



Communicating the societal value of the entrepreneurial university: Evidence from South Korea



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ABSTRACT

This study examines two concurrent trends in higher education. First, universities are increasingly focused on enabling entrepreneurship to fulfil their "third mission" of contributing to the regional economy. Second, they are intensifying efforts to communicate the entrepreneurial university portfolio as evidence of their societal value. Although previous research has explored these areas, how universities convey their entrepreneurial efforts remains unclear. Are entrepreneurial universities primarily portrayed as institutions that train future entrepreneurs, spin out companies and intellectual property, or drive cultural change towards entrepreneurship? To address this, we use natural language processing techniques to provide novel insights into how universities communicate entrepreneurship-focused activities and capability-building efforts. Our empirical focus is South Korea's top ten universities, for which we analyzed 7889 national newspaper articles in terms of a sociological capital framework. Our findings indicate that human capital-related activities receive greater emphasis than cultural and social capital capability-building efforts. This finding suggests that the third mission may not be clearly conveyed in coverage of the entrepreneurial university. The managerial implications are that university leadership can enhance communications to better showcase their societal connections and contributions in line with their third mission.

1. Introduction

Universities are increasingly expected to contribute to socio-economic development in the communities, regions, and countries where they are based. Changing political and social contexts require universities to justify their access to public funding by demonstrating their positive socio-economic impact (Brenzitz et al., 2022; Compagnucci & Spigarelli, 2020; Guerrero and Dabić, 2023, chap. 1; Guerrero et al., 2024). They should not simply exist as an "ivory tower" that operates outside of its local context (Etzkowitz et al., 2000). To address public pressures and to meet growing rankings expectations for positive impact (Dabić, 2021), university leadership are motivated to positively convey what they are doing to deliver value through education, research and service to wider society. They strive to communicate their value-add to prospective graduates in the form of future employment prospects, in terms of contribution to scientific advances, and to regional

development, talent and growth (Grant, 2021; Seri & Compagnucci, 2024; Shapiro, 2005). University leaders deliver on, and communicate, these aims by investing in knowledge exchange and stakeholder engagement efforts, such as creating public communications teams that leverage a growing array of media channels (Benneworth et al., 2015; Borlaug & Elken, 2024; Peruta & Shields, 2018).

Despite the growing importance of entrepreneurial universities communicating their societal value, research has only examined aspects of this phenomenon. Marketing and media communications researchers have examined the contours of universities' rising public engagement efforts (Peruta & Shields, 2018), and management studies, entrepreneurship, and higher education scholars have analyzed the leadership organization, activities, and performance of the entrepreneurial university (Borlaug & Elken, 2024; ForlanoDe et al., 2021; Meek & Giannidis, 2023). These two strands have remained disparate, as how the university communicates the value of its entrepreneurial efforts has not

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yet been examined.

This leads us to our central research question: How is the entrepreneurial university portrayed in the media? Specifically, is it presented as an institution with entrepreneur-flavored education and research, or a driver of entrepreneurial mindsets and activity beyond the university? Our empirical context is the national media coverage of South Korea's ten highest-ranked entrepreneurial universities over a 23-year period (1998–2021). Our focus on Korea offers a geographic extension of research on the entrepreneurial university, especially in the East Asian context. The entrepreneurial university phenomenon has thus far been widely studied in North American and European contexts, with less research examining non-Western contexts. Only a modest number of studies focus on East Asia (Eun et al., 2005; Park & Jeong, 2015; Wong et al., 2007). Korea is an interesting case to study because Seoul's startup cluster is now ranked in the global top 20 by Startup Genome, and the country's entrepreneurial universities likely contributed to this rise (D-W Sohn et al., 2007; Mok, 2013). We use text-as-data techniques to analyze 7889 media documents to assess how South Korea's entrepreneurial universities have been covered in high-circulation national newspapers.

We find that Korea's entrepreneurial universities emphasize human capital terms most, accounting for 51% of the terminology used to describe university activities. Cultural capital language, in contrast, is least used, representing just 15%. Human capital efforts are most-often described in terms of 'research', 'program', and 'educate' over the 20+ year period, just as cultural capital descriptors are most-often 'culture', 'prize', and 'promote'. Collectively, Korea's top universities speak most about skill-based activities, and relatively less about efforts to foster an entrepreneurial mindset, to build bridges, and to enable capabilities through coaching and mentoring. In short, the entrepreneurial universities are conveying their core education and research activities, but say less about their efforts to drive connections and encourage entrepreneurial culture. This focus on human capital activities is perhaps not surprising, given the primacy of education and research to the institution, but it does raise questions about how much the entrepreneurial university is being conveyed as part of a wider, or distinct, third mission.

These findings have clear implications for campus leadership. First, by revealing evidence of how the entrepreneurial university is portrayed, universities can reflect on whether this is what they intend to convey. Rather than entrepreneurial university communications centering on education and research, would university leader like to elevate its emphasis of the networking opportunities and entrepreneurial mindset building that these activities strive to boost? To what extent is the portrayal of the entrepreneurial university meant to align with the more traditional framing of the university's thrust, versus showing a broader, and more varied, means of engaging in socio-economic development? Third, insight into strategic communications can inform a review and reconsideration of the entrepreneurial university offerings themselves. This aligns with scholarly calls for university leaders to proactively manage the entrepreneurial university (Leih, 2016), and to reimagine the "rebirth" of the model (Meek & Gianiodis, 2023) that best delivers value for the university and wider society. Perhaps additional offerings, that go beyond entrepreneurial education and research, which constitute a greater range of interactions with the local community, are needed to deliver on a distinct third mission (and not the university's 'business as usual' education and research with an entrepreneurship theme).

The paper is structured as follows: The next section reviews literature on the university's third mission and its public engagement. Section 3 develops our 'types of capital' theoretical framework for understanding the language used to portray the entrepreneurial university. Section 4 then details the data and methods employed, starting with the development of our novel dictionary of n-grams—combinations of one or more words that capture specific themes or concepts—and the approach we used for our text-as-data analysis of the Korean media corpus. The following section presents the empirical results. Finally, we offer

conclusions, discuss the limitations of this study, suggest directions for future research, and present the findings' theoretical, methodological and practical implications.

2. Literature review: The entrepreneurial university and public engagement

Universities' entrepreneurial activities and capability-building efforts are an increasingly important means of demonstrating their "third mission" of driving regional socio-economic development (Borlaug & Elken, 2024; Etzkowitz, 1983; Uslu et al., 2019). In this article, the entrepreneurial university is understood as distinct from the traditional approach to tertiary education and research, aiming to foster entrepreneurial activity and embody entrepreneurial capabilities among its staff, students, and alumni, along with partnerships with industry and government (ForlanoDe et al., 2021; Klofsten et al., 2019). Activities include entrepreneurial education and learning, research, service, spinouts, and technology transfer activities (Etzkowitz & Zhou, 2021; Ozen et al., 2023). Cognate terms, and research streams, to the entrepreneurial university include "academic entrepreneurship" (Goethner & Wyrwich, 2020), "professorial entrepreneurship" (Kenney & Goe, 2004), "university entrepreneurship" (Rothaermel et al., 2007), and research on the Triple Helix Model (Etzkowitz, 1983) and "academic engagement" (Perkmann et al., 2013).

Scholars have shown that a key category of the university's third mission includes public engagement activities, such as knowledge transfer, technology transfer, and entrepreneurship (Benneworth et al., 2015; Borlaug & Elken, 2024; Etzkowitz, 1983). In this sense, the third mission is both the *doing* of entrepreneurial activities, but also, public engagement to shape local awareness, policy, and more. Research has revealed that by "facilitating innovation/entrepreneurship and regional benefits, universities not only enhance their reputation but also the reputation of their university community" (Guerrero et al., 2016). Thus, in this article we understand the suite of entrepreneurship activities and their portrayal as collectively comprising the entrepreneurial university and the third mission.

Despite the awareness of the need for this evaluation of public engagement as part of the entrepreneurial university, previous studies have tended to focus inwards, by assessing its efforts based upon preferences and activities of its community (e.g., alumni, staff, students). In a similar way, meta-synthesis and bibliometric studies of entrepreneurial university research show that metrics center on data emanating from *within* the university (Arroyabe et al., 2022; Uslu et al., 2019). In fact, Henry and Lahikainen refer to this inward focus as 'intrapreneurial' orientations of the entrepreneurial university (Henry & Lahikainen, 2024). Other studies analyze (longitudinal) cases—detailing missions, processes, and organizational changes—that employ quasi-experimental methods to ascertain performance on specific community members (Etzkowitz et al., 2022). Other scholars conduct interviews with a range of internal stakeholders, including alumni, commercialization managers, faculty, management, and students to analyze what activities constitute the entrepreneurial university and their impact on participants (Dabic et al., 2015; Padilla-Meléndez et al., 2021). Quantitative studies draw on secondary sources for indicators of the university community's entrepreneurial intentions and activities (Lechuga Sancho et al., 2021), stock market data (Audretsch & Lehmann, 2005), and social network analysis (FusterPadilla-et al., 2019) to ascertain the entrepreneurial university's impact on alumni, faculty, and students. Researchers also use surveys and questionnaires to measure the activities, capabilities, intentions, and perceptions of members of the entrepreneurial university (Ozen et al., 2023; Redondo & Camarero, 2019).

In a disparate line of research, studies examine universities' growing public engagement activities, offering insight into the increasing number and sophistication of channels used, as well as their performance (Borlaug & Elken, 2024). Research offers insight into the delivery of external engagement, from a more traditional "press office" toward

teams that offer social media, video production, and traditional media capabilities (Garner, 2017). Research at the intersection of science and public policy explores how universities' scientific advances are communicated to wider society, particularly around salient issues such as climate change and health (Retzbach & Maier, 2015; Tøsse, 2013; Winter 2004). Studies of social media as a platform for university marketing reveal both how these platforms are leveraged and how certain subjects (e.g., athletics) "perform" (Peruta & Shields, 2018).

The engagement of universities with the media has been analyzed from various disciplinary perspectives, including science and public policy (Compagnucci & Spigarelli, 2020; Tøsse, 2013; Winter 2004) and marketing (Peruta & Shields, 2018; Rutter et al., 2016). This body of literature examines the tools utilized, trends, and the efficacy of universities' public engagement efforts (Rowe & Frewer, 2005). It highlights campus leadership's increasing desire to demonstrate their value (Grant, 2021; Meek & Gianiodis, 2023; Shapiro, 2005), moving beyond the "ivory tower" critique (Etzkowitz et al., 2000). It has revealed how university leadership has ramped up investments in public engagement (Rutter et al., 2016). Communications and public relations (PR) teams have expanded to secure more and higher-quality media appearances as part of their efforts to demonstrate societal impact, enhance reputation, and support their rankings performance.

Universities' communications and PR teams are primarily responsible for two areas of engagement. One focuses on connecting individual researchers and teams with targeted audiences by organizing events such as roundtables with policymakers and forming partnerships with community groups. The initial goal is to engage key external stakeholders who can influence public policy and business decisions (Cohen, 2022). Subsequently, other communication channels are used to convey this impact to a broader society. The second approach involves increasing media coverage, focusing on communicating the university's impact to high-circulation newspapers, radio, television programs, and social media channels (Peruta & Shields, 2018; Rutter et al., 2016). Universities' communications teams engage with the media, especially high-circulation newspapers, through press releases and by pitching content to journalists. Thus, by 'portrayed in the media', this article refers to the university's communications teams and public relations agencies that write press releases to communicate their portrayal directly, and journalists that write articles focused on universities' entrepreneurial offerings. To facilitate these efforts, university leadership has invested in media training and staff experienced in PR, who have strong networks with journalists and possess pitching skills for the media (Garner, 2017).

In reaching broader society, the university aims to demonstrate a positive "town-gown relationship", which refers to local community members recognizing the value that the university brings to its local region (Bruning et al., 2006). This includes collaboration with local industry in specific domains, like smart specialization strategies (Bukhari et al., 2021). Despite the advance of university efforts, some studies suggest that society may be "unresponsive to the efforts made by university staff" (Compagnucci & Spigarelli, 2020) and that conveying scientific uncertainty can hinder public engagement efforts (Retzbach & Maier, 2015). Therefore, while the growing investment by leadership in engaging with society at large is well-documented, there is a lack of evidence regarding the effectiveness of these efforts in raising societal awareness and perceived value. The question is not whether communications have increased, but rather, what the portrayal of the university is. For instance, to what extent do universities' communications center on students' contributions to the regional economy, as revealed by Breznitz and co-authors (Breznitz et al., 2022)?

We contend that the language used to portray activities is an essential factor in the efficacy of communications. Therefore, our first task is to deepen our understanding of the language used in media coverage. Emerging studies have started to explore the language used to describe the efforts of the entrepreneurial university and its third mission. Notably, Compagnucci and Spigarelli (Compagnucci &

Spigarelli, 2020) conducted a systematic review of journal articles regarding the third mission, and Forlano and co-authors (ForlanoDe et al., 2021) analyzed the language of the entrepreneurial university through a bibliometric review of academic literature. This has revealed important insight into the ways in which academics conceptualize the entrepreneurial university. However, researchers have not yet examined the language used to convey the value of the entrepreneurial university to external audiences. Studies have not examined the language used in media coverage of the entrepreneurial university. More broadly, the content of media communications related to the entrepreneurial university remains under-conceptualized and under-studied.

3. Theoretical framework: A sociological capital framework for understanding the language of the entrepreneurial university

To investigate how the entrepreneurial university is portrayed in the media, we need to establish analytical expectations regarding the language used. We could operationalize the entrepreneurial university in terms of whether we refer to external or internal aspects (Centobelli et al., 2019) or delineate them in terms of formal or informal factors (Gordon et al., 2012). Our focus is on conveying efforts in terms of value-add, and so delineating in terms of these binaries do not seem optimal for describing impact or value. Thus, we turn to research that describes the entrepreneurial university in the language of the types of capital generated through its activities and the capabilities it cultivates (Audretsch, 2007; Audretsch & Keilbach, 2004).

There is a growing range of types of capital that are used to depict the entrepreneurial university and its environs. We conceptualize three foundational types of capital using an sociological capital framework: cultural, human, and social. These types of capital have been individually and collectively explored in social science research, for an example on the types of capital and entrepreneurial performance (Klingler-Vidra et al., 2021). Audretsch refers to this collectively as the 'entrepreneurial capital' of the university (Audretsch, 2014). We considered codifying according to the additional categories that have been developed, especially in the study of the entrepreneurial university. This includes 'information capital' (Rodionov et al., 2021), 'knowledge capital' (Audretsch & Belitski, 2021; Rothaermel et al., 2007), and 'intellectual capital' which refers to the accumulation of human, relational and structural capital of the university in its local region (Stewart, 1997; Trequattrini et al., 2018). While these are important concepts, our decision to focus on cultural, human, and social capital stems from their seminal status across social sciences research (Becker, 1993; Bourdieu and Richardson, 1986; Coleman, 1988; Granovetter, 1973). These three types of capital provide a robust foundation for examining the entrepreneurial university's societal value, offering (relatively, though imperfectly) distinct categories for analysis. While intellectual, information, or knowledge capital could indeed align with our research goals, incorporating additional types would risk further blurring the boundaries of our analytical categories, making it more challenging to produce clear and meaningful insights. For example, intellectual and knowledge capital share significant conceptual similarities with human capital, which could lead to further redundancy in the interpretation of our data.

These types of capital form the foundation of our analytical framework, which is based in the wider sociological capital tradition. According to Bourdieu, cultural capital is distinct from economic, human and social capital. It has two forms that are particularly relevant in the educational context: the embodied state, which relates to "long-lasting dispositions of the mind and body," and the objectified state, such as in pictures and books, which reflects these dispositions (Bourdieu and Richardson, 1986). Becker defines human capital as investments in education and training in both formal education and on-the-job training (Becker, 1993). In contrast, social capital often refers to the contours and benefits of social networks (Granovetter, 1973) and the "sociological glue" that underpins social trust in society (Coleman, 1988). Collectively, we employ this sociological capital framework for understanding

how the entrepreneurial university portrays its (non-pecuniary) contribution to socio-economic development. We now discuss the three types in the entrepreneurial university research context.

First, in the context of the entrepreneurial university, cultural capital is seen in terms of the promotion of shared values around entrepreneurship, including attributes such as creativity, resilience, mindset, perseverance, problem-solving, and risk-taking (Martínez-Martínez & Ventura, 2020). Culture has been examined in the entrepreneurial university context in terms of informal environmental factors, such as attitudes (Guerrero et al., 2016). This promotion occurs through activities such as the organization of clubs and events that cultivate attitudes favoring entrepreneurship, as well as universities' production of materials (often marketing materials) that reinforce these values (Pittaway et al., 2011). Beyond the classroom, entrepreneurship clubs invite successful startup founders and venture capitalists to deliver guest talks, raising awareness of and admiration for entrepreneurship. Demonstrating how these values permeate the university in the contemporary era, research reveals that proximity, both spatially and through social networks, influences entrepreneurship across universities (Goethner & Wyrwich, 2020). These activities that aim to boost entrepreneurship-focused cultural capital go beyond the core education and research mechanisms. Rather than delivery through a degree program or lecture, or through research on the subject of entrepreneurship, it takes the shape of extracurricular clubs and events.

Second, in the context of the entrepreneurial university, human capital is conceived as encompassing (formal) education and training, as well as research and commercialization activities that shape the community's knowledge and skills (Dabic et al., 2015; Uslu et al., 2019). Academic entrepreneurship and entrepreneurship education are both forms of entrepreneurship-specific human capital, with a focus on academic faculty and teaching (Oosterbeek van et al., 2010). Teaching (education and training) and research (knowledge creation exemplified by copyrights, patents, licenses, and trademarks) activities are seen as fostering entrepreneurial human capital within and beyond the university. Human capital activities constitute a core of the universities' offerings: degree programs and research, which in this case, are both focused on the theme of entrepreneurship. These modes are key to the university's primary mission, not only a third mission.

Third, social capital has been studied in the context of how the entrepreneurial university influences its community members' entrepreneurial intentions and performance (Redondo & Camarero, 2019). Entrepreneurial universities promote networking activities, enhance professional social skills, and encourage community engagement (Martínez-Martínez & Ventura, 2020). At the level of academic

entrepreneurs and the broader faculty, this includes collaborations between professors and university incubators with external firms (Lee & Miozzo, 2019). Social capital has also been explored in the context of the social embeddedness fostered among professorial entrepreneurs (Kenney & Goe, 2004). Klofsten and colleagues detail social networking activities that encompass coaching and mentorship provided by a wider set of community members, including "alumni entrepreneurs, experienced volunteers, and professors with prior academic entrepreneurship experience" (Klofsten et al., 2019). The social capital elements comprise a mode that delivers bridge building within university communities and more widely, connecting the university with the broader (local) community. This social engagement character speaks to the third mission aims of engaging wider society; in this context, through entrepreneurship-themed activities.

These types of capital comprise language that refers to activities or capabilities. Audretsch and Keilbach and Siegel and colleagues both emphasize entrepreneurship as a set of *activities*, such as managing a startup and conducting R&D (Audretsch & Keilbach, 2004; Siegel et al., 2007). These studies focus on the actions and tangible outcomes of efforts, rather than just the intention or ability to be a successful entrepreneur. In contrast, Centobelli and co-authors describe the entrepreneurial university as focusing on building *capabilities* and emphasize its intangible benefits—competence, intention, and potential—rather than just the physical actions involved in becoming an entrepreneur (Centobelli et al., 2019). In Table 1, we distill the types of capital into the language of activities (e.g., tangible interactions and spaces) and capabilities (e.g., intangible and potential). This allows us to evaluate how the entrepreneurial university is portrayed in media in terms of which resources are being accumulated (e.g., types of capital) and how (e.g., through activities or capability-building).

Just as in the seminal studies of the types of capital, within the literature on the entrepreneurial university, researchers have noted that each of the university's domains can foster capital. Notably, Coleman's *Social capital in the creation of human capital* (Coleman, 1988), and Bourdieu's *The Forms of Capital*, both critiqued Becker's economic understanding of educational attainment as too narrow (Bourdieu and Richardson, 1986). These sociological capital scholars posited that learning produced, and was shaped by, other types of capital. In a similar way, entrepreneurship-focused university degrees provide students with the skills and knowledge of entrepreneurship, primarily constituting human capital. However, within the degree program, students also build their social networks, fostering social capital (which values entrepreneurship), which in turn increases cultural capital favoring entrepreneurship. Explaining this mutually reinforcing

Table 1
Types of capital in the context of the entrepreneurial university.

	Sub-category	Activities	Capabilities
Cultural capital	Awareness and values	<ul style="list-style-type: none"> • Events, fairs, festivals, prizes • Marketing campaigns • Role models and success stories 	Awareness; Behavior; Intention; Interest; Motivation; Norm; Passion; Perseverance; Risk-taking; Spirit.
Human capital	Education Training	<ul style="list-style-type: none"> • Entrepreneurship-focused degree programs (majors and minors), concentrations, and modules • Guest lectures and talks by entrepreneurs • Teaching of entrepreneurship case studies • Accelerators and incubators • Boot-camps and hackathons • Commercialization and technology transfer • Internships and jobs placements in startups and venture capital firms • Spin-offs and spin-outs 	Ability; Acumen; Competence; Expertise; Innovative; Knowledge; Learn; Leader; Science; Skill; Talent; Technique.
Social capital	Social networking	<ul style="list-style-type: none"> • Café and co-working space • Coaching and mentoring schemes • Competitions (ideas, business plans, pitches) • Entrepreneurship-themed clubs and activities • Networking events 	Bond; Bridge; Cluster; Community; Contact; Ecosystem; Institute; Link; Mentor; Network; Partner; Relation; Team; Tie.

Source: See Appendix for full list of dictionary terms (including stemming of the words) and hand-coding sources according to the type of capital.

relationship, Lechuga Sancho and colleagues describe how some university courses that focus on entrepreneurship foster cultural values in addition to skills (human capital) (Lechuga Sancho et al., 2021). Networking events emphasize the intention to endow participants with expanded social capital. However, participants also learn from others in their network, and shared values can be developed in such interactions. Similarly, although incubators are chiefly seen as a form of on-the-job training and are therefore primarily centered on human capital, they also contribute to social capital in the form of relationships with external entities (bridging social capital) and internal contacts (bonding social capital) (Redondo & Camarero, 2019). Thus, we categorize the activities of the entrepreneurial university as *primarily, though not exclusively*, facilitating the accumulation of either cultural, human, or social capital.

Our engagement extends this sociological capital framework by exploring the relative thrust of entrepreneurial university media communications. As the study is, as far as we are aware, the first to evaluate the relative thrust of entrepreneurial university activities across the types of capital, we hope our conceptualization and initial empirical test helps to build analytical tools for future research into the relative weight of the different types. Here, we offer an initial analysis of what the thrust of media portrayal means given the entrepreneurial university's positioning in terms of its third mission.

4. Data and methods

In this section we detail the analytical tools we developed to examine how the entrepreneurial university is depicted in the media. First, we created a novel corpus-based dictionary of n-grams to operationalize the concepts of entrepreneurial universities' activities and capabilities, aligning with state-of-the-art dictionary generation methods (Gentzkow et al., 2019; Prüfer & Prüfer, 2020; Rice & Zorn, 2021). Our dictionary is developed based on terms gathered from state-of-the-art literature on entrepreneurial universities (refer to Table A3 in the Appendix for a full list of sources). This dictionary approach addresses the call made by Klofsten and co-authors (Klofsten et al., 2019) for broader assessments of universities' impact, emphasizing the need to "collect appropriate data and also to define different levels of outcome success." Our method for operationalizing the theoretical framework comprises the following steps.

First, we conducted a Web of Science search for all articles published between January 2019 and April 2022 in the fields of business, economics, education, educational research, management, psychology, and social issues, with "entrepreneurial university" or "entrepreneurial universities" in the title. The Web of Science searches yielded 47 results for "entrepreneurial university" and 26 results for "entrepreneurial universities." We reviewed the abstracts of the 73 articles. We identified those that presented theoretical frameworks and/or operationalization of the types of capital in the context of the entrepreneurial university and found that 19 out of the 73 articles discussed at least one of these types of capital. The chosen timeframe (2019–2022) aimed to capture the latest debates in the literature. To expand the range of studies included in the research, we also identified seminal studies on types of capital in the entrepreneurial university referenced in the 19 articles.

Second, we manually coded the 19 articles based on the words used to describe cultural, human, and social capital. Each article was coded by at least two team members to ensure intercoder reliability. While conducting this term-gathering exercise, we identified an additional 15 cited articles that conceptualized the entrepreneurial university using at least one type of capital. To maintain intercoder reliability at this stage, two members of the research team independently coded these 15 articles for the words used to describe each type of capital. Upon completing the hand-coding of the 34 articles, we reached a point of saturation, where

we no longer discovered new words and phrases in each additional article (for complete details of the 34 articles, refer to Appendix Table A3).

The hand-coding stage generated 147 n-grams, consisting of 39 related to cultural capital, 61 to human capital, and 47 to social capital n-grams. Dictionary terms can be single words or terms composed of multiple words (e.g., bi-grams or tri-grams). Approximately 41% of the 147 n-grams describe human capital (e.g., "educate" and "research"), approximately 32% describe social capital (e.g., "institute" and "network"), and approximately 27% describe cultural capital (e.g., "environment" and "prize"). For n-grams where the primary category was coded differently by the two coders (e.g., "accelerator"), we sought external expert opinions from our network of practitioners (e.g., the university's entrepreneurship institute head) and academic colleagues (e.g., entrepreneurship researchers) to make the final coding decision.

Third, we categorized our 147 n-grams based on their depiction of an *activity* (e.g., event, incubate, networking) or a *capability* that the university aims to develop (e.g., ecosystem, mindset, skill). This method of word-type categorization aligns frameworks used in previous studies of the entrepreneurial university (Audretsch & Keilbach, 2004; Centobelli et al., 2019). This coding as activity or capability offers further insight into how the entrepreneurial university's value is portrayed; either in terms of what occurs (e.g., activities) or the objectives (e.g., capabilities). See Appendix Table A2.

Next, we enabled the empirical test by completing the following steps. We compiled the national media corpus to assess the frequency of the n-grams. We utilized Dow Jones Factiva to gather media coverage of South Korea's 10 highest-ranked universities, as per the Times Higher Education rankings for 2022, spanning a 23-year period from 1998 to 2021. We note that the Quacquarelli Symonds (QS) World University Rankings 2022 have the same top 10 universities, except for one. Gwangju Institute of Science and Technology (GIST) is included, rather than Sejong University. It should be noted that Sejong University had just 121 media documents, which constitutes less than 2% of our corpus. See Appendix Table A1 for the list of included universities. Studies on Korea have focused on one or two universities. Our analysis began in 1998, coinciding with the East Asian Financial Crisis, a period in which entrepreneurship promotion surged in Korea (Pacheco PardoKlingler and Vidra, 2019).

We collected media materials from the three highest-circulation English-language newspapers in the country: *Korea JoongAng Daily*, *Korea Herald*, and *Korea Times*. We performed searches using the university names as well as search strings containing their acronyms (KAIST, POSTECH, SKKU, SNU, and UNIST), within the timeframe of January 1, 1998, to December 31, 2021. We limited the search to "Headline and Lead Paragraph" to ensure that the coverage captured was substantively centered on the university. The media coverage encompassed articles that effectively served as press releases from the universities and articles in which university content was included in a journalist's piece. This approach allowed us to investigate how the entrepreneurial university is portrayed in the media beyond the universities' official websites and social media accounts. This process yielded 7889 individual media documents, and you can find a list of the universities, their acronyms, and the number of search results in Appendix Table A1.

Our search was confined to English-language media coverage, which inherently has a somewhat limited reach in representing media portrayal to the wider Korean-speaking society compared to Korean-language newspapers. To mitigate this limitation, we adopted an approach used in state-of-the-art natural language processing studies of media data by selecting English-language newspapers that are affiliated with three decades-old prominent Korean-language newspapers with

the largest readerships: *Herald Business/Korea Herald*, *Hankook Ilbo/Korea Times*, and *JoongAng Ilbo/Korea JoongAng Daily*. We note that the English-language version may be written for a migrant and international audience, and thus not a pure translation, but rather emphasizing certain traits or activities. While acknowledging these issues, we note that our strategy of using English-language media coverage is consistent with practices employed in studies on East Asian media that have drawn upon English-language sources (Klingler-VidraR and Chalmers, 2023; Massey & Chang, 2002). Due to the sensitivity of the natural language processing techniques, which focus on analyzing the use of specific terms, we accept this limitation rather than introducing judgement which would come from translating Korean into English.

In accordance with the text-as-data techniques employed in research, we pre-processed our media corpus through a series of steps (Prüfer & Prüfer, 2020). First, we organized the corpus by publication date, source, title, and university. Second, we eliminated all stop words (commonly occurring words such as “and,” “for,” and “the”), punctuation, words containing three or more repeated letters, and all single-digit words (e.g., single-letter words) from the primary document text. Third, we *normalized* the dataset and our list of n-grams by stemming all remaining words (e.g., “requires,” “requiring,” “required” all become “requir”).

Our text-as-data analysis employs two techniques using the R packages *Quanteda* and *tidyR*. The *Quanteda* package can be found at <https://quanteda.io/> and the *tidyR* package can be found at <https://cran.r-project.org/web/packages/tidyR/index.html>. These packages have been used in state-of-the-art research (Klingler-VidraR and Chalmers, 2023; Pagliari & Wilf, 2020). First, we assess the significance of cultural, human, and social capital n-grams for each news media article using two measures: (1) a count of the number of times each term appears in an article, with higher term frequencies indicating more occurrences in news coverage of the n-grams; and (2) the Term Frequency-Inverse Document Frequency (TF-IDF) score for each term per article. TF-IDF

is a statistical measure that evaluates the importance of a word in a document relative to its frequency across a collection of documents. For example, if the word “innovation” frequently appears in a specific article but is rarely used in all other articles, its TF-IDF score is high, indicating its significance in that article.

Next, we examine the “co-location” of capital n-grams and entrepreneurship terms within individual sentences in the same news article. This elucidates the degree to which the types of capital text is connected to language about entrepreneurship. To accomplish this, we establish a set of entrepreneurship terms: “business creation,” “entrepreneur,” “enterprise,” “startup,” and “venture.” We measure co-location through a pairwise correlation, which denotes the likelihood of types of capital n-grams appearing alongside entrepreneurship terms.

The pairwise correlation method yields the Phi coefficient, a widely used measure for binary correlation. The Phi coefficient is calculated as:

$$\phi = \frac{n_{11}n_{10} - n_{10}n_{01}}{\sqrt{n_1 \cdot n_0 \cdot n_0 \cdot n_1}}$$

The Phi coefficient assists in assessing the probability of both X and Y appearing together, one appearing without the other, or neither appearing in an article. For instance, if every occurrence of “applied research” (a human capital n-gram) coincided with the term “business creation”, they would exhibit a high positive Phi coefficient. Essentially, Phi coefficients enable us to predict the likelihood of one term’s occurrence based on the occurrence of another term. The Phi coefficient ranges from -1 to 1 , where 0 signifies no relationship, 1 denotes a perfect positive relationship, and -1 represents a perfect negative relationship. For our analysis, we examined the probability of entrepreneurship terms co-occurring with cultural, human, and social capital n-grams *within the same sentence in the news articles*.

Fig. 1 summarizes our data and methods into eight steps, first in terms of our operationalization of the conceptual framework and then (the second row), the empirical text-as-data analysis of the national

Operationalising the conceptual framework

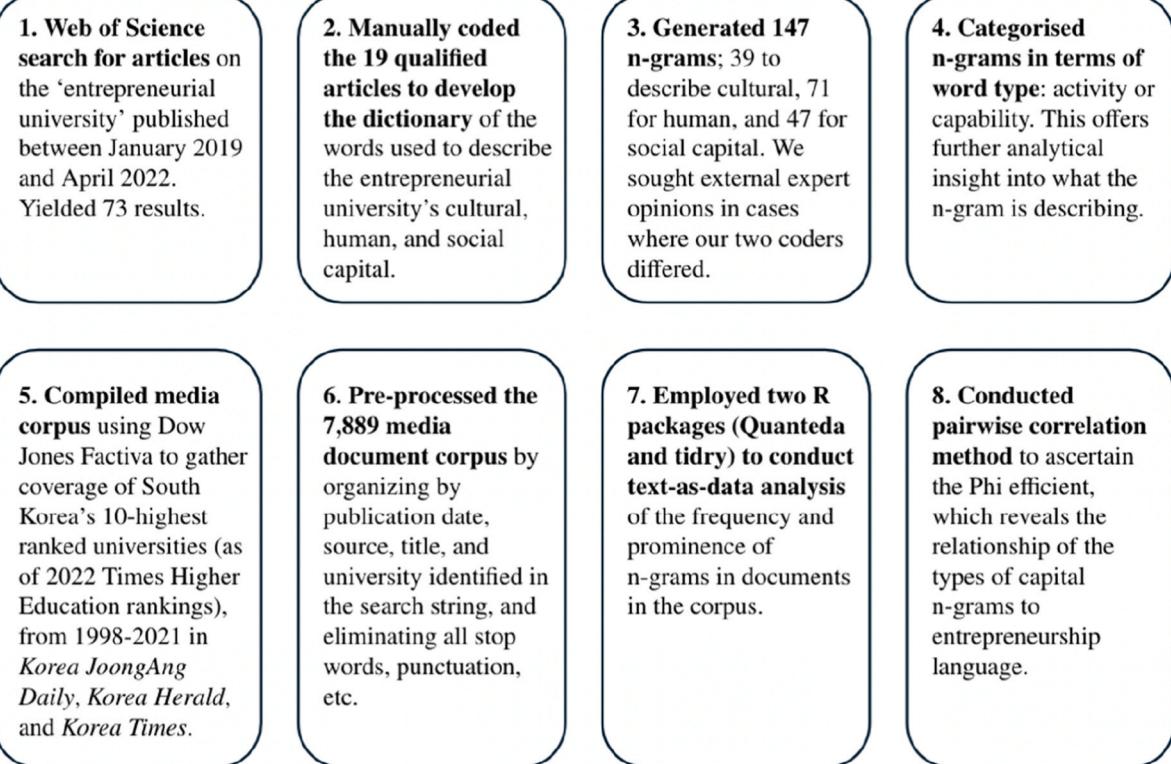


Fig. 1. Flowchart of data and methods.

media corpus.

In addition to the TF-IDF and pairwise correlation analyses, we completed a manual read of a subset of the articles to ascertain whether the results were consistent with our own intuition about the thrust of the piece. We initially read 10 articles to check whether the results of our quantitative analysis were robust. We conducted four more rounds of this random reading of articles until we were satisfied by the alignment between the NLP findings and our manual assessment of each article. In total, we read approximately 50 articles in this way before feeling sufficiently reassured that the text-as-data analysis was capturing what we intended.

5. Results and discussion

Our analysis begins with an exploration of the frequency of cultural, human, and social capital n-grams in our corpus. The proportions of these n-grams from 1998 to 2021 are as follows: human capital emerges as the dominant category, accounting for 51% of all n-grams in our corpus (compared to its 41% representation). Following closely is social capital at 34%, with cultural capital n-grams making up 15%. Fig. 2 displays the proportions of cultural, human, and social capital n-grams annually over the 23-year period (1998–2021). The most notable observation in Fig. 2 is the consistent distribution of the types of capital over time. The relative share of human capital coverage persists, ranging from the highest proportion of 56% in 2006 to the lowest proportion of 42% in 2004, in comparison to social capital, which hovers around 30–40%, and cultural capital, which oscillates between 12% and 18%.

Further examination of this distribution reveals standard deviations of 3.18 for human capital, 3.13 for social capital, and 1.8 for cultural capital. This suggests that the language of cultural capital is the least utilized over time, remaining relatively stable.

Human capital is clearly the most prominent in the entrepreneurial university's media portrayal over time. Still, there are questions about which language is most used within each type of capital. Figs. 3–5 employ heatmaps to visually depict the evolving significance of individual n-grams in the corpus based on their TF-IDF scores. Each row corresponds to an n-gram, while columns represent distinct time periods. A darker color intensity indicates a higher TF-IDF score, signifying that an n-gram holds greater prominence during a specific time frame compared to other periods. Figures include only the top 15 n-grams in terms of TF-IDF scores. This visual representation facilitates the identification of both the relative importance of specific n-grams within a given period and the shifting emphasis of these n-grams over time.

We begin by examining the human capital n-gram heatmap. Fig. 3 reveals that the most frequently used terms are “research,” “program,” “educate,” “lecture,” and “job”, respectively.

These human capital n-grams comprise the core university activities of education and research with an entrepreneurship flavor. This includes academic entrepreneurship activities, such as incubators and commercialization, as well as in the realm of entrepreneurship education, including the launch of degree programs explicitly focused on entrepreneurship. For example, a 2017 *Korea JoongAng Daily* article covering KAIST mentioned that the university operates “a startup *incubator*, as well as K-School, a one-year master’s *course* that *teaches* the requirements for starting a business in collaboration with 19 departments” (Seo, 2017). Expressing their motivation, a professor at Hanyang University stated in a 2017 interview with the *Korea Herald* that “what we have to do now is to give the artificial intelligence industry a jump-start by advancing *research*, development, and *commercialization*” (Shin, 2017). Perhaps unsurprisingly, 11 of the 15 most-used n-grams (or 73%) are activity terms, whereas only four are capability n-grams. Collectively, this points to the predominant coverage of the entrepreneurial university in Korea as comprising education and research activities related to entrepreneurship. In this way, there is a core, or main, university mission character to this bulk of media communications. This does not necessarily convey its contribution to the university’s third mission, which is expected to be more about community engagement and regional socio-economic development (Borlaug & Elken, 2024; Seri & Compagnucci, 2024).

This raises questions about whether there is a similar thrust of activity-based language in the second most-prevalent type of capital: social capital. Like human capital, Fig. 4 shows that activity-type words dominate the top 15 n-grams. Among the top 15 terms, 11 (73%) are activity n-grams, while only four are capability n-grams. However, unlike human capital, among the top five, there is a mix of activity and capability terms as “institute”, “center”, and “team” are amongst the most-used terms.

Other frequently appearing social capital n-grams include activity-related terms such as “association,” “conference,” “event,” and “society.” As an example, illustrating the prevalence of activity terms in news reports discussing social capital-themed entrepreneurial university coverage, a 2016 *Korea Herald* article on Yonsei University’s efforts simply stated that “the renovated space includes the Seoul Startup Cafe, which provides *office space* and *mentoring* programs for student entrepreneurs” (Doo, 2016). Terms such as “office space” and “mentoring” received more media attention than n-grams describing intended

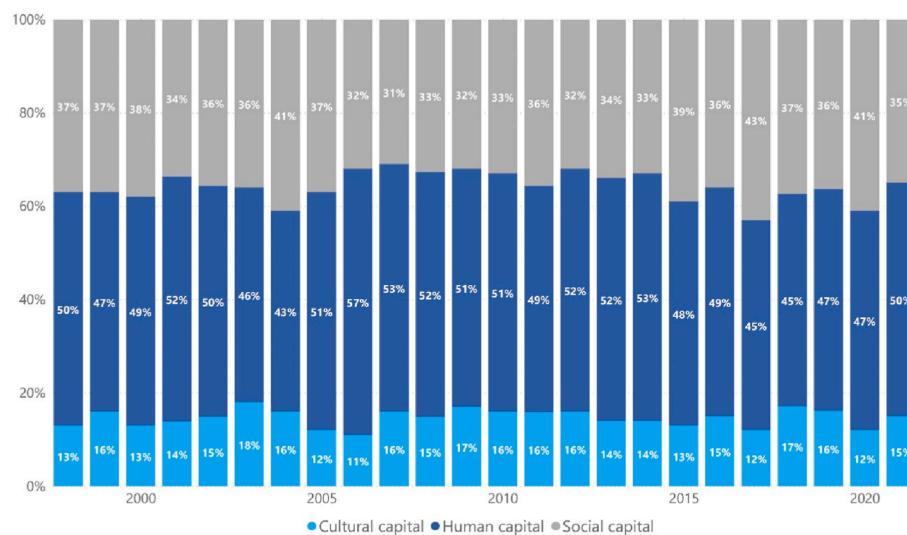


Fig. 2. Comparison of cultural, human, and social capital n-grams over time.

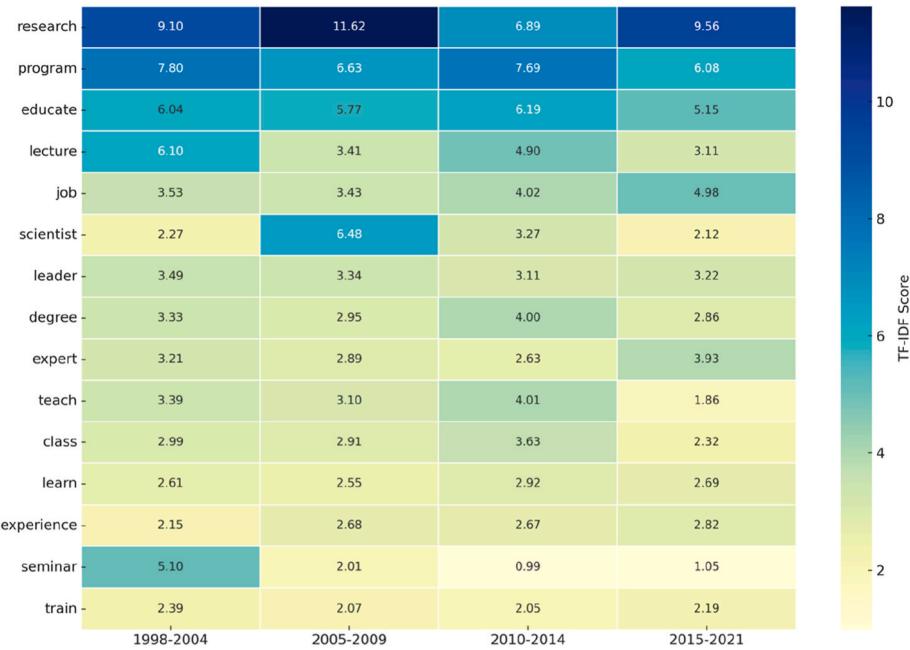


Fig. 3. Top 15 human capital N-grams.

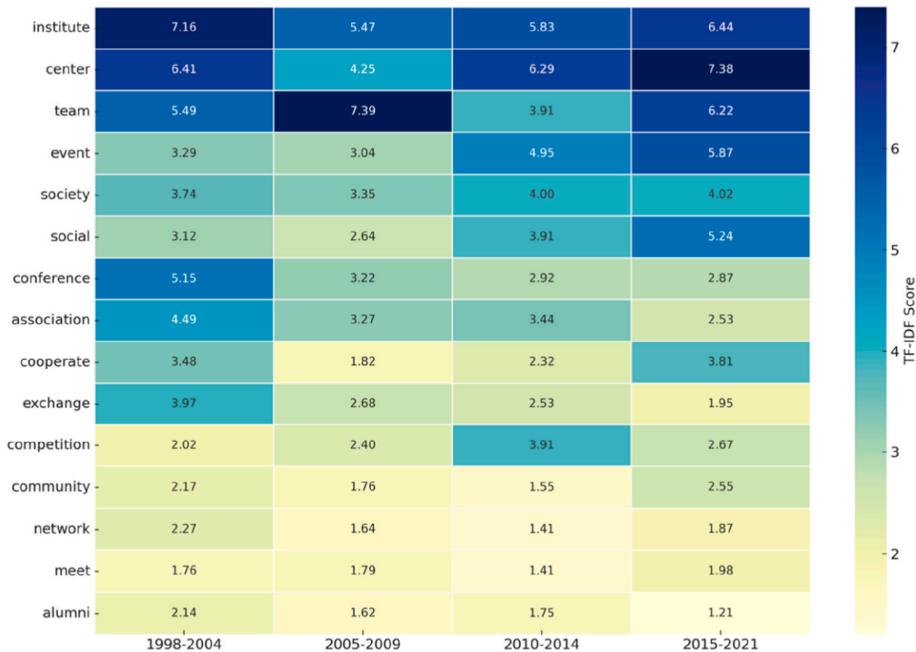
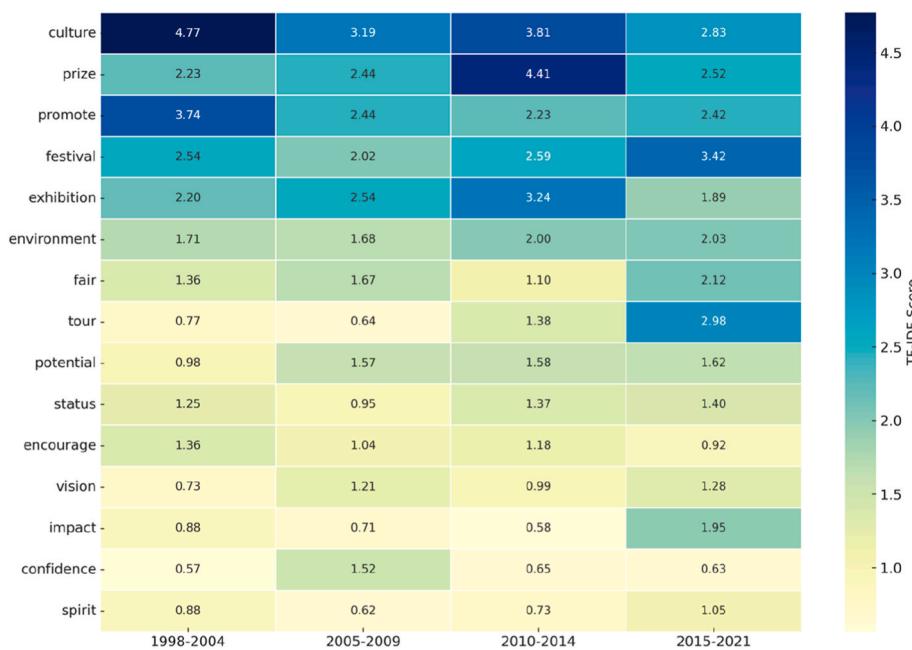


Fig. 4. Top 15 social capital N-grams.

**Fig. 5.** Top 15 cultural capital N-grams.

capabilities such as “collaborations,” “links,” and “networks.” In sum, coverage of the entrepreneurial university related to social capital emphasizes activities and the physical spaces in which people meet, with less discussion of the capability-enhancing objectives of the efforts. The nature of the language used to describe the social capital domain for Korea’s entrepreneurial universities has more of a community and bridge-building character to it (Bruning et al., 2006; Bukhari et al., 2021), which has more of a third mission character than the human capital lexicon did.

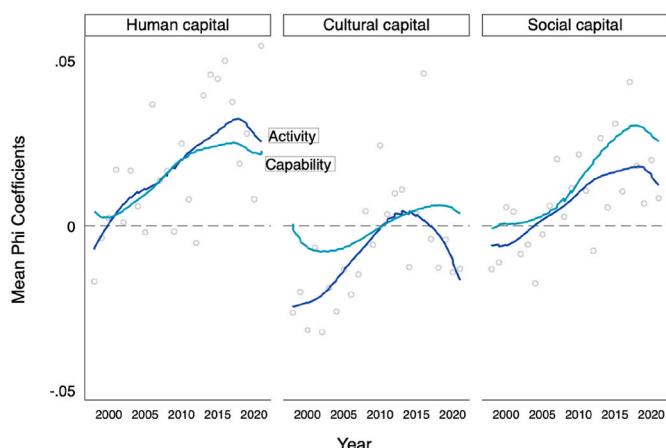
In Fig. 5, which illustrates results related to cultural capital, n-grams such as “culture,” “prize,” “promote,” “festival,” and “exhibition” consistently stand out.

Among these, “culture” emerges as the most dominant. Notably, it is the sole capability n-gram, whereas the other terms represent activities. Like human and social capital, the language of activity, rather than capabilities, is most-used to portray the entrepreneurial university in the

media. To provide insight into how these cultural capital n-grams appeared in media coverage, a senior leader at KAIST explained in a 2021 interview with *Korea JoongAng Daily* that his motivation for creating a startup program involving students visiting Silicon Valley stemmed from his eagerness to expose Korean students to that “culture and mindset” (Park, 2021). Some news coverage, however, mentioned the capabilities that universities aimed to foster through activities. For instance, a 2017 news article covering Seoul National University explained that one of the participants was “just one of many entrepreneurs *pitching* their ideas” and that “they enthusiastically extolled the *virtues* of their startup ideas to their audience” (Jeong, 2017). In contrast to the human capital language, the cultural capital media coverage conveys interactions and wider shifts towards entrepreneurship, and more of a distinct third mission, going beyond education and research programming.

Overall, the language of human capital is central to the portrayal of the entrepreneurial university in the media. This may reinforce the sense that the entrepreneurial university remains focused on its core education and research activities, rather than engaging in a wider array of formats to build bridges and drive mindset shifts. In short, the human capital prevalence may unwittingly convey the persistence of the university’s long-standing mission, and now its third mission of public engagement and driving socio-economic development through entrepreneurial elements. It may reinforce concerns that the entrepreneurial university operates in an intrapreneurial way, rather than entrepreneurial (Henry & Lahikainen, 2024).

Having explored the prevalence of cultural, human, and social capital n-grams in the news media, we now evaluate the likelihood of their co-occurrence with entrepreneurship terms. To achieve this, we examine pairwise correlations expressed as Phi coefficients, indicating the colocation of entrepreneurship language and cultural, human, and social capital n-grams. As mentioned earlier, this measures how much the presence of entrepreneurship terms in a sentence *predicts* the appearance of cultural, human, or social capital n-grams in the same sentence. Fig. 6 presents our findings (please also see Appendix A.4 for a more granular analysis of these variables). Each data point in the figure represents the

**Fig. 6.** Pairwise correlation of n-grams for activity and capability types.

mean Phi coefficient by year, categorized by cultural, human, and social capital types and distinguishing between activity and capability n-gram types.

Fig. 6 reveals several trends. First, the likelihood of n-grams co-occurring with entrepreneurship terms is highest for human capital n-grams. Indeed, human capital n-grams exhibit a relatively high mean Phi coefficient (0.02) across all the years studied. Social capital demonstrates a similar pattern, with a mean Phi coefficient of 0.01; however, the mean Phi coefficient for cultural capital is notably lower, at -0.002. Said differently, the language of human capital appears most often, and closely, alongside entrepreneurship terms. This further augurs for the entrepreneurial university's portrayal in education and research terms, rather than through other mechanisms that build bridges with external stakeholders and fosters mindset change.

Furthermore, the results also reinforce TF-IDF findings that activity terms are used more often than the language of capabilities. **Fig. 6** shows that activity terms have become more prevalent in human capital media coverage since approximately 2010. Around the same inflection point, however, capability terms became more prominent in media coverage of cultural and social capital n-grams. Further studies are needed to systematically reveal the causes of this divergence. Here, we offer initial reflections about what may be driving the rise in activity language for human capital, but capabilities terms in coverage of cultural and social capital domains. The shift follows the election of Lee Myung-bak, who had previously served as the CEO of Hyundai Engineering and Construction and Mayor of Seoul. The onset of the Global Financial Crisis resulted in South Korean policymakers doubling down on encouraging entrepreneurial activity, including cooperation with universities along with government and big business, that had been initiated in the late 1990s. Structured degree courses were complemented with a rise in study tours and research exchanges aimed at cultivating an entrepreneurial mindset. From 2013, Park Geun-hye announced her "creative economy" initiative, which encouraged risk-taking and an entrepreneurial culture, with multiples clusters spread across the country (Klingler-Vidra, 2020; Pacheco Pardo Klingler- and Vidra, 2019; Park & Jeong, 2015). More research is needed to ascertain how the national political context may have influenced how universities' entrepreneurial efforts were affected. Collectively, policy may have oriented universities towards organizing entrepreneurial degrees and commercialization activities in an effort to enhance Korea's wider entrepreneurial culture and related social networks.

Finally, **Fig. 6** shows an upward trajectory in the Phi coefficients for both human and social capital between 1998 and 2019, though this trend is less pronounced for cultural capital. Said another way, there has not been the same growth in media coverage of cultural capital activities and capabilities, despite the government's Creative Economy push. The Phi coefficients for cultural capital tend to be predominantly negative, signifying that it is more likely for cultural capital n-grams to appear in the *absence* of entrepreneurship language. This reflects the prominence of cultural capital n-grams such as "culture" and "promote" in broader university discourse, not only in relation to entrepreneurship-focused efforts. Again, this suggests that relative to human and social capital, cultural capital is not as closely linked to the portrayal of the entrepreneurial university. The entrepreneurial university is portrayed as emphasizing education, research, centers and institutes, but less about fostering wider connections to catalyze an entrepreneurial culture, mindset, and greater risk-taking. The education and research flavors of entrepreneurship could be perceived as an extension of the university's remit, and not necessarily in terms of a distinct third mission.

6. Conclusions and implications

There is a paucity of research on how the entrepreneurial university is portrayed to the broader society. Does media portrayal of the entrepreneurial university showcase a widening spectrum of mechanisms and aims for engaging regional communities and economies? Or, is the entrepreneurial university portrayed as one that is delivering education and research activities with an entrepreneurship lens? The aim of this paper is to offer initial answers to these questions, by offering analytical tools, and an initial empirical test of how entrepreneurial university leadership are communicating their efforts to wider society. We discuss the theoretical, methodological, and practical implications in term.

Theoretically, our findings advance the scholarly understanding of how the elements that constitute the entrepreneurial university relate to its third mission (Benneworth et al., 2015; Borlaug & Elken, 2024; Compagnucci & Spigarelli, 2020). We advance a sociological capital framework to ground an analysis of what comprises the entrepreneurial university and how those domains—cultural, human and social capital—align with the third mission. We find that human capital activities are the most frequently reported. In this way, the portrayal of the (Korean) entrepreneurial university's value to wider society emphasizes the university's core education and research activities, not necessarily its contribution to boosting social networks and mindsets that encourage entrepreneurship. Even in the Korean case, where national policy has emphasized the importance of a creative economy since 2013, entrepreneurial universities spoke about culture, grit, mindset and risk taking relatively less than core education and research activities. Given societal scrutiny over the public value of universities, is this human capital activity focus ideal, or even sufficient for showcasing efforts to deliver on the third mission? The centrality of human capital language may reinforce the entrepreneurial university in its traditional terms; centering on education and learning for its own community. The portrayal is not one that emphasizes bridge-building and the cultivation of entrepreneurial mindsets, to convey the breadth of the third mission and its broader impact on socio-economic development.

Methodologically, we extend work by emerging studies that have begun exploring the language used to describe the efforts of the entrepreneurial university and its third mission. Notably, we contribute to recent state-of-the-art research by Compagnucci and Spigarelli (Compagnucci & Spigarelli, 2020) and Forlano and co-authors (ForlanoDe et al., 2021) who conducted text-based analyses of the language used in academic research to describe the entrepreneurial university. These studies offer insight into knowledge of the entrepreneurial university, but not whether this same language is used in external communications. We contribute by operationalizing a dictionary for analyzing the language used by universities, particularly in how they portray their entrepreneurial university activities to wider society. In addition, we contribute by offering an initial set of analytical expectations for the relative emphasis on cultural, human and social capital in the entrepreneurial university's portrayal.

Finally, these findings have practical implications for university leadership teams. By uncovering how the entrepreneurial university is portrayed, leaders can critically assess whether these human capital-centric portrayals align with their strategic intentions. Understanding the current narrative allows leadership to refine key aspects of their communications strategy, such as making a concerted effort to run stories about promoting networking opportunities and fostering wider society's entrepreneurial mindset, or intentionally weaving more language about capability-building into coverage of events and institute

news. If university leadership aim to boost the perception that they are contributing to local communities in increasingly diverse, innovative ways, then communications teams can make a concerted effort to use this engagement language, rather than the more traditional education and research lexicon. In addition to reconsidering communications, these insights offer an opportunity to potentially reshape the university's entrepreneurial offerings. This approach supports the scholarly call for university leaders to actively manage the entrepreneurial university model (Guerrero et al., 2024; Leih, 2016; Meek & Gianiodis, 2023), ensuring it delivers meaningful value to both the institution and wider society. This is especially important given the acknowledgements of the tensions and limited resources that university leadership teams face (Benneworth et al., 2015). In short, the findings raise questions about the extent to which, and ways in which, current programs of entrepreneurship are delivering on the strategic objectives of this third mission.

There are some limitations to our approach. First, as discussed in the Data and methods section, due to the sensitivity of the analysis to language, our n-grams are restricted to English-language analysis (this was also in line with recent state-of-the-art studies of media coverage using NLP techniques (Klingler-VidraR and Chalmers, 2023; Massey & Chang, 2002)). Future research should aim to adapt the n-grams for studies in other languages. Second, while we aimed to expand our geographical coverage beyond the European and North American contexts by examining the case of South Korea, this study focuses on a single country, which entails a trade-off between external validity and internal validity. Nonetheless, the depth of our analysis of the Korean context, encompassing a long timeframe (20 years) and a multitude of universities (10), provides robust internal validity. Conducting research in other empirical contexts will elucidate the extent to which our findings apply to broader phenomena, consequently enhancing external validity. Future studies should investigate whether media coverage in other contexts similarly emphasize human capital activities. Third, this study serves as an initial endeavor to codify a dictionary representing the activities and capabilities of the entrepreneurial university in cultural, human, and social capital terms. While we have confidence in the robustness of our hand-coding process based on state-of-the-art literature (Gentzkow et al., 2019; Prüfer & Prüfer, 2020), it is inevitable that there will be advancements in refining the dictionary used to analyze the language of

the entrepreneurial university in the future.

We anticipate that future research can employ our dictionary to provide fresh insights into the content and effectiveness of public engagement by entrepreneurial universities. Researchers can utilize this dictionary to analyze media coverage of entrepreneurial university activities and capabilities in various national contexts and make comparative assessments across sets of universities. Studies could also examine the relationship between national policies, such as Korea's Creative Economy Action Plan, and universities' media portrayal. They may also explore other text sources. In addition to analyzing national media, future studies can examine social media to investigate how society interacts with entrepreneurial universities. Conducting sentiment analysis on media data can help gauge perceived value. This approach would establish a connection between what the university communicates and societal perceptions of its contribution to the local community. It would offer the crucial assessment of whether the public sees, and values, a distinct third mission.

CRediT authorship contribution statement

Robyn Klingler-Vidra: Writing – review & editing, Writing – original draft, Validation, Methodology, Funding acquisition, Data curation, Conceptualization. **Adam William Chalmers:** Writing – review & editing, Visualization, Methodology, Formal analysis, Data curation. **Ramon Pacheco Pardo:** Writing – review & editing, Funding acquisition, Data curation.

Declaration of competing interest

The authors have no competing interests or conflicts of interest.

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Appendix

Table A1

Korea's 10 highest-ranked universities (Times Higher Education Rankings 2022)

World Rank	South Korea Rank	University	City	Factiva media results (#)
= 54	1	Seoul National University (SNU)	Seoul	3438
= 99	2	Korea Advanced Institute of Science and Technology (KAIST)	Daejeon	503
= 122	3	Sungkyunkwan University (SKKU)	Seoul	311
= 151	4	Yonsei University	Seoul	1181
= 178	5	Ulsan National Institute of Science and Technology (UNIST)	Ulsan	21
= 185	6	Pohang University of Science and Technology (POSTECH)	Pohang	91
201–250	7	Korea University	Seoul	1143
251–300	= 8	Kyung Hee University	Seoul	429
251–300	= 8	Sejong University	Seoul	121
351–400	10	Hanyang University	Seoul	327

Table A2

N-grams by capital (blue = activity, teal = capability)

#	Human Capital	Social Capital	Cultural Capital
1	abilit*	access	ambition
2	accelerat*	advice	aspir*
3	acumen	advise	attitude
4	applied research	alliance	attract
5	basic science	alumni	awareness
6	boot-camp	association	behavior
7	business plan	bond	confidence
8	case study	bridge	cultivat*
9	capabilit*	center	culture
10	class	club	encourag*
11	commerciali*	cluster	engage
12	competenc*	coach	environment
13	concentration	coalition	exhibition
14	contract	collaborat*	fair
15	copyright	collective	festival
16	course	colliqium	grit
17	curricul*	community	impact
18	degree	competition	intention
19	diploma	conference	interest
20	educat*	connect*	mindset
21	experience	consult*	motivate
22	expert	contact	motivation
23	guest lecture	cooperat*	norm
24	guest speaker	counsel	passion

25	incubat*	ecosystem	perseverance
26	innovat*	event	potential
27	intellectual property	exchange	prestige
28	IP right*	guest speaker	prize
29	intern*	hackathon	promot*
30	invent*	hub	reward
31	job	industrial liaison	risk-tak*
32	knowledge	institute	role model
33	learn*	interact	spirit
34	lecture	liaison	status
35	licens*	link	success stor*
36	leader*	meet	thinking
37	method	mentor	tour
38	module	mobility	values
39	patent	network	vision
40	pitch	networking	
41	placement	partner*	
42	practice	relation	
43	practicum	social	
44	program	society	
45	qualification	stakeholder engage	
46	R&D	team	
47	research	tie	
48	science park		
49	scientist		
50	seminar		

51	skill*
52	spin-off
53	spin-out
54	talent
55	teach
56	technique
57	technology transfer
58	trademark
59	train*
60	work experience
61	workshop

Table A3

Entrepreneurial university literature hand-coded to generate cultural, human and social capital n-grams (most recent listed first)

#	Year	Author(s)	Title	Journal	Geo-graphic focus	Data and methods	Capital type(s)	Web of Science result
1	2022	Arroyabe, Schumann, Arranz	Mapping the entrepreneurial university literature: a text-mining approach	<i>Studies in Higher Education</i>	Global	Text-mining 1110 papers	All	yes
2	2022	Salamzadeh, Sangosanya, Salamzadeh	Entrepreneurial universities and social capital: The moderating role of entrepreneurial intention in the Malaysian context	<i>The International Journal of Management Education</i>	Malaysia	Questionnaire completed by 382 students	Social	yes
3	2022	Etzkowitz, Dzisah, Clouser	Shaping the entrepreneurial university: Two experiments and a proposal for innovation in higher education	<i>Industry and Higher Education</i>	United Kingdom, United States	Theory-building/historical narrative	All	yes
4	2021	Forlano, Bernardi, Yahiaoui	Entrepreneurial universities: A bibliometric analysis within the business and management domains	<i>Technological Forecasting & Social Change</i>	Global	Bibliometric analysis of 511 documents	All	yes
5	2021	Etzkowitz, Zhou	Licensing life: The evolution of Stanford university's technology transfer practice	<i>Technological Forecasting & Social Change</i>	United States	Case study (interviews, archives and participant observation)	Cultural, Human	
6	2021	Audretsch, Belitski	Three-ring entrepreneurial university: in search of a new business model	<i>Studies in Higher Education</i>	Global	Theory-building	Human	yes
7	2021	Bukhari, Dabic, Shifrer, Daim, Meissner	Entrepreneurial university: The relationship between smart specialization innovation strategies and university-region collaboration	<i>Technology in Society</i>	Croatia	Questionnaire responses by 162 faculty and staff members	Social	yes
8	2021	Padilla-Meléndez, Fuster, Lockett, del-Aguila-Obra	Knowledge spillovers, knowledge filters and entrepreneurial university ecosystems. Emerging role of University-focused venture capital firms	<i>Knowledge Management Research & Practice</i>	United Kingdom	Interviews with "agents" at 15 universities	Human, Social	yes
9	2021	Lechuga Sancho, Ramos-Rodriguez, Vega	Is a favorable entrepreneurial climate enough to become an entrepreneurial university? An international study with GUESSS data	<i>International Journal of Management Education</i>	Global	Global University Entrepreneurial Spirit Students' (GUESS) Survey results	All	yes
10	2020	Hulen and Tumunbayarova	Building students' entrepreneurial mindsets: Results from an intervention at a Russian university	<i>International Journal of Management in Education</i>	Russia	Quasi-experimental; course delivery	Cultural	
11	2020	Martinez-Martinez and Ventura	Entrepreneurial Profiles at the University: A Competence Approach	<i>Frontiers in Psychology</i>	Spain	Questionnaire responses by 1104 students	All	
12	2020	Gianiodis, Meek	Entrepreneurial education for the entrepreneurial university: a stakeholder perspective	<i>Journal of Technology Transfer</i>	Global	GUESS Survey results	Cultural, Human	yes

(continued on next page)

Table A3 (continued)

#	Year	Author(s)	Title	Journal	Geo-graphic focus	Data and methods	Capital type(s)	Web of Science result
13	2020	Guerrero, Urbano, Gajon	Entrepreneurial university ecosystems and graduates' career patterns: do entrepreneurship education programmes and university business incubators matter?	<i>Journal of Management Development</i>	Mexico	Graduate career choice sample of 11,512 graduates	Cultural, Human	yes
14	2020	Morland, Scott, Thompson	Experiential Entrepreneurship Education and the student-focused Entrepreneurial University	<i>Education and Training</i>	Global	Meta-literature review to distil case study-level insights	Human	yes
15	2019	Redondo and Camarero	Social Capital in University Business Incubators: dimensions, antecedents and outcomes	<i>International Entrepreneurship Management Journal</i>	Netherlands, Spain	Survey questionnaire responses by 101 incubates	Social	
16	2019	Klofsten, Fayolle, Guerrero, Mian, Urbano, Wright	The entrepreneurial university as driver for economic growth and social change – Key strategic challenges	<i>Technological Forecasting and Social Change</i>	Global	Theory-building/introduction to special issue	All	yes
17	2019	Fuster, Padilla-Meléndez, Lockett, Rosa del-Aguila-Obra	The emerging role of university spin-off companies in developing regional entrepreneurial university ecosystems: The case of Andalusia	<i>Technological Forecasting and Social Change</i>	Spain	University spin-off mapping to inform social network analysis	Human, Social	yes
18	2019	Etzkowitz, Germain-Alamartine, Keel, Kumar, Smith, Albats	Entrepreneurial university dynamics: Structured ambivalence, relative deprivation and institution-formation in the Stanford innovation system	<i>Technological Forecasting and Social Change</i>	United States	Stanford University case study	All	yes
19	2019	Guerrero, Herrera, Urbano	Strategic knowledge management within subsidized entrepreneurial university-industry partnerships	<i>Management Decision</i>	Mexico	University-industry case studies	All	yes
20	2019	Centobelli, Cerchione, Esposito, Shashi	The mediating role of knowledge exploration and exploitation for the development of an entrepreneurial university	<i>Management Decision</i>	China	Analysis of 279 questionnaire responses by academics	Human	yes
21	2019	Sanchez-Barrioluengo, Uyarra, Kitagawa	Understanding the evolution of the entrepreneurial university. The case of English Higher Education institutions	<i>Higher Education Quarterly</i>	United Kingdom	Quantitative analysis of HEBCI Survey results	Human, Social	yes
22	2019	Muscio, Ramaciotti	How does academia influence Ph.D. entrepreneurship? New insights on the entrepreneurial university	<i>Technovation</i>	Italy	Questionnaire responses by 9062 PhD students	All	yes
23	2019	Uslu, Calikoglu, Seggie, Seggie	The entrepreneurial university and academic discourses: The meta-synthesis of Higher Education articles	<i>Higher Education Quarterly</i>	Global	Meta-synthesis of literature	Human, Social	yes
24	2019	Yoshioka-Kobayashi	Institutional Factors for Academic Entrepreneurship in Publicly owned Universities in Japan: Transition from a Conservative Anti-industry University Collaboration Culture to a Leading Entrepreneurial University	<i>Science Technology and Society</i>	Japan	Chronological case study, including interviews and media document analysis	All	yes
25	2019	Bizri, Hammoud, Stouhi, Hammoud	The entrepreneurial university: a proposed model for developing nations	<i>Journal of Management Development</i>	Lebanon	Survey of faculty and students	All	yes
26	2016	Guerrero, Urbano, Fayolle, Klofsten, Mian	Entrepreneurial universities: emerging models in the new social and economic landscape	<i>Small Business Economics</i>	Global	Theory-building/introduction to special issue	All	
27	2016	Hayter	A trajectory of early-stage spin-off success: The role of knowledge intermediaries within an entrepreneurial university ecosystem	<i>Small Business Economics</i>	United States	Social network analysis; survey and interviews of students and faculty	Human, Social	
28	2015	Guerrero, Cunningham, Urbano	Economic impact of entrepreneurial universities' activities: An exploratory study of the United Kingdom	<i>Research Policy</i>	United Kingdom	Economic impact assessment of 147 universities	Human	
29	2014	Audretsch	From the entrepreneurial university to the university for the entrepreneurial society	<i>Journal of Technology Transfer</i>	Germany, United States	Theory-building/historical narrative	Human	
30	2013	Hayter	Conceptualising knowledge-based entrepreneurship networks: Perspectives from the literature	<i>Small Business Economics</i>	Global	Literature review	Human, Social	
31	2012	Guerrero and Urbano	The development of an entrepreneurial university	<i>Journal of Technology Transfer</i>	Spain	SEM of Spanish Entrepreneurial University Scoreboard data and 200 questionnaires	All	
32	2011	Pittaway, Rodriguez-Falcon, Aiyegebayo, King	The role of entrepreneurship clubs and societies in entrepreneurial learning	<i>International Small Business Journal</i>	United Kingdom	Unstructured interviews, a telephone interviews and e-mails	All	
33	2006	Binks, Starkey, Mahon	Entrepreneurship education and the business school	<i>Technology Analysis & Strategic Management</i>	Global	Theory-building/special issue	Human, Social	

(continued on next page)

Table A3 (continued)

#	Year	Author(s)	Title	Journal	Geo-graphic focus	Data and methods	Capital type(s)	Web of Science result
34	2004	Kenney and Goe	The role of social embeddedness in professorial entrepreneurship: a comparison of electrical engineering and computer science at UC Berkeley and Stanford	<i>Research Policy</i>	United States	Historical research, a survey of faculty, and an Internet-based research	Social	

Table A4
OLS regression of Type and Capital on Phi*

Variables		Model 1
Type	Capability	0.003 (0.001)
Capital	Human	0.02 (0.002)
	Social	0.01 (0.02)
	Constant	-0.004 (0.001)
	Adj R-squared	0.01
	Observations	10560

Note: Regression coefficients with standard errors in parentheses.

p-values: 0.05; 0.01; 0.001.

*We conducted a linear regression analysis to further explore the relationships between the Phi coefficients (our dependent variable) and our main independent variables. To do this we employed a simple Ordinary Least Squares (OLS) regression model. The regression equation is as follows.

$\Phi = \beta_0 + \beta_1(\text{Type}) + \beta_2(\text{Capital: Human}) + \beta_3(\text{Capital: Social}) + \epsilon$.

In this model, *Phi* is the dependent variable, representing the outcome we aim to predict, namely the likelihood of the co-occurrence of two n-gram sets. The equation includes an intercept, β_0 , which is the constant term. Each independent variable has its own coefficient: β_1 represents the effect of the dummy variable for *Type*, while β_2 and β_3 are the coefficients for *Capital: Human* and *Capital: Social*, respectively. Finally, ϵ epsilonone is the error term, capturing the variance in *Correlation* not explained by the independent variables in the model. This model is appropriate because the dependent variable, *Phi*, is continuous, with a mean of 0.0098, a standard deviation of 0.0836, and a range from -0.176 to 1. Additionally, both independent variables (*Type* and *Capital*) are factor variables, allowing OLS to estimate the linear relationships between each category and the dependent variable effectively. The model provides unbiased estimates, making it suitable for analyzing how variation across categories of *Type* and *Capital* relates to changes in *Phi*.

The results, presented in Table A4. Based on the regression results, the coefficient for *Type*: *Capability* is 0.003, indicating a small positive association with the dependent variable, *Phi*, relative to the base category of *Activity*. However, this effect is not statistically significant. For *Capital*, *Human Capital* shows a positive and statistically significant effect on *Phi* with a coefficient of 0.02 (SE = 0.002, $p < 0.001$), suggesting that *Human Capital* is associated with an increase in *Phi* compared to the base category *Cultural Capital*. Similarly, *Social Capital* has a positive and statistically significant effect, with a coefficient of 0.01 (SE = 0.02, $p < 0.001$), indicating that it also positively impacts *Phi* relative to *Cultural Capital*. The constant term is -0.004 (SE = 0.001, $p < 0.01$), showing the expected value of *Phi* when all predictors are at their 'baseline' levels.

These findings align with findings obtained through other analysis presented in Fig. 6. First, the predicted impact on *Phi* coefficients is considerably higher for human capital and social capital compared to cultural capital. Second, while capability n-grams have a slightly larger predicted impact on *Phi* coefficients compared to activity terms, these differences are small and, furthermore, not statistically significant when considering 95% confidence intervals. Collectively, our different results point to the predominance of human capital, relative to social and cultural capital, and the relative dominance of activity language, rather than capabilities.

Data availability

We can post the underlying media data as an online supplement.

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