st century skills in the selected journal?

Literature Review

The Components of 21st Century Skills

The evolution of information technology has substantially transformed the worldwide economic landscape and the social fabric of human existence (Chen et al., 2022). This shift is driven by factors such as "globalization, emerging technologies, migration patterns, international competition, evolving markets, and transnational environmental and political challenges, collectively necessitating that students acquire skills and knowledge essential for their resilience and success in the 21st century (Luna Scott, 2015). The inclusion of the phrase "21st century" when describing this skill set implies a significant departure from the prerequisites of previous eras, notably the twentieth century and earlier periods, and that individuals transitioning from various educational levels to the professional sphere require a distinct skill set to excel and contribute to the economy and society within a competitive global environment (Tight, 2021).

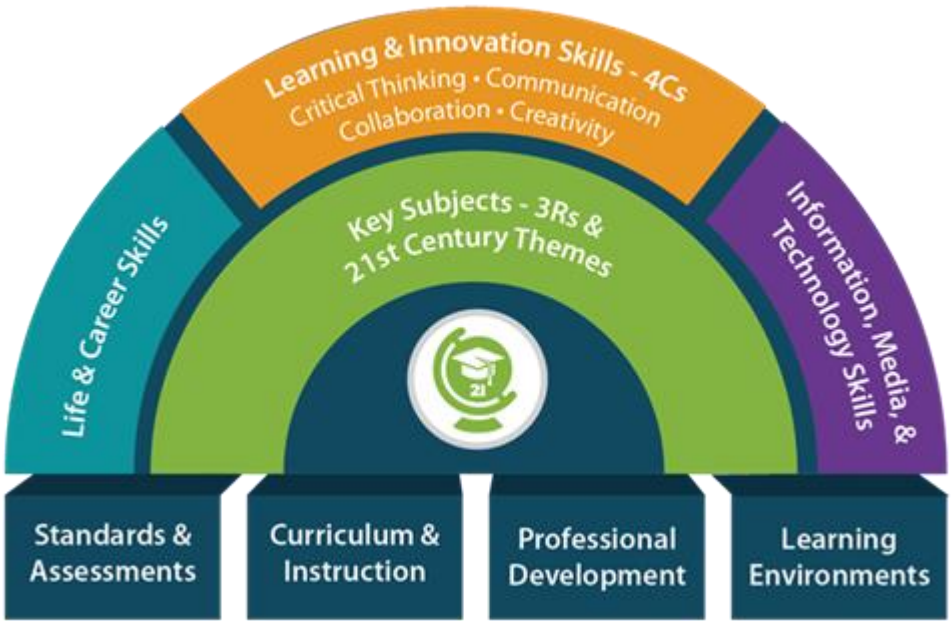
Similar to numerous terms commonly employed, the concept of "21st century skills" has been elucidated in diverse manners, lacking a universally acknowledged definition (Tight, 2021), which explains various lists available suggesting the skills pertaining to 21st century. For example, van Laar et al. (2017), who examined 75 articles on this issue, identified seven skills, including "technical, information management, communication, collaboration, creativity, critical thinking, and problem-solving," along with five contextual skills such as "ethical awareness, cultural awareness, flexibility, self-direction, and lifelong learning". Trilling and Fadel (2009) came up with another list of skills known as "7Cs" including "(1) critical thinking and problem solving, (2) creativity and innovation, (3) collaboration, teamwork and leadership, (4) cross-cultural understanding, (5) communications, information and media literacy, (6) computing and ICT [Information and communication technology] literacy, (7) career and learning self-reliance." Similarly, Wagner (2010) introduced seven skills for survival and success in 21st century: "(1) Critical thinking and problem solving, (2) Collaboration and leadership, (3) Agility and adaptability, (4) Initiative and entrepreneurialism, (5) Effective oral and written communication, (6) Accessing and analysing information, (7) Curiosity and imagination" (p. 4). The Partnership for 21st Century Skills has identified critical thinking and problem solving, communication,

collaboration, as well as creativity and innovation (referred to as the 4Cs) as essential competencies for students to acquire in the present age (Häkkinen et al., 2017). These competencies align with the top 10 skills recommended by the World Economic Forum for 2020, which include "complex problem-solving, critical thinking, creativity, people management, collaborative abilities, emotional intelligence, judgment and decision-making, service orientation, negotiation, and cognitive flexibility skills" (Luna Scott, 2015). Furthermore, a survey conducted by the Brookings Institution across 102 countries revealed that 86% of the countries incorporated 21st century skills in their educational aspirations, with creativity, communication, critical thinking, and problem-solving being the most common ones (Tindowen et al., 2017; van Laar et al., 2017).

In addition, 21st century skills have been classified into "cognitive skills (e.g., critical thinking, problem solving, creativity), interpersonal skills (communication skills, social skills, teamwork, cultural sensitivity, dealing with adversity), and intrapersonal skills (self-management, self-regulation, time management, self-development, lifelong learning, adaptability, executive functioning)" (Kyllonen, 2012, p.18). Another classification has been suggested by P21 (2007) (Partnership for 21st century skills) as visualized in Figure 1.

Figure 1

Framework for 21st Century Learning (Source: P21, 2007)



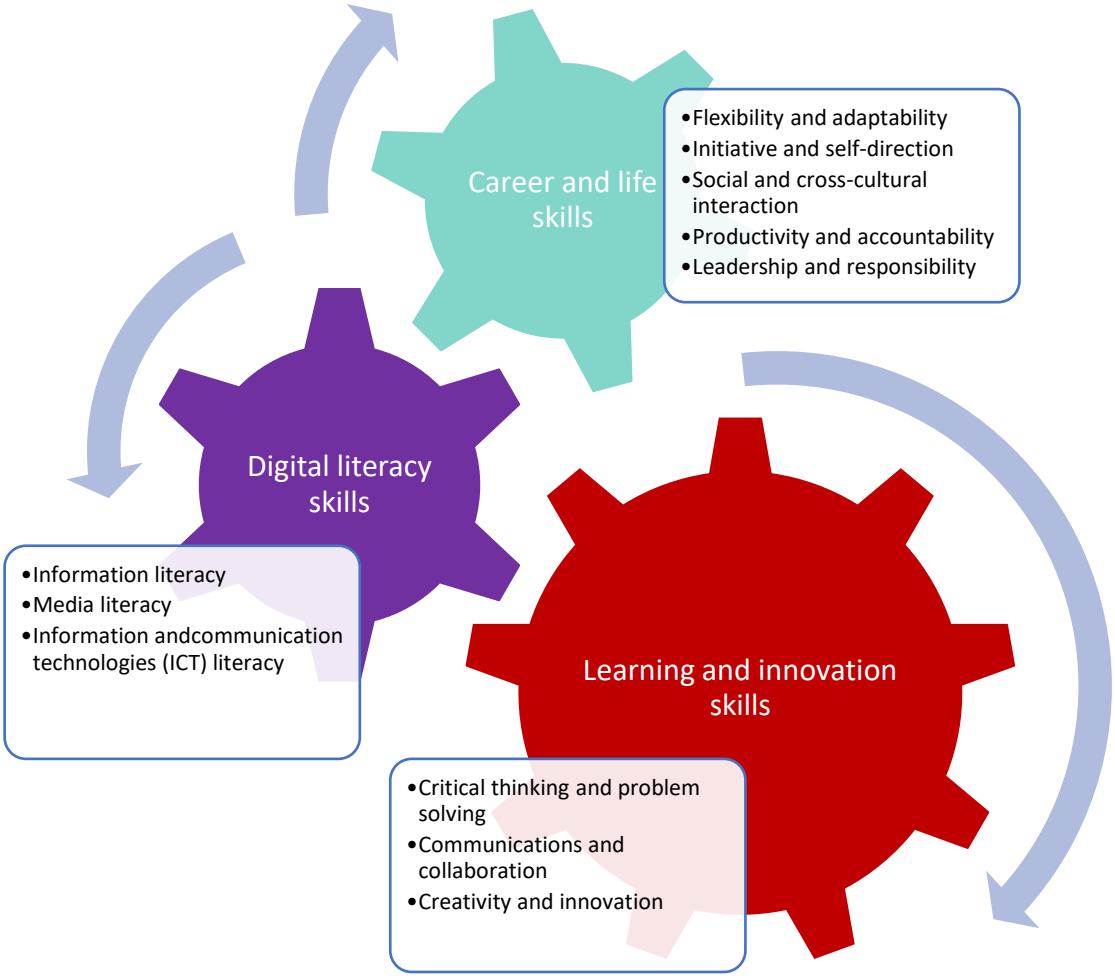
This rainbow showcases the knowledge, skills, and expertise the students need to master to live and work successfully in the 21st century (Trilling & Fadel, 2009). The key subjects include "English, reading, or language arts, world languages; arts; mathematics, economics; science; geography; history; government; and civics", while the 21st century themes include "Global Awareness; Financial, Economic, Business, and Entrepreneurial Literacy; Civic Literacy; Health Literacy; Environmental Literacy" (P21, 2015).

The skills pertaining to this categorization visualized in Figure 1 are reported by Trilling and Fadel (2009) as presented in Figure 2. This review underscores the presence of numerous

compilations and classifications concerning the components of 21st century skills, with the possibility of new enumerations emerging over time. A discernible outcome gleaned from this review is the consistent identification, across various researchers and time periods, of key elements integral to 21st century skills. What is clear is the fact that though put forward by different researchers, creativity, critical thinking skills, problem solving skills are included in every list as important 21st century skills.

Figure 2

Categories and Key Elements of 21st Century Skills



The Nexus Among the Components of 21st Century Skills

Several research findings substantiate a significant association between critical thinking and problem-solving skills. Individuals displaying robust critical thinking abilities are consistently observed to manifest heightened proficiency in problem-solving (Ozyurt, 2015). Wechsler et al. (2018) underscored the imperative of fostering critical and creative thinking skills as a means to cultivate problem-solving capabilities. Chang et al. (2015) provided empirical support for the relationship between critical thinking and creative thinking through an experimental research

investigation, elucidating the synergistic development inherent in these two cognitive faculties. The widely accepted notion recognized a strong correlation between teamwork and critical thinking, with teamwork acting as a catalyst for the nurturing of critical thinking abilities. Furthermore, an increased range of teamwork skills and heightened motivation to engage in collaborative efforts can significantly contribute to the enhancement of critical thinking (Rodríguez-Sabiote et al., 2022). Moreover, the caliber of teamwork plays a moderating role in shaping an individual's aptitude for creative thinking. Elevated teamwork quality is associated with reduced levels of creative motivation, whereas creative thinking thrives and attains its peak under conditions of appropriately lower-quality teamwork (Hoegl & Parboteeah, 2007). Conversely, teams marked by insufficient collaboration may lead to a decline in team members' motivation for innovation (Taggar, 2002).

It is apparent that the components of 21st century skills are interconnected and interdependent. This implies that these components are not isolated entities, but rather interrelated components mutually influencing each other. Teamwork/collaboration as an interpersonal skill has a moderating effect on cognitive skills, namely creativity, problem-solving skills, and critical thinking.

Method

Various methodologies, such as literature review, content analysis, meta-analysis, and meta-synthesis, can be employed to examine research trends within a specific field (Kaya, 2023). However, these methods may have limitations in terms of the quantity of research studies they can encompass (Zupic & Cater, 2015). To address the challenge of information overload, scholars have embraced computer-assisted methodologies, aiming to facilitate comprehensive exploration and navigation of the subject domain (Antons et al., 2021), bibliometric analysis being one of them. This method enables the analysis of large volumes of research studies conducted within a field, facilitating the identification and comprehension of relationships between studies (Zupic & Cater, 2015). It also aids in identifying trends, current status, and potential gaps within a particular field (Romanelli et al., 2018), as well as exploring the content within a specific domain (Fahimnia et al., 2015; Hallinger & Suriyankietkaew, 2018). By utilizing bibliometric analysis, researchers and professionals gain a comprehensive perspective on the research landscape, allowing them to make data-driven decisions that contribute to the advancement of knowledge and effective decision-making.

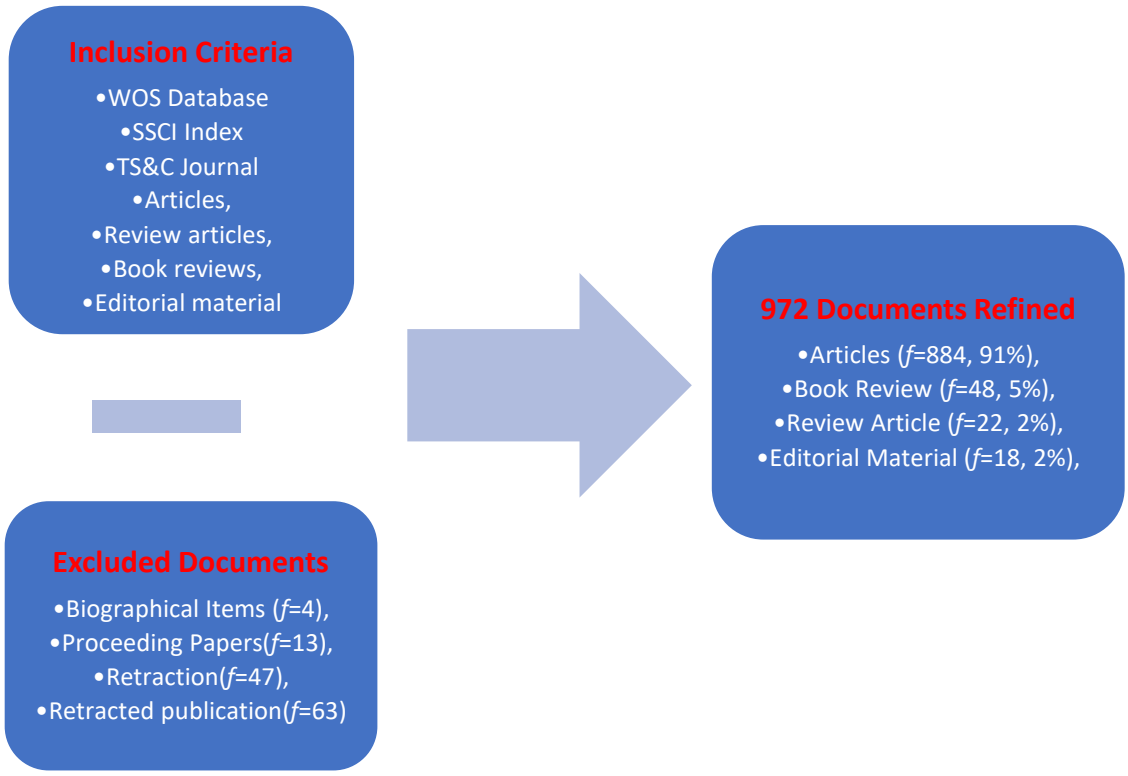
Data Collection

In bibliometric analysis, there are two main approaches to preparing a data set. The first involves searching using selected keywords or phrases and then identifying relevant studies through detailed readings. This method is commonly used in studies that focus on a specific subject. The second approach entails selecting one or more journals and including all the studies published within them or studies determined as a result of the examinations in the analysis (Zupic & Cater, 2015). For this study, the second approach was adopted, involving the selection of a single journal (TS&C) that publishes research on 21st century skills. As shown in Figure 3, the data source was the WOS database, which is considered "the most common source of bibliographic data" (Zupic & Cater, 2015, p.14). The search was initiated by looking for publications with the title "Thinking Skills and Creativity." An initial search yielded 1140 documents. Subsequently, articles published in 2023 were excluded since the year had not concluded yet and data were collected on 1st of January 2023. Furthermore, the search was further refined to exclude document types such as

"Retracted Publication," "Retraction," "Proceeding Paper," or "Biographical-Item." These refinements resulted in 972 publications for analysis. As illustrated in Figure 3, the vast majority of the documents included in this study were articles (91%).

Figure 3

Selection Process of the Publications



Data Analysis

The collected data were initially analyzed using descriptive statistics within the WOS system. Subsequently, bibliometric analyses were conducted using the freely accessible VOSviewer software version 1.6.17, a tool specifically designed for creating bibliometric maps (Van Eck & Waltman, 2021).

Among various bibliometric analysis methods—such as citation analysis, co-citation analysis, bibliographic coupling analysis, and co-author analysis—co-occurrence analysis was specifically chosen in alignment with the study's objective: to analyze recent topics discussed in relation to 21st century skills. Co-occurrence analysis involves connecting keywords when they appear in the same title, abstract, or keyword list (Zupic & Cater, 2015, p.4). The premise underlying co-word analysis posits that keywords emanating from a common document can effectively articulate the pertinent and principal concepts encapsulated within the original content of the respective article (Ding et al., 2001). Simply, the underlying concept of co-occurrence/co-word analysis is that words frequently occurring together in documents are indicative of related concepts (Zupic & Cater, 2015). This analysis approach allows for the exploration of the

interconnectedness of ideas within a field of 21st century skills. This method was employed to identify thematic clusters, trends, and topics pertaining to 21st century skills.

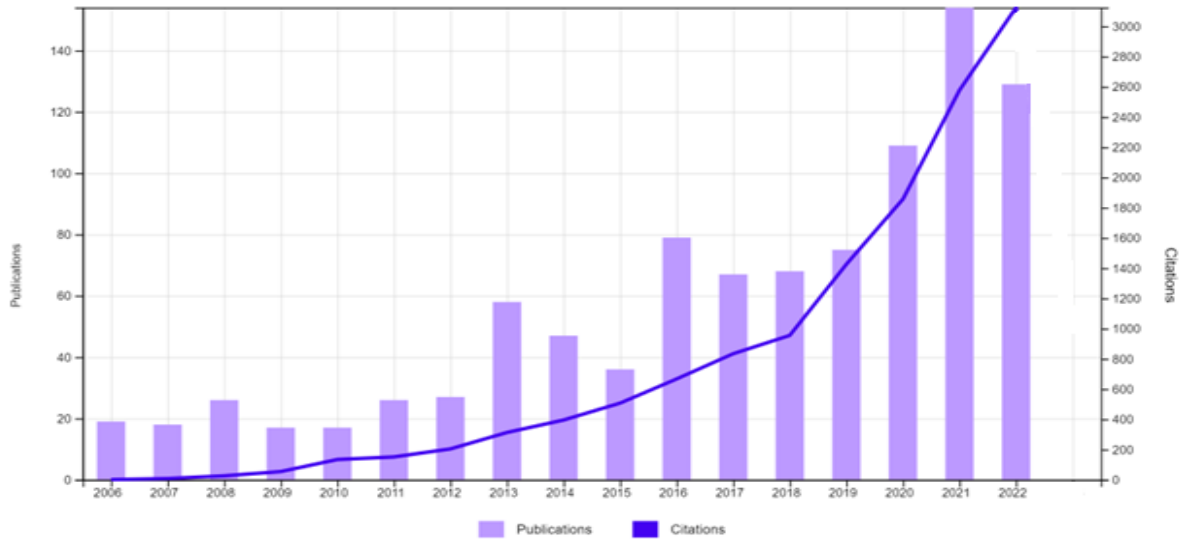
Results

Descriptive Findings

Figure 4 presents the annual distribution of documents published in the journal. As evident, there have been fluctuations in the number of documents published up until 2021, which marks the peak point in terms of quantity with more than 140 published documents. Subsequent to this peak, a decrease in the number of published documents is observed in 2022.

Figure 4

Annual Distribution of Publications and Citations



This figure also displays the citations of documents published in TS&C. Based on these findings, it can be concluded that citations of these documents exhibit an upward trend since the journal's inception in 2006. The trend culminates in 2022 with more than 3000 citations (f=3203). In summary, Figure 4 illustrates the yearly document distribution in the journal, reflecting fluctuating publication patterns. It also demonstrates the trajectory of citations for TS&C publications, indicating a steady rise over the years.

Figure 5

Distribution of Publications by Countries

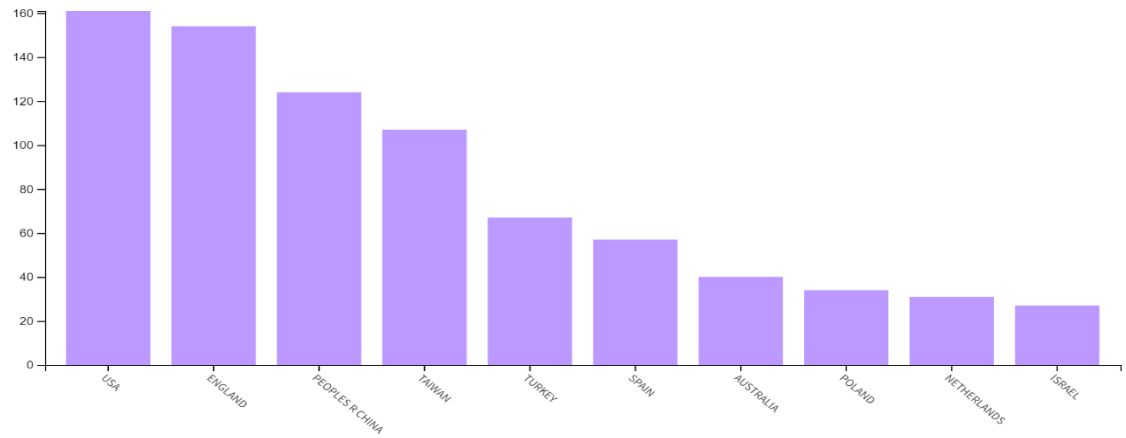


Figure 5 illustrates the distribution of papers published by country. Notably, the USA emerges as the most prolific nation in addressing topics explored by TS&C, accounting for 161 papers (17%). Following closely is England with 154 papers (16%), followed by China with 124 papers (13%), and Taiwan with 107 papers (11%). Other significant contributors include Turkey with 67 papers (7%), Spain with 57 papers (6%), Australia with 40 papers (4%), Poland with 34 papers (3%), Netherlands with 31 papers (3%), and Israel with 27 papers (3%).

Figure 6

The Most Productive Authors

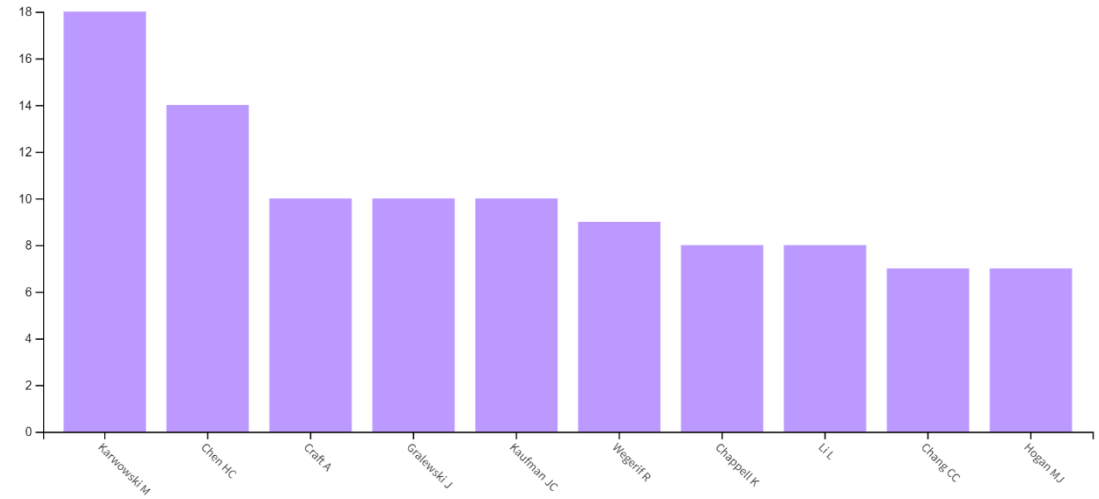


Figure 6 and 7 showcase findings regarding the most prolific authors and institutions contributing to this journal. As depicted in Figure 6, the author with the highest productivity is M. Karwowski, having published 18 papers followed by H.C. Chen with 14 papers. Moving on to

institutions depicted in Figure 7, the most productive one is RLUK Research Libraries UK, with a significant contribution of 104 papers. RLUK Research Libraries UK is a consortium comprising various member universities situated in the United Kingdom and Ireland, which can be the reason behind more research from this institution. Following closely is National Taiwan Normal University, which has contributed 43 papers.

Figure 7

Distribution of Publications by Countries

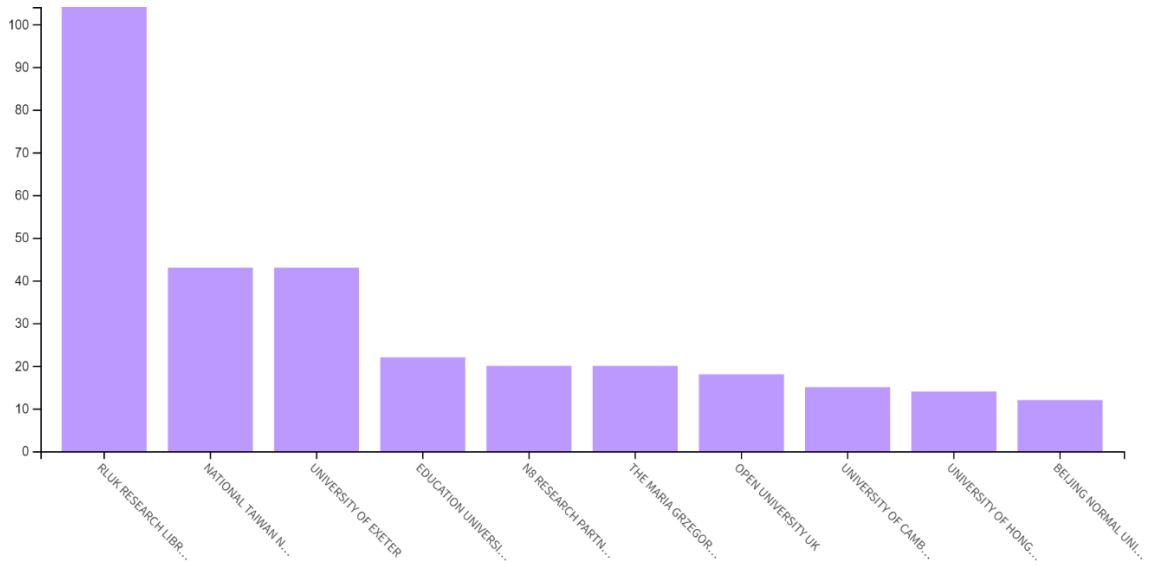


Table 1 presents the findings related to the most influential authors and their papers. Based on the results presented in Table 1, it can be asserted that the most impactful paper published in TS&C is authored by Davies et al. (2013), garnering 294 citations. Following closely are Sawyer (2016), Dwyer et al. (2006), Ku (2009), Marin and Halpern (2011), Silvia et al. (2009), Cremin et al. (2006), Kangas (2010), Piffer (2012), and Perignat and Katz-Buonincontro (2019).

Considering the titles of these publications, it is possible to state that the most influential papers deal with two 21st century cognitive skills: critical thinking and creativity. In addition, review studies seem to be the most cited papers.

Table 1

The Most Influential Authors and Publications

Author/s	Publication	Citation
Davies et al. (2013)	"Creative learning environments in education-A systematic literature review"	294
Sawyer (2016)	"Educating for innovation"	213
Dwyer et al. (2006)	"An integrated critical thinking framework for the 21st century"	173
Ku (2009)	"Assessing students' critical thinking performance: Urging for measurements using multi-response format"	157
Marin & Halpern (2011)	"Pedagogy for developing critical thinking in adolescents: Explicit instruction produces greatest gains"	141

Silvia et al. (2009)	"A snapshot of creativity: Evaluating a quick and simple method for assessing divergent thinking"	135
Cremin et al. (2006)	"Pedagogy and possibility thinking in the early years"	121
Kangas (2010)	"Creative and playful learning: Learning through game co-creation and games in a playful learning environment"	117
Piffer (2012)	"Can creativity be measured? An attempt to clarify the notion of creativity and general directions for future research"	111
Perignat & Katz-Buonincontro (2019)	"STEAM in practice and research: An integrative literature review"	107

Research Trends and Current Topics of 21st Century Skills

Figure 8 presents the keywords utilized in research published in TS&C. Among the most frequently used terms in these papers are creativity (occurring [f]=302), critical thinking (f=94), divergent thinking (f=72), creative thinking (f=44), higher education (f=32), problem solving/problem-solving (f=28), assessment (f=25), and thinking skills (f=23), among others. As demonstrated in Table 2 and Figure 8, a total of nine clusters were formed based on a cut-point of 5 for the recurrence of keywords. As a matter of fact, 10 clusters were formed, but the tenth cluster included only one word (six-thinking hats) having relationship with only creativity. Therefore, this cluster was removed from the table and figures to have a bigger map which could show the keywords and the relationships among the keywords more vividly.

The keywords within the first cluster encompass several concepts related to education, cognition, and creativity. This cluster notably underscores the significance of enhancing creative thinking, design education, computational thinking, higher-order thinking, experiential learning, emotional considerations, inclusive approaches, argumentation skills, improvisation abilities, and teacher education. These keywords collectively fall under the broader theme of "Enhancing Creativity and Learning in Education." The keywords within this cluster are intricately interconnected, sharing various relationships. For instance, creative thinking, computational thinking, and higher-order thinking all involve cognitive processes that transcend basic knowledge acquisition, demanding skills such as problem-solving, analysis, and evaluation. Similarly, design education and design thinking stress a human-centered approach, innovation, and problem-solving via creative methodologies. Moreover, creative self-efficacy and emotion can significantly impact an individual's motivation, engagement, and confidence in their creative abilities. Overall, this cluster underscores the interconnectedness of creativity, critical thinking, design, and education. It underscores the imperative of nurturing creativity and critical thinking skills within educational environments, integrating design principles and thinking into pedagogy, and considering variables like self-efficacy, emotion, gender, and experiential learning to effectively foster education and personal growth.

The keywords in the second cluster point to a connection between concepts related to creativity, problem-solving, education, and interdisciplinary approaches. They highlight the importance of incorporating art and design into STEM disciplines, fostering convergent thinking, developing problem-solving and reasoning skills, embracing failure as a learning opportunity, nurturing motivation, and recognizing the interdisciplinary nature of scientific exploration, so they can be gathered under the theme of "Promoting Creativity and Problem-Solving in STEM Education".

Moving to the third cluster, the compiled keywords highlight the theme of "Nurturing Creativity and Development in Adolescent Education." These keywords highlight the importance of recognizing and cultivating creative potential, promoting creative problem-solving, understanding the creative process, assessing creativity, providing creativity education, fostering insight and metacognition, and nurturing intrinsic motivation and openness to enhance adolescents' creative development. This cluster, in short, emphasizes the multifaceted nature of creativity, its development, assessment, and the interplay of various factors such as metacognition, motivation, and the creative process.

Figure 8

Co-occurrence of Keywords

Transitioning to the fourth cluster, a focus on various aspects of education emerges. These aspects include academic achievement, cognitive abilities, social interaction, curriculum, and

personal development. Under the theme of "Fostering Holistic Learning and Success in Education," this cluster underscores the significance of promoting cognitive flexibility, collaboration, and self-efficacy to enrich learning outcomes, stimulate innovation, and cultivate reflective, creative thinkers.

Table 2

Clusters of the Words in Publications

Clusters	Words (occurrence [*f*])
1st Cluster	creative thinking (*f*=44), design thinking (*f*=20), creative self-efficacy (*f*=13), computational thinking (*f*=13), learning (*f*=10), improvisation (*f*=9), pre-service teachers (*f*=7), argumentation (*f*=7), design education (*f*=7), gender (*f*=7), higher-order thinking (*f*= 6), emotion (*f*=5), experiential learning (*f*=5)
2nd Cluster	problem solving/problem-solving (*f*=28), motivation (*f*=14), intelligence (*f*=13), reasoning (*f*=11), art (*f*=7), convergent thinking (*f*=7), stem (*f*=6), failure *f*=6), science (*f*=6) steam (*f*=5), design (*f*=5)
3rd Cluster	creative process (*f*=14), creative problem solving (*f*=12), metacognition (*f*=10), creative potential (*f*=9), creativity assessment (*f*=8), insight (*f*= 8), intrinsic motivation (*f*=7), adolescents (*f*=6), openness (*f*=6), remote association (*f*=6) creative performance (*f*=5), creativity education (*f*=5), creativity development (*f*=5)
4th Cluster	collaboration (*f*=15), innovation (*f*=12), imagination (*f*=12), self-efficacy (*f*=11), engineering education (*f*=9), academic achievement (*f*=8), reflective thinking (*f*=8), project-based learning (*f*=7), cognitive flexibility (*f*=6), curriculum (*f*=6), emotional intelligence (*f*=5), literacy (*f*=5)
5th Cluster	critical thinking (*f*=94), creative thinking (*f*=44), higher education (*f*=32), pedagogy (*f*=14), teaching for creativity (*f*=10), creative teaching (*f*=10), creative learning (*f*=8), play (*f*=7), possibility thinking (*f*=7), 21st century skills (*f*=6), creative pedagogy (*f*=6), systematic review (*f*=5), technology (*f*=5)
6th Cluster	creativity (*f*=302), assessment (*f*=25), thinking skills (*f*=23), intervention (*f*=11), children (*f*=7), scientific creativity (*f*=7), collaborative learning (*f*=7), productive failure (*f*=6), young children (*f*=6), interventions (*f*=5), meta-analysis (*f*=5)
7th Cluster	divergent thinking (*f*=72), originality (*f*=12), training (*f*=11), gender differences (*f*=7), creative imagination (*f*=6), flexibility (*f*=6), fluency (*f*= 5), novelty (*f*=5), thinking styles (*f*=5), validity (*f*=5)
8th Cluster	thinking (*f*=10), critical thinking skills (*f*=9), students (*f*=8), teacher education (*f*=8), mathematical creativity (*f*=6), primary education (*f*=6), teachers (*f*=6), critical thinking dispositions (*f*=5)
9th Cluster	education (*f*=28), collaborative creativity (*f*=12), creativity training (*f*=11), secondary education (*f*=10), creative writing (*f*=7), adolescence (*f*=7), idea generation (*f*=6)

Shifting to the fifth cluster, the keywords primarily revolve around creativity, critical thinking, pedagogy, and technology integration in education. This cluster is suitably compiled under the theme of "Fostering Creativity and Critical Thinking in 21st Century Education." The emphasized points here revolve around equipping students with 21st century skills, fostering creative and critical thinking through innovative pedagogical approaches, and leveraging technology to enhance the learning experience.

Progressing to the sixth cluster, a wide range of topics related to assessment, children, creativity, collaborative learning, interventions, and thinking skills is covered. This comprehensive set of keywords is aptly grouped under the theme of "Nurturing Creativity and Learning in Children." The emphasized concepts underscore the importance of assessing and nurturing creativity and thinking skills in children and young learners, comprehending the effectiveness of interventions, and cultivating collaborative learning environments that foster creativity and critical thinking.

The keywords, in the seventh cluster, encompass various aspects of creative thinking, imagination, thinking styles, gender differences, and training. These keywords collectively form the theme of "Exploring Creative Thinking and Individual Differences." This theme highlights the dynamics of creative thinking, thinking styles, gender differences, and factors influencing creativity. It also underscores the importance of cultivating flexible and fluent thinking,

understanding individual differences, and considering the validity of measures used to assess creativity.

Transitioning to the eighth cluster, the keywords cover various facets related to critical thinking, creativity in mathematics, primary education, teacher education, and students. Under the theme of "Promoting Critical Thinking and Creativity in Education," this cluster illuminates the interrelationships between critical thinking, mathematical creativity, education, students, and educators. It accentuates the importance of nurturing critical thinking skills and mathematical creativity in primary education, facilitating effective teacher education, and empowering teachers to foster critical thinking and creativity in their students.

Proceeding to the ninth cluster, the keywords within it coalesce under the theme of "Fostering Creativity and Collaboration in Secondary Education." This theme spotlights the intersections between adolescence, education, collaborative creativity, creative writing, and idea generation. It underscores the significance of offering educational opportunities that cultivate creativity, collaboration, and self-expression during adolescence and secondary education.

Figure 9

Co-occurrence of Keywords Between 2016-2020

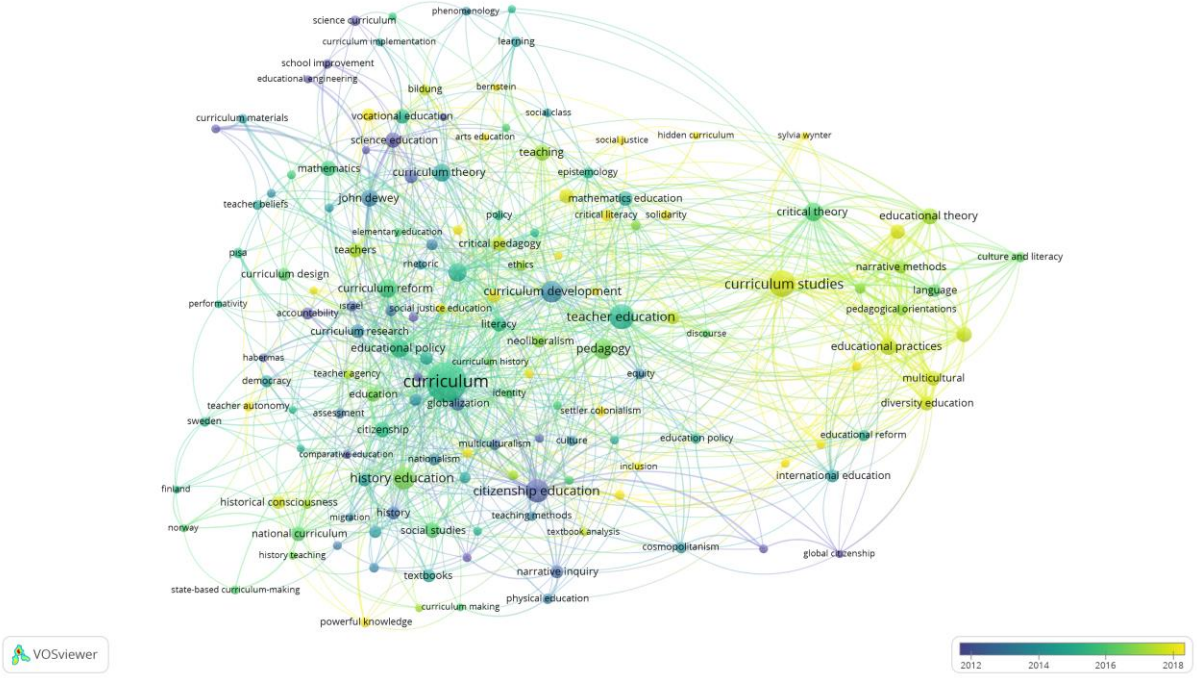


Figure 9 offers a visual representation of the evolution of topics over time. From approximately 2016 to 2018, research studies exhibited a predominant focus on two key themes. The first of these themes centers on "creativity." This encompassing topic delved into sub-topics such as "creativity training," "creative imagination," "teaching for creativity," "creative teaching," "creative learning," and "collaborative creativity." These sub-topics collectively underscored the multifaceted nature of nurturing creativity within educational contexts.

Simultaneously, the second noteworthy theme revolved around "divergent thinking." This theme featured interconnected elements including "problem-solving," "convergent thinking," "teaching strategies," "improvisation," "creative potential," and "science." This cluster of topics exemplified the nuanced exploration of various cognitive processes intertwined with the broader spectrum of creative thinking.

As we transition to the subsequent time frame of around 2018 to 2020, the research landscape shifted its focus towards emerging domains. One prominent area of exploration was "21st century skills," with particular emphasis on "critical thinking." This theme was interlinked with concepts like "argumentation," "problem-solving," "critical thinking dispositions," "metacognition," "science education," and "higher education." These connections illuminated the intricate relationship between critical thinking and various educational dimensions.

Another paramount theme that emerged during this period was "technology." This sphere brought to the forefront discussions on "critical thinking," "creativity," and the integration of technology within education. The crossroads between technology and education were further emphasized through references and connections to "STEM," "STEAM," "computational thinking," and "design thinking." These interwoven facets underscored the evolving landscape of education in the digital age.

In essence, Figure 9 effectively illustrates the shifting research foci over different time periods. The initial years saw an emphasis on creativity and divergent thinking, while the subsequent era highlighted the exploration of critical thinking within the context of 21st century skills and the integration of technology in education. This visual representation provides valuable insights into the evolving trends within the realm of 21st century skills research.

Discussion and Conclusion

The findings of this study provide valuable insights into the recent research trends and topics within the field of 21st century skills. The analysis of publications in TS&C using bibliometric techniques has revealed several important patterns and themes. These findings are expounded upon below.

Beginning with the descriptive outcomes, the study indicates fluctuations in the volume of published documents until the year 2021, representing the pinnacle in terms of quantity. The upward trajectory in document numbers could be ascribed to advancements in educational technologies, the emergence of 21st century skills, and the need for new competencies to address evolving employment prospects. Following this peak, a decline in the volume of published documents is evident in 2022, accompanied by a simultaneous rise in citation numbers. It is possible that the decrease of publications in 2022 is an artifact as some papers being published late 2022 might not yet have been in the WOS database. As posited by Zupic and Cater (2015), citations can be regarded as a metric of influence, with a high number indicating the significance of a given paper. Consequently, it can be asserted that the papers disseminated in the context of TS&C exhibit effectiveness and ongoing contributions to the domain of 21st century skills over time. Another noteworthy finding concerning citations is that the most influential papers, in terms of citation numbers, are review studies, aligning with the observations of De-Marchis and Shchebetenko (2022). An additional noteworthy observation meriting discussion pertains to the geographical dispersion of contributions among various countries, institutions, and authors within the context of TS&C. The findings revealed substantial contributions from diverse countries and continents, highlighting the widespread interest and engagement with the subjects discussed in TS&C, which

signifies global representation. This is a notable observation deserving further discussion. In the bibliometric analysis of two journals dealing with curriculum studies, the findings reported by Kaya (2023), for example, indicated a tendency toward localized rather than global contributions, prompting consideration of the countries, institutions, and authors involved. It was highlighted that migration trends, particularly towards economically developed nations such as the United States, Canada, and the United Kingdom, have been on the rise. This trend contributed to the formation of increasingly diverse and multicultural societies, often accompanied by heightened societal tensions and enduring racial dichotomies in these countries. The prevalence of contributions from these nations in the analyzed journals suggested a concentration of academic output in response to the challenges posed by these demographic shifts. As academic research endeavors to address pressing societal issues, the emphasis on contributions from countries experiencing significant migration trends could be seen as a proactive response to the associated challenges and complexities. Kaya (2023) proposed another plausible explanation for this geographical concentration, considering the potential influence of the location of the journals' publishers on the distribution of contributions. These findings, in this sense, highlight 21st century skills as a hot topic touched upon globally and that TS&C welcomes and embraces contributions, within the scope of the journal, from any country/author.

The findings with respect to co-word/co-occurrence analysis revealed many keywords related to 21st century skills. The most encompassing skills included problem-solving, critical thinking, and creativity, which are called "cognitive skills" by Kyllonen (2012), "learning and innovation skills" by Trilling and Fadel (2009). These skills also align with the top 10 skills recommended by the World Economic Forum for 2020 (Luna Scott, 2015). In addition to these skills, there were references to self-efficacy, collaboration, innovation, flexibility, literacy, cognitive flexibility, and emotional intelligence, which also align with the top 10 skills recommended by the World Economic Forum for 2020. In a similar vein, these skills are among interpersonal and intrapersonal skills (Kyllonen, 2012), and career and life skills (Trilling & Fadel, 2009). In addition, the keywords within the clusters point to the key subjects (e.g., Maths, science), curriculum and instruction, assessment of the skills and achievement, and personal development, among others. Taken together, TS&C manages to present the knowledge, skills, and expertise showcased in Figure 1, which the students need to master to live and work successfully in the 21st century (Trilling & Fadel, 2009).

An additional noteworthy observation meriting discussion pertains to the dominance of creativity among other 21st century skills, appearing in 302 papers published in TS&C. In addition, the number of other keywords related to creativity (e.g., creative pedagogy, creativity training, creative potential etc.) almost doubled this occurrence. This finding was further supported by the themes originating from the clusters as reported above. Creativity, a person's competence to utilize brand-new ways and ideas to solve a problem/challenge is primarily characterized by the elements of originality, effectiveness/usefulness (Runco & Jaeger, 2012), and surprise (Simonton, 2018). Additional research establishes a connection between creativity and "discovery" (Martin & Wilson, 2017), and "innovation" (Ceh et al., 2023). In this sense, the keywords, "originality and innovation" appearing in several papers increases the dominance of creativity even further.

Literature shows that definitions of creativity vary across levels and domains. Slavich and Svejenova's (2016) examination of the definition of creativity in 400 articles, for example, revealed that creativity is linked to four fundamental processes: synthesis, engagement, interactions, and creations, with a focus on both individuals and organizations. The papers published in TS&C

context, in this sense, seem to be mainly individual-level lacking a focus on organizations considering the keywords in the clusters. In a related vein, Puryear and Lamb's (2020) review of 600 articles aimed to analyze variations in the definition of creativity across the realms of business, education, and psychology. Their findings suggested that problem-solving is accentuated by scholars in education and business, whereas psychology scholars predominantly rely on psychometric definitions as the core determinants of creativity. Quite similarly, previous research on creativity highlights differences among domains. Wehner et al. (1991) conducted an analysis of dissertations that establish connections between creativity, innovation, and entrepreneurship. Their work resulted in the development of a typology of creativity research spanning various fields including education, business, economics, history, and political science. Subsequently, Kahl et al. (2009) built upon Wehner's research, focusing on dissertations and reintroducing attention to psychology and science and engineering, which were not previously emphasized. The keywords pertaining to this study reveal that the papers published in TS&C mainly deal with education and psychology, so the definitions of creativity are expected be in line with these domains.

Subsequent research on creativity dealt with the topics related to creativity through review or bibliometric studies. Feist and Runco (1993) involved the initial review of academic articles, concentrating on publications within a prominent academic outlet for creativity research, the Journal of Creative Behavior. This review emphasized a growing interest in themes such as creativity enhancement, education, problem-solving, social influences, and the personalities of creative individuals which echoes the findings of this study to a great deal. One of the contributions of this study is the addition of critical thinking as a current interest related to creativity. Zhang et al. (2015) conducted a comprehensive exploration of two decades (1992-2011) of creativity research with the objective of elucidating the "spatial structure" of creativity, referring to the central themes investigated during that specific period. Their methodology facilitated the identification and categorization of 163 keywords into five overarching topical trends: practical applications of creativity, pathology and physiology of creativity, individual-level creativity, organizational-level creativity, and the fundamental theories and methodologies of creativity. Two trends (practical applications of creativity and individual-level creativity) align with the findings of this study. Similarly, Williams et al. (2016) conducted a keyword-based analysis spanning 25 years of creativity research. Their examination of 1,472 articles revealed three primary trends: workplace innovation, the influence of personality and intelligence on divergent thinking, and creative performance with a specific emphasis on idea generation, which partly align with the findings of this study.

Hernández-Torrano and Ibrayeva (2020) conducted a bibliometric analysis delineating the landscape of creativity and education spanning the last 45 years (1975-2019). The exploration of creativity and education exhibited a notable interdisciplinary nature, primarily emanating from the realms of educational sciences and various branches of psychology. The authors further identified overarching themes in the field, encompassing a) the pedagogy (teaching) and acquisition (learning) of creativity, b) psycho-educational factors associated with creativity, c) the impact of creativity within organizational contexts, and d) cognitive and affective processes that influence creativity. Mejia et al. (2021) highlighted twelve prominent trends within the domain of creativity research. These trends included "organizational creativity and team creativity", "social psychology of creativity", "creative industries and creative cities", "idea generation", "neuroscience of creativity", "creative arts and art therapy", "creativity and mental illness", "expertise and productivity", "enhancing creativity", "identity and multiculturalism", "creative destruction", and

"others". De-Marchis and Shchebetenko (2022) analyzed the creativity research conducted within European Union. The results suggested that the domain of creativity is grounded in four scientific disciplines/domains, namely "Business & Economics, Psychology, Education & Educational Research, and Computer Science". Further findings pointed to "engineering", "computer science", and "education & educational research" as the most interconnected areas of research.

Compared to this literature, it is possible to assert that the papers published in TS&C mainly deal with creativity within education, psychology, science, and technology echoing previous studies by Hernández-Torrano and Ibrayeva (2020), De-Marchis and Shchebetenko (2022), and Kahl et al. (2009). In addition, the themes originating from the clusters of keywords in this study parallel the trends of Mejia, Dippolito and Kajikawa's (2021) two themes, which are "social psychology of creativity", and "enhancing creativity"; Hernández-Torrano and Ibrayeva's (2020) three themes (a, b, d); Feist and Runco's (1993) themes such as creativity enhancement, education, problem-solving, social influences, and the personalities of creative individuals. The most notable contribution of the present study is the snapshot showing the relationship between creativity and other 21st century skills such as critical thinking, teamwork/collaboration, and problem-solving skills; a relationship empirically supported by Ozyurt (2015), Wechsler et al. (2018), Chang et al. (2015), Rodríguez-Sabiote et al. (2022), Hoegl and Parboteeah (2007), and Taggar (2002).

Time to discuss the journey of TS&C with respect to the topics touched upon over time. The patterns and themes revealed in this study show temporal visualization of shifting research foci. The first significant trend identified between 2016-2018 in the study is the growing interest in promoting creativity and critical thinking skills in education. The themes of "Enhancing Creativity and Learning in Education" and "Fostering Creativity and Critical Thinking in 21st Century Education" suggest a strong emphasis on integrating creative and critical thinking into educational practices. This aligns with the current educational landscape's recognition of the importance of equipping students with the skills needed to thrive in a rapidly changing world as highlighted by Geisinger (2016), and Voogt and Roblin (2012). The focus on incorporating design principles, computational thinking, emotional considerations, and experiential learning underscores the multidimensional nature of fostering creativity and critical thinking in this digital era.

Another notable trend is the recognition of the significance of nurturing creativity and development in adolescent education. The theme of "Nurturing Creativity and Development in Adolescent Education" highlights the importance of understanding and supporting the creative potential of adolescents. This is a crucial stage in cognitive and personal development, and educators need to provide opportunities for adolescents to explore their creativity, problem-solving abilities, and metacognition.

Taken together, the findings of the current study align with the bibliometric research on creativity by Hernández-Torrano and Ibrayeva (2020) who highlighted "a general interest in teaching and learning of creativity in educational contexts, as denoted by frequently cooccurring words such as curriculum, assessment, pedagogy, knowledge, and thinking skills," and "the psychoeducational correlates of creativity in children, including personality, intelligence, divergent thinking, and achievement, among others," and "the cognitive and affective processes involved in creative thinking, including cognition, thinking, mood, activation, and hedonic tone" (p.13) between 1975 and 2019. Namely, these issues are still being studied and discussed recently. The relationship between creativity and other 21st century skills (e.g, critical thinking, problem-solving,

collaboration) in the current study could be taken as a further contribution or recent popular area of research.

Additionally, the study sheds light on the role of technology in education (Fostering Creativity and Collaboration in Secondary Education) between 2018 and 2020. The keywords related to technology (e.g., computational thinking, STEM) indicate the increasing role of digital tools and platforms in enhancing creative and critical thinking skills. In the modern digital era, intensive efforts are made to inject computational thinking across STEM fields, aiming at formulating a well-trained citizenry and workforce capable of confronting intricate problems that would not be solvable unless exercising CT skills (Kanaki & Kalogiannakis, 2022). This finding highlights the fact that integrating technology into education might provide new avenues for fostering creativity and collaboration among students, which stands out as a new contribution in the context of creativity not mentioned in the previous corresponding research (e.g., De-Marchis and Shchebetenko, 2022; Hernández-Torrano & Ibrayeva, 2020; Kahl et al., 2009; Mejia et al., 2021). In a related vein, design thinking (DT), a relatively recent academic discipline (Dragičević et al., 2023), has been the focus of TS&C recently, as it was found to increase overall creativity and its sub-components such as fluency, originality, and flexibility (Kuo et al., 2022). DT, a human-centered approach, drawing upon the cognitive processes and methodologies employed by designers (Johansson-Sköldberg et al., 2013), has gained prominence in scholarly literature as a distinctive practice diverging from conventional methods of innovation and problem-solving in the realms of education and business (Dragičević et al., 2023). Therefore, there is a growing emphasis on the need for ongoing research that establishes connections between DT and digital transformation, particularly within the spheres of business and education (e.g., Kuo et al., 2022; Taimur & Onuki, 2022). In this context, the tendency towards integration of technology could be taken as another addition to the findings reported by Hernández-Torrano and Ibrayeva (2020).

By analyzing the clusters/themes and the relationships among the keywords, it is possible to observe the interconnectedness of various concepts related to creativity, critical thinking, reflective thinking, problem-solving, divergent, and convergent thinking, self-efficacy education, and learning. These clusters highlight the importance of fostering creativity, problem-solving and critical thinking skills, integrating design principles and thinking in education, understanding individual differences and factors influencing creativity and other 21st century skills, and leveraging technology and collaborative learning for innovative and effective educational practices. They emphasize the significance of nurturing "cognitive skills" and "learning and innovation skills" (creativity, problem-solving and critical thinking) from early childhood through higher education and highlight the roles of students, teachers, and educational interventions in promoting these skills. Taken together, an individual needs to develop most of these skills simultaneously to survive, succeed and adapt in the 21st century.

Limitations and Suggestions for Further Research

In reflection, while this study illuminates an array of compelling insights, it is important to acknowledge its limitations and contemplate avenues for future exploration. First, the study remains anchored to one specific journal, potentially overlooking a broader array of influential studies dealing with 21st century skills. Hence, a potential trajectory for future research lies in encompassing analogous studies published across diverse journals to obtain a comprehensive perspective.

Second, the analysis, constrained to the confines of keywords used in the TS&C research, is unable to dive deep into the intricate variables associated with 21st century skills. This limitation prompts the exploration of meta-studies that can encompass an array of 21st century skills categories, thereby facilitating a more profound comprehension of the underlying mechanisms, experiences, and contextual factors that shape 21st century skills and their intricate interplay within educational contexts.

Furthermore, the findings revealed that all 21st skills have not been covered in TS&C. Future research, in this sense, might analyze these skills and the relationship among these skills.

In addition, the findings underscored the evolving landscape of education in the digital age. Therefore, more research is needed to integrate technology in the educational process to explore its influence on 21st century skills, specifically cognitive skills mentioned above.

Last, the creativity studies published in TS&C mainly deal with educational research. Further bibliometric or meta research, in this respect, might analyze creativity within other specific domains (e.g., business, science, political science etc.) to compare the results.

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Geniş Özet

Problem Durumu

Gelecekteki toplum, insan, deneyim ve bilgelik temelli rekabetle karakterize edilir (Powell, 2020; Schmidt, 2022), bu nedenle geleceğin vatandaşları olan öğrencilerin sadece bilgi biriktirmenin ötesine geçerek, eleştirel düşünme, karar verme ve problem çözme gibi ileri düzey bilişsel yeteneklerini geliştirmeye odaklanmaları zorunludur (Miri vd., 2007). Sonuç olarak, eski ve yeni bilgileri birbirine bağlama, bilgileri yeniden düzenleme ve işleme, sorunları yaratıcı bir şekilde analiz etme, karmaşık meseleleri etkili bir şekilde çözme, takımlar içinde işbirliği yaparak ortak faydaya ulaşma ve dünyayı eleştirel bir gözle gözlemleme yeteneğine sahip yüksek düzey düşünürlere ve yaşam boyu öğrenenlere olan talep artmaktadır (Kroth vd., 2022). Bu dönüştürücü gelişmeler, eğitimcilere yeni zorluklar sunmakta ve öğrenme içeriği ile bu öğrenme sürecini kolaylaştırmak için kullanılan yöntemlerde önemli değişiklikler yapılmasını gerektirmektedir (Voogt vd., 2013). Bu durum, toplumsal ilerlemeye duyarlı ve etkin bir şekilde rekabet edebilecek insan kaynakları üretecektir (Tight, 2021a; Tijsma vd., 2020). Bu gelişmelerin bir sonucu olarak, son zamanlarda öğrenicilerin bilişsel ve öğrenme yeteneklerinin geliştirilmesine yönelik akademik ilginin belirgin bir şekilde arttığı gözlenmiştir (Wegerif vd., 2015; akt. Li, 2016).

Bir araştırma alanını tanımlamanın en uygun yaklaşımı, o alana ilişkin araştırma çalışmalarının incelenmesini içerir ve her disiplinin kendi bilimsel çıktısını periyodik olarak değerlendirme sorumluluğu vardır (Staton-Spicer & Wulff, 1984). Ayrıca, belirli bir disiplinde yürütülen araştırmaları analiz etmek, aynı alanda araştırma yapmak isteyen araştırmacılar için değerli bir rehberlik sağlar (Cohen vd., 2007). Bu bağlamda, bu araştırma, 21. yüzyıl becerileri ile ilgili mevcut literatürün kapsamlı bir incelemesini, bibliyometrik analiz yaklaşımını kullanarak sunmaktadır. Analiz, akademik yayınların ve atıfların zamansal gelişiminin incelenmesi, etkili makalelerin, yazarların ve kurumların belirlenmesi, alana ait anahtar kelimelerin araştırılması üzerinde yoğunlaşmaktadır. Bu çalışmanın genel amacı, 21. yüzyıl becerileri alanında araştırma eğilimlerinin belirlenmesini kolaylaştırmak ve gelecekteki araştırmalar için potansiyel yönler önermektir. Bu amacı gerçekleştirmek için, düşünme becerileriyle ilgili konuları yayımlamayı hedefleyen Thinking Skills and Creativity (TS&C) başlıklı dergide yayımlanan yayınlar dikkate alınmıştır. 2006 yılında kurulan TS&C, yaratıcılık ve düşünme becerilerini, düşünme öğretimi dahil olmak üzere ele alan araştırmaları içermektedir (TS&C, 2023). Bu anlamda, bu bibliyometrik analiz şu araştırma sorularına yanıt bulmayı amaçlamaktadır:

1. Seçilen dergide yayımlanan çalışmaların yıl, ülkeler, yazarlar ve kurumlar bakımından dağılımı nedir?
2. Seçilen dergide 21. yüzyıl becerileri ile ilgili araştırma eğilimleri nelerdir?

Yöntem

Belirli bir alandaki araştırma eğilimlerini incelemek için literatür taraması, içerik analizi, meta-analiz ve meta-sentez gibi çeşitli metodolojiler kullanılabilir (Kaya, 2023). Ancak, bu yöntemlerin kapsamlayabilecekleri araştırma çalışmaları miktarı açısından sınırlamaları olabilir (Zupic & Cater, 2015). Bilgi yığılmasının üstesinden gelmek için, akademisyenler, bilgisayar destekli yöntemleri benimseyerek, konu alanının kapsamlı bir şekilde keşfedilmesini ve gezinilmesini kolaylaştırmayı hedeflemektedirler; bu yöntemlerden biri de bibliyometrik analizdir. Bu yöntem, bir alanda yürütülen büyük hacimli araştırmaların analizini sağlayarak, çalışmalar arasındaki ilişkilerin tanımlanmasını ve anlaşılmasını kolaylaştırır (Zupic & Cater, 2015).

Bibliyometrik analizde, veri seti hazırlamanın iki ana yaklaşımı vardır. İlk yaklaşım, seçilen anahtar kelimeler veya ifadeler kullanılarak arama yapmayı ve ardından ayrıntılı okumalara dayanarak ilgili çalışmaların belirlenmesini içerir. Bu yöntem, belirli bir konuya odaklanan çalışmalarda yaygın olarak kullanılır. İkinci yaklaşım ise, bir veya daha fazla derginin seçilmesini ve bu dergilerde yayımlanan veya incelemeler sonucunda belirlenen tüm çalışmaların analize dahil edilmesini içerir (Zupic & Cater, 2015). Bu çalışma için, 21. yüzyıl becerileri üzerine araştırmalar yayımlayan tek bir derginin (TS&C) seçilmesini içeren ikinci yaklaşım benimsenmiştir. Toplanan veriler başlangıçta WOS sistemi içinde tanımlayıcı istatistikler kullanılarak analiz edilmiştir. Daha sonra, bibliyometrik analizler, özellikle bibliyometrik haritalar oluşturmak için tasarlanmış VOSviewer yazılımı sürüm 1.6.17 kullanılarak gerçekleştirilmiştir (Van Eck & Waltman, 2021).

Bulgular

Bu çalışmanın bulguları, 21. yüzyıl becerileri alanındaki son araştırma eğilimleri ve konuları hakkında değerli bilgiler sunmaktadır. TS&C'deki yayınların bibliyometrik teknikler kullanılarak analizi, birkaç önemli desen ve tema ortaya çıkarmıştır. Eş kelime/eş-oluşum analizine ilişkin bulgular, 21. yüzyıl becerileri ile ilgili birçok anahtar kelimeyi ortaya çıkarmıştır. En kapsamlı beceriler arasında problem çözme, eleştirel düşünme ve yaratıcılık yer almaktadır; bu beceriler Kyllonen (2012) tarafından "bilişsel beceriler" olarak adlandırılmıştır ve Trilling ve Fadel (2009) tarafından "öğrenme ve yenilik becerileri" olarak tanımlanmıştır. Bu beceriler aynı zamanda Dünya Ekonomik Forumu'nun 2020 için önerdiği ilk 10 beceriyle de uyumludur (Luna Scott, 2015). Bu becerilere ek olarak, öz yeterlilik, işbirliği, yenilikçilik, esneklik, okuryazarlık, bilişsel esneklik ve duygusal zeka gibi becerilere de referanslar bulunmaktadır; bu beceriler de Dünya Ekonomik Forumu'nun 2020 için önerdiği ilk 10 beceriyle uyumludur. Benzer şekilde, bu beceriler Kyllonen (2012) tarafından kişilerarası ve içsel beceriler olarak tanımlanmış ve Trilling ve Fadel (2009) tarafından kariyer ve yaşam becerileri olarak adlandırılmıştır. Ayrıca, kümeler içindeki anahtar kelimeler, Matematik ve fen gibi ana konuları, müfredat ve öğretim, becerilerin değerlendirilmesi ve başarıyı, kişisel gelişim gibi konulara işaret etmektedir.

Sonuç ve Tartışma

Kümeler/temalar ve anahtar kelimeler arasındaki ilişkiler analiz edildiğinde, yaratıcılık, eleştirel düşünme, yansıtıcı düşünme, problem çözme, farklı ve birleşik düşünme, öz yeterlilik eğitimi ve öğrenme gibi çeşitli kavramların birbirine bağlılığı gözlemlenebilir. Bu kümeler, yaratıcılık, problem çözme ve eleştirel düşünme becerilerinin geliştirilmesinin, eğitimde tasarım ilkelerinin ve düşünmenin entegrasyonunun, bireysel farklılıkların ve yaratıcılığı ve diğer 21. yüzyıl becerilerini etkileyen faktörlerin anlaşılmasının ve yenilikçi ve etkili eğitim uygulamaları için teknolojinin ve işbirlikçi öğrenmenin kullanılmasının önemini vurgulamaktadır. Ayrıca, bu becerilerin geliştirilmesinin, öğrencilerin, öğretmenlerin ve eğitimsel müdahalelerin bu becerileri teşvik etmedeki rollerinin altını çizmektedir. Bir arada ele alındığında, bireyin 21. yüzyılda hayatta kalabilmesi, başarılı olabilmesi ve uyum sağlayabilmesi için bu becerilerin çoğunu aynı anda geliştirmesi gerekmektedir.