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Development of Entrepreneurial Skills in Adolescence and Impact on Economic Transformation: A Systematic Review

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Development of Entrepreneurial Skills in Adolescence and Impact on Economic Transformation: A Systematic Review

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Foreword

An educated population is key to transforming economies, building inclusive and harmonious societies and ensuring lasting protection of the planet and its natural resources, that is, to realise the ultimate goals of the UN Agenda 2030 for Sustainable Development. Academic and technical knowledge and skills are key for technological advancements, whereas entrepreneurship is crucial to bringing promising technologies, products, services and novel processes to the market as well as societies.

Different routes are open to developing skills during the life span of an individual. But, schooling is a crucial one because it targets youth at the time when human brain is most plastic, laying the foundation for self-reinforcing motivation and ability to continue learning throughout life.

With its mandate to promote inclusive and sustainable industrial development, UNIDO places great importance in fostering academic, industrial and entrepreneurial skills of the youth for structural change, technological upgrading and entrepreneurial ecosystems. Today's shift from simple assembly and processing to technology-intensive industries calls for skilled persons capable of using state-of-the-art technologies as well as developing new applications, processes and products. Fostering an entrepreneurial mindset in youth is the catalyst for translating innovation into action. Schools at all levels are an ideal place for young people to explore their entrepreneurial potential — and they should be viewed as catalysts for an entrepreneurial society.

Through its programmes and projects, UNIDO has long helped governments in their efforts to enhance technical and vocational skills of young people for manufacturing and related services as well as work with secondary schools and universities to introduce entrepreneurship learning curricula, as in the case of UNIDO’s Entrepreneurship Curriculum Programme (ECP).

This working paper reviews current conceptual frameworks and empirical studies on the effects that entrepreneurship school programmes may have in fostering an entrepreneurial mindset in adolescents. It offers a basis for reflection and discussion among educational policy makers and practitioners for designing entrepreneurship curricula in secondary schools.

Abstract

With an increased emphasis on entrepreneurial thinking and acting in today's careers, we have witnessed a growing body of research on entrepreneurship education over the last two decades. However, most studies have focused on mature age groups and paid less attention to the early stages of youth and adolescence. The present study systematically reviews the literature on the theoretical foundations, measurement, antecedents, and outcomes of the Development of Entrepreneurial Skills in Adolescence while addressing three core questions.

Specifically, this review aims to address the following research questions:

1. What are entrepreneurial mindsets and enterprising behaviours? How and when are they formed during an individual's lifespan? What are their potential impacts on an individual's work and social life, as well as the potential effects on labour market outcomes and social behaviours, especially in developing countries and rural contexts?

2. Can entrepreneurship education programs, especially in developing countries and rural contexts, help foster enterprising behaviours and entrepreneurial alertness in adolescents? If so, why, how, and to what extent?

3. Does entrepreneurship education have the same impact on female and male adolescents in developing perceptions of entrepreneurial competencies and intentions? If not, what are the differences?

Based on the review, we develop an agenda for future research, and highlight implications for entrepreneurship education and training. Overall, the reviewed studies suggest that entrepreneurship education programs can effectively develop non-cognitive entrepreneurial skills at an early age, supporting the idea that such skills can be nurtured and cultivated among young students in both underdeveloped and developed contexts.

The review identifies the need to:

a) Conduct more research utilising a stronger emphasis on relevant theories in entrepreneurship.

b) Conduct more research using more rigorous research designs and considerations of causality through experimental studies, especially in rural settings.

c) Conduct more research on gender-specific effects of entrepreneurship programs in the respective sociocultural local contexts.

d) Have entrepreneurship education program designers and executives pay attention to contextual factors.

e) Integrate and investigate the impact of recent topics in entrepreneurship literature, such as digitalisation and new technologies, on entrepreneurship programs designed for early ages and adolescents.

1. Background

Given the importance of entrepreneurial thinking and acting in modern society, developing entrepreneurial skills in young generations is widely regarded as a global priority (European Commission, 2015, 2017; World Economic Forum, 2009). Education systems around the globe have, therefore, developed several strategic approaches to fostering entrepreneurial learning in various settings and contexts, including formal and informal entrepreneurship and enterprising education (QAA, 2018). Comprehensive competence frameworks, such as EntreComp (McCallum et al., 2018), provide guidelines for practitioners and policymakers on fostering entrepreneurial skills development.

Despite this clear focus on entrepreneurial skill development on the political agenda, as society's "investments in young people" (Cunha & Heckman, 2010), the scientific study of the early development of entrepreneurial skills is still a smaller niche field of study. Over the last decade, academic research has been devoting growing attention to concepts, theories, and empirical evidence targeting the development of entrepreneurial skills in various age groups and contexts, including relevant skill growth in the early formative years – childhood and adolescence (Brüne & Lutz, 2020; Lerner & Damon, 2012; Obschonka, 2016; Obschonka et al., 2017). Such research is embedded in the broader field of entrepreneurship research, which, as a relatively young scholarly field of investigation, has experienced a major boom since 2000 contributing to its development into a bona fide field of study (Audretsch, 2021; Landström, 2020). Research on the development of entrepreneurial skills also builds on other fields, such as education research, psychology, and economics. This multi-disciplinary existing research on entrepreneurial skills involves for example relatively rigorously designed evaluation studies of skill development programs (Huber et al., 2014; Oosterbeek, Van Praag, et al., 2010; Schroder & Schmitt-Rodermund, 2006), often with a focus on cognitive vs. non-cognitive skills. Other research in this field examined developmental precursors and trajectories of early entrepreneurial competencies in childhood and adolescence, often through longitudinal data and representative samples (Obschonka, Silbereisen, et al., 2012; Schoon & Duckworth, 2012). There is also growing empirical evidence on the psychological definition of an entrepreneurial mindset *in adolescence* (Geldhof et al., 2014; Salami, 2019) as well as adjacent topics such as the role of gender (Lechner et al., 2018), entrepreneurial personality, and relevant interplay with and between developmental and educational contexts (Hopp et al., 2019; Obschonka, 2016).

The development of entrepreneurial skills is located as part of a person’s vocational education in adulthood (specific, work-related skills). There is converging theoretical and empirical evidence pointing to the imprinting role of learning in the early formative years for developing

entrepreneurial skills, and an entrepreneurial mindset in general. For example, both developmentalists and economists hint at the central relevance of the early formative years for skill formation and its returns for the respective individual over his or her lifespan, and for society in general (Hartung et al., 2005; Heckman, 2006; Masten et al., 2010). Likewise, entrepreneurship scholars have identified childhood and adolescence as particularly critical periods in a person's development of entrepreneurial skills (Obschonka, 2016; Obschonka, Silbereisen, et al., 2012), with important implications for educational systems and policy making (e.g., by underlining the importance of *early* education and learning for the stimulation of entrepreneurship in society).

Building on previous work (e.g., European Commission, 2015), this work will review the existing literature on the development of entrepreneurial skills in adolescence. It is generally accepted that there are many personal and context factors that influence the formation of skills and the development of an entrepreneurial mindset among young people - e.g., family, peers, community, social groups, etc. In this work, we will provide a general overview of relevant theories in this field, and in the systematic literature review, we will focus on the educational context - educational programs delivered in schools (which there is a variety of, and includes early education). This concerns for example schools and training centres building these skills in adolescents. We are mindful of the fact that UNIDO's entrepreneurship education work focusses on adolescents in secondary school, which is, therefore the focus of this paper.

This review aims to address the following research questions:

1) What are entrepreneurial mindsets and enterprising behaviours? How and when are they formed during the individual's lifespan? What are their potential impacts on the individual's work and social life as well as the potential effects on the labour market outcomes and social behaviours, especially in developing countries and rural contexts?

2) Can entrepreneurship education programs, especially in developing countries and rural contexts, help to foster enterprising behaviours and entrepreneurial alertness in adolescents? If so, why, how and to what extent?

3) Does entrepreneurship education have the same impact on female and male adolescents in developing perceptions of entrepreneurial competencies and intentions? If not, what are the differences?

The rest of the paper is organised as follows. The introduction reviews the associated literature and provides answers for the first research question in two sections; namely "Definition of entrepreneurship and related key terms" and "Theory". Specifically, the former section established an understanding of the key terminology including entrepreneurial mindset, entrepreneurial skills, and entrepreneurial behaviour. In the latter section, we present a discussion of relevant theories addressing the development of entrepreneurial skills throughout an individual's lifespan. We also pay attention to theories providing a rationale for gender differences in the development of entrepreneurial skills in this section. The "Systematic review" section outlines our systematic literature review strategy. In the "Findings section", we summarise our findings. In particular, we provide answers for the second and third research questions. Finally, we conclude the paper in the "Discussion" by highlighting the analysis and discussion of the key results.

2. Introduction

This section answers our first research question: *What are entrepreneurial mindsets and enterprising behaviours? How and when are they formed during the individual's lifespan? What are their potential impacts on the individual's work and social life, as well as the potential effects on the labour market outcomes and social behaviours, especially in developing countries and rural contexts?*

2.1. Definition of entrepreneurship and related key terms

There is no general consensus in entrepreneurship research on how to best define entrepreneurship (and entrepreneurial skills). Many scholars in the field would agree, however, that entrepreneurship in its narrow economic definition can be defined as the process comprised of the recognition, evaluation and exploitation of entrepreneurial opportunities (Shane & Venkataraman, 2000), as new-to-the-market economic activity (for example in the form of a new startup and thus new venture creation, Davidsson, 2004). In its broader definition, "entrepreneurship applies to both individuals and groups (teams or organisations), and it refers to value creation in the private, public and third sectors, and in any hybrid combination of the three" (QAA, 2018). By applying an even wider lens, entrepreneurship can also be understood as an individual mindset that combines entrepreneurial personality characteristics, cognitions, identity features and human capital factors in a person's personality system (Obschonka & Stuetzer, 2017). This perspective is also reflected in the definition of entrepreneurship applied by the European Reference Framework for critical competencies for lifelong learning: "A sense of initiative and entrepreneurship is the ability to turn ideas into action. It involves creativity, innovation, risk-taking, and the ability to plan and manage projects to achieve objectives. The

individual is aware of the context of his/her work and is able to seize opportunities that arise. It is the foundation for acquiring more specific skills and knowledge needed by those establishing or contributing to social or commercial activity. This should include awareness of ethical values and the promotion of good governance" (Eurpoean Commission, 2017, p.3).

Characteristics and actions of an individual:

2.1.1. Entrepreneurial

By entrepreneurial, we refer to those combined qualities directly conducive to entrepreneurship (defined as the process of recognition, evaluation, and exploitation of entrepreneurial opportunities as new-to-the-market economic activity) (Davidsson, 2004).

2.1.2. Entrepreneurial Behaviour

There is no consistent definition of entrepreneurial behaviour in the literature. Entrepreneurial behaviour can refer to a wide range of behaviour. Following the definition of entrepreneurship presented above, however, entrepreneurial behaviour can be defined as a set of behaviours that allow individuals to recognise, evaluate, and exploit entrepreneurial opportunities, leading to new-to-the-market economic activity (Bird, 1988; Gartner et al., 2010).

2.1.3. Entrepreneurial Intention

It is generally well-accepted that entrepreneurial behaviour represents intentional behaviour (Bird, 1988). Acting entrepreneurially is something that people choose or plan to do (Shaver & Scott, 1992). The most proximal predictor of the final decision to engage in entrepreneurial behaviour is, therefore, often seen in entrepreneurial intentions, which are cognitive representations of a person's readiness to actively engage in entrepreneurship (Obschonka et al., 2010). Entrepreneurial intentions signal how intensely one is prepared and how much effort one is planning to commit to carrying out entrepreneurial behaviour. In other words, even if people may have significant potential for their own entrepreneurship (e.g., a potential business idea and the personal capacities required to start and run a business), they will refrain from making the transition into entrepreneurship when they lack the respective intentions (Krueger et al., 2000). Entrepreneurial intentions are often studied as a proxy variable for actual entrepreneurial behaviour (Obschonka et al., 2010). For example, if study subjects are still in an early phase of their occupational career or still in school, assessing their entrepreneurial intentions is often seen as a proxy not only for their abstract entrepreneurial potential but also concrete willingness and planning to actually engage in own entrepreneurial behaviour in the future (Athayde, 2009; European Commission, 2013; Huber et al., 2014; Von Graevenitz et al., 2010).

2.1.4. Entrepreneurial Mindset

From a psychological perspective, an entrepreneurial mindset can be defined as the intraindividual constellation and dynamics between relevant personality characteristics, cognitions, identity factors, and human capital factors associated with entrepreneurial behaviour (Kuratko et al., 2021; Obschonka & Stuetzer, 2017; Shepherd & Patzelt, 2018). In other words, such a mindset is defined not only by a single personality quality (e.g., higher need for achievement) but by the *individual configuration* of relevant psychological and human capital factors that shape this individual's thinking, decision-making, and motivation. This view follows a holistic, person-oriented personality perspective (Magnusson et al., 1993). The entrepreneurial mindset is embedded in and interacts with a person's lifespan development and various developmental and educational/learning contexts (Fayolle, 2018; Obschonka, 2016). Hence, many evaluation studies examining the impact of early entrepreneurship education programs also look at entrepreneurial intention and how it changes as a function of the program.

2.1.5. Entrepreneurial Alertness

While not without criticism in the literature (e.g., Foss & Klein, 2010; McCaffrey et al., 2021), the concept of entrepreneurial alertness can be regarded as a critical construct in entrepreneurship research and a central component of an entrepreneurial mindset (Baron, 2006; Tang et al., 2012). While originally defined as an individual's ability to perceive new opportunities that are overlooked by others (Kirzner, 1979), today it is defined as a theoretically and empirically elaborated three-component construct consisting of a) "scanning and searching for information", b) "connecting previously-disparate information", and c) "making evaluations on the existence of profitable business opportunities" (Tang et al., 2012). In other words, individuals high on entrepreneurial alertness show these three sets of behaviours regularly. Such entrepreneurial alertness, as a personal psychological quality, is not only seen as conducive to entrepreneurial behaviour and opportunity creation (Kirzner, 2009; Lanivich et al., 2022) but also to adaptive career development in general. Today's world of work often requires an "entrepreneurial" approach to navigating one's career through changing conditions, manifold opportunities, and massive challenges such as uncertainty, risk, and resource constraints (Obschonka et al., 2017).

2.1.6. Entrepreneurial Skills

While many scholars agree that entrepreneurial skills can be defined as those learnt skills that represent an ability to perform entrepreneurial tasks effectively and efficiently successfully, it is still not fully clear what precisely entrepreneurial skills are (vs. non-entrepreneurial skills). As indicated above, the literature does not provide a clear picture regarding an unequivocal definition of entrepreneurial skills. This shortcoming concerns inconsistent and unclear findings in

entrepreneurship research devoted to the role of human capital (and its specific components). Entrepreneurial human capital remains one of the black boxes of contemporary entrepreneurship research, given that the existing body of research could only show relatively small and often inconsistent effects, particularly in the explanation of entrepreneurial success and when one looks at actual skills and not just at prior entrepreneurial experience (Lazear, 2004; Martin et al., 2013; Marvel et al., 2016; Unger et al., 2011).

Skills are often divided into cognitive vs. non-cognitive skills – both relevant to a person's success in the labour market (Hartog et al., 2010). Still, it might require different educational approaches to develop them. Whereas cognitive skills generally represent intelligence – successful intellectual effort (e.g., for example, invested in thinking, reasoning, and remembering to solve abstract problems) that can be measured in intelligence or achievement tests, non-cognitive skills represent "soft skills" – such as personality traits, motivation, attitudes, and preferences (Kautz et al., 2014). Such non-cognitive entrepreneurial skills overlap with the definition of an entrepreneurial mindset. While cognitive skills should not be irrelevant for entrepreneurship, for example, research indicates that general cognitive ability pays off better for entrepreneurship than wage employment (Hartog et al., 2010), the research could not identify *the entrepreneurial* general intelligence so far (Sternberg, 2004). One can postulate that actual *entrepreneurial* skills are mainly non-cognitive skills in nature (Von Graevenitz et al., 2010), which does not mean that cognitive skills might be irrelevant. For the present review, interested in the development of entrepreneurial skills in adolescence, it is thus advisable to put a particular focus on the literature on the development of *non*-cognitive skills in adolescence (Hoeschler et al., 2018; Kassenboehmer et al., 2018). However, it should be noted that a person's cognitive and non-cognitive skills may often not develop and function completely independent of each other (although non-cognitive skills are typically only weakly correlated with intelligence).

2.1.7. Entrepreneurship and Enterprise Education

While there might be some different definitions, "The term 'entrepreneurship education' can refer to learning to become entrepreneurial (cultivating a mindset), learning to become an entrepreneur to create a venture (acquiring skills and knowledge) and becoming an entrepreneur by founding a venture (entrepreneurship as practice)." (Lindner, 2020, p.13).

Education experts often distinguish between enterprise and entrepreneurship education, which are overlapping fields showing several distinct features (see QAA, 2018). Other than entrepreneurship education, enterprise education, as a relatively generic concept, addresses "the generation and application of ideas, which are set within practical situations during a project or

undertaking'' (QAA, 2018, p.7). Enterprise education, therefore, targets rather broad traits and skills such as "creativity, originality, initiative, idea generation, design thinking, adaptability and reflexivity with problem identification, problem-solving, innovation, expression, communication and practical action" (QAA, 2018, p.7). This focus means that entrepreneurship education is the concrete application of enterprise behaviours – but not all enterprising traits and skills always lead to entrepreneurial traits and skills. Whereas enterprise education aims at developing students' "enhanced capacity to generate ideas, and the behaviours, attributes, and competencies to make them happen", which are critical occupational skills that enhance the employability of these students, entrepreneurship education "aims to build upon the enterprising competencies of students who are capable of identifying opportunities and developing ventures, through becoming self-employed, setting up new businesses or developing and growing part of an existing venture" (QAA, 2018, p.9). This means that entrepreneurship education is intended to target relatively concrete entrepreneurial skills. Still, it could be based on enterprising education (e.g., students first learn the generic skills and then later apply them in a more specific entrepreneurship education program to learn the more concrete entrepreneurial skills). In many nations around the globe, entrepreneurial education is delivered predominantly through formal education (Fayolle, 2018; Valerio et al., 2014).[1]

2.1.8. Entrepreneurial Learning

Learning and knowledge figure prominently in scholarly entrepreneurship theories (Minniti & Bygrave, 2001). For example, relevant skills enabling entrepreneurs to start and run their own businesses are often seen as the outcome of learning – and entrepreneurs must learn continuously (e.g., from entrepreneurial failure, Cope, 2011). Entrepreneurial learning can, therefore, be defined as the process of acquiring and updating entrepreneurial skills and knowledge conducive to successful entrepreneurial behaviour. An important mechanism through which entrepreneurship education operates is entrepreneurial learning. However, it is essential to note that entrepreneurial learning can also happen outside of (formal) entrepreneurship education (e.g., informal education, peer learning, etc.). Besides such a narrow definition of entrepreneurial learning, early entrepreneurship education might also target students' level of interest in and motivation for entrepreneurship and their own entrepreneurial intentions (European Commission, 2017). It also implies that entrepreneurship education might need to target all students, not only those who are (already) interested in entrepreneurship.

[1] "Enterprise Education" is a term more commonly used in British contexts. In Continental Europe and Asia, the preferred terms are usually "Entrepreneurship Education" or, in some instances, "Entrepreneurial Learning".

2.1.9. Early Education Programs

Whereas, traditionally, entrepreneurship education was mainly delivered by higher education institutes (e.g., Business Schools) (Fayolle, 2018; Pittaway & Cope, 2007), the focus has broadened over the last two decades or so, with a stronger emphasis on early entrepreneurship education in secondary education and even in primary education. Many countries and regions have developed comprehensive national and regional entrepreneurship education strategies where such early entrepreneurship education plays a crucial role (European Commission, 2017). Such strategies often focus on evidence-based approaches and impact outcomes reflecting the effects of education programs not only on students but also on teachers, institutions, and the economy and society as a whole. One central goal of such entrepreneurship education strategies centres around developing entrepreneurial skills in students, thereby acknowledging the importance of learning processes, and effective educational measures stimulating such learning for acquiring such skills in the early formative years.

Another goal focuses on developing entrepreneurial characteristics such as leadership in students, thereby acknowledging the importance of an entrepreneurial mindset to become more entrepreneurial in life in general (Pepin & St-Jean, 2019).

3. Theories and Related Research

In the following, we present a set of theories directly or indirectly addressing the development of entrepreneurial skills. It is essential to highlight that this list is not exhaustive and it is a selection of theories deemed important for the topic.

3.1. Human Capital

Human capital theory suggests that individuals or groups with greater knowledge, skills, and other competencies will achieve greater performance outcomes than those with lower levels (Becker, 1964; Mincer, 1958). Some entrepreneurship studies have shown a positive relationship between human capital and entrepreneurial outcomes (e.g., Colombo & Grilli, 2005, 2010; Zarutskie, 2010). Typical measures of human capital in such studies include the level of education, work experience, industry experience, upbringing by entrepreneurial parents / entrepreneurial role models, and other life experiences (see also Marvel et al., 2016). Results of meta-analytic studies show the value of entrepreneurship education and training for effective human capital formation and, hence, more (successful) entrepreneurship. For instance, Martin et al. (2013) meta-analytic results indicate a significant positive relationship between entrepreneurship education and training and entrepreneurship-related human capital assets and entrepreneurial performance. Moreover, they showed that the relationship between

entrepreneurship education and training and entrepreneurship outcomes was stronger for academic-focused entrepreneurship education and training interventions than for training-focused entrepreneurship education and training interventions.

Through a finer-grained perspective on human capital theory, Unger et al. (2011) meta-analysis study differentiates between human capital *investment* (i.e., conceptualisation based on past experiences such as education and work experience) and *outcomes* of human capital investments (i.e., conceptualisation based on direct assessments of entrepreneurs' knowledge, skills, and competencies). They argue and show that experience is not equal to knowledge because the experience may or may not lead to increased knowledge in a person. Therefore, an increased number of years of schooling does not indicate what has been learnt (knowledge as a result of the experience). Human capital conceptualised as outcomes of human capital investments is a direct assessment of human capital and, therefore, represents a learning outcome. Unger et al. (2011) findings show that the relationship between human capital and entrepreneurial success is higher for outcomes of human capital investments than for human capital investments. Additionally, the acquired human capital's relevance is important for success. Unger et al. (2011) also show that the relationship between human capital and entrepreneurial success is higher for human capital related to entrepreneurial tasks than for human capital not associated with entrepreneurial tasks. This finding informs policymakers to coordinate and develop programs that teach various skills that should be relevant and supportive of business creation activities. However, it is also important to stress that the authors found relatively low correlations between human capital as typically measured and entrepreneurial success (the population effect between human capital and entrepreneurial success was estimated to be .098, indicating a small correlation).

In another meta-analytic analysis, van der Sluis et al. (2008) found that "there is no evidence of a systematic relationship between an individual's schooling level and the probability of selection into entrepreneurship" (p. 817). The authors assume that educational attainment can have opposing effects on entrepreneurial entry (which would result in such a null effect). On the one side, better educational attainment might come with better managerial ability, which might increase the probability of entrepreneurship. Conversely, better educational attainment might decrease the likelihood of entrepreneurship as the preferred choice because it generates better "outside options" (wage employment with attractive working conditions and income). This could mean that effective promotion of entrepreneurial skills in adolescence can contribute to this opposing effect pattern: While it could indeed increase the likelihood of a subsequent entrepreneurial career in adulthood, at the same time, it could also decrease it

(resulting in a potential overall null effect). Interestingly, van der Sluis et al. (2008) also found in their meta-analysis that "the relationship between schooling and performance is significant and positive, in line with the economic theory" (p. 817). The higher the entrepreneur's schooling level or the more years of education, the higher the likelihood for better entrepreneurial earnings, growth, and business survival. They calculated the average return (log annual dollar earnings as an entrepreneur in the USA) to a year of schooling pursued to be 6.1%.

Knowledge plays a unique role in entrepreneurship, including entrepreneurial knowledge per se (e.g., how to start and run successful businesses) and the knowledge that forms the basis of an innovative business idea. Hence, it should be noted that since knowledge is an essential component of human capital, and new knowledge is at the core of various entrepreneurship theories (see Audretsch & Keilbach, 2007; Braunerhjelm, 2008), entrepreneurship research has been revealing important mechanisms of how (budding) entrepreneurs access and utilise such new knowledge (e.g., new ideas and technologies) as part the entrepreneurial process. Such research emphasises that entrepreneurs often do not create new knowledge but rather access and apply new knowledge created elsewhere (e.g., in scientific discoveries, via R&D in other firms, etc.). In other words, if entrepreneurs have low human capital in terms of such new knowledge themselves, this might not necessarily mean that they are unsuccessful per se. It also matters that they can access such new knowledge and leverage it via entrepreneurial means (e.g., development of new products and services and new venture creation). This perspective stresses an innovation perspective (e.g., innovative entrepreneurship), where new ideas and knowledge are a central basis of competitive advantage, and it implies that entrepreneurial human capital should also be defined as skills, knowledge, and competencies needed to access and apply new knowledge that then forms the basis of on innovative business idea.

Besides such knowledge, industry experience is often discussed as a particularly relevant human capital component in entrepreneurs. It is argued that they need to understand the industry in which their new venture operates to succeed. Such knowledge is, however, often tacit and challenging to acquire without direct exposure and deeper learning processes within that industry itself (e.g., via working in this industry for some time), which might explain why research indicates that many entrepreneurs have the highest likelihood in their career to start a successful, growing business when there are in the middle of their career, after accumulating significant amounts of relevant industry-specific knowledge (Azoulay et al., 2020). This is an essential perspective given the purpose of the present work. It challenges the view that successful entrepreneurship is often equally likely and successful in young adults (who often

have less industry experience) than older adults. It would mean that the development of entrepreneurial skills in adolescence should also be seen from an industry experience perspective because the usefulness of such entrepreneurial skills might depend to a certain degree on the accumulation of relevant industry experience later in life (many adolescents might develop their entrepreneurial skills, for example via early enterprising education, but they might not have a chance yet to accumulate industry experience). It would also suggest that while adolescents can develop their entrepreneurial skills from an early age to prepare for their subsequent careers, the best chances to succeed as an entrepreneur by actually engaging in entrepreneurship (e.g., starting their own business) are probably much later in life (e.g., around the age of 40, after accumulating relevant industry experience).

However, one can also argue that with contemporary massive technological and social change, younger generations might get better access to such industry knowledge than previous younger generations (e.g., via digital tools, the internet, new types of learning-related networks, etc.). Hence, it is likely that technological progress could level the playing field in this regard. Also, younger age groups might have similar chances for entrepreneurial success than older age groups.

Finally, there is a discussion in the literature according to which entrepreneurial skills, as entrepreneurial human capital, are nothing else than broader, so-called 21st-century skills that are general human capital features of modernity (e.g., to deal with and utilise the challenges and opportunities of the modern economy and society) (Ghafar, 2020; Obschonka et al., 2017). From this perspective, broader theories on such 21st-century skills and their formation and development have implications for research and practice in the specific field of entrepreneurial skills (Care, 2018; Griffin & Care, 2014).

3.2. Life Cycle Skill Formation

Considering the importance of human capital investment outcomes for entrepreneurial success, it is important to know when and how such investments are more likely to pay off and lead to developing skills (e.g., entrepreneurial skills). Early childhood years are sensitive periods in one's life when the individual is more receptive to the environment (Sluckin, 2017). One of the most influential theories about the importance of early childhood skill development is the "Life Cycle Skill Formation" model proposed by James Heckman – a Nobel prize winner in economics – and his team. According to this theory, the human skill formation process (including both cognitive and non-cognitive skills) is governed by a multistage process where each stage corresponds to a period in the life cycle of a child (Heckman, 2000). The output for

each stage (i.e., the levels of each skill achieved at that stage) may differ, with some stages being more productive in producing specific skills than others (Cunha et al., 2006). The most productive periods are called "sensitive periods" for those skills (Cunha et al., 2006). Accordingly, if one stage is particularly effective in producing a skill, it is called a "critical period" for that skill (Cunha et al., 2006). This model has two key features: *self-productivity* and *complementarity* (Cunha & Heckman, 2007). Self-productivity points to the persistence of skills into future developmental periods since the model suggests that skills produced at one stage augment the skills attained at later stages (Cunha & Heckman, 2007; Masten et al., 2010). Complementarity points to the synergistic nature of skill development, where skills produced at one stage raise the productivity of investment at subsequent stages (Cunha & Heckman, 2007). In other words, early investment has to be followed up by later investment for the early investment to be productive. Together, complementarity and self-productivity produce multiplier effects, which explain how skills beget skills and abilities beget abilities (Cunha et al., 2006).

Studies of enriched childcare programs that targeted the early years of disadvantaged children have shown impressive impacts of early childhood programs on longer-term life outcomes such as employment, earnings, and criminal activity (García et al., 2020). Heckman (2006, p.1900) suggests "(i) early learning confers value on acquired skills, which leads to self-reinforcing motivation to learn more, and (ii) early mastery of a range of cognitive, social, and emotional competencies makes learning at later ages more efficient and therefore easier and more likely to continue". Life cycle skill formation is a dynamic process in which early childhood inputs strongly affect the productivity of later inputs (Figure 1) (Heckman, 2006). Therefore, an important implication of the life cycle skill development model is high returns to early investment in children from disadvantaged environments. In contrast, the returns on later investments are much lower (Cunha et al., 2006). In other words, this implies that if a society wants to promote the general skills level (e.g., in disadvantaged children) it is more economical and efficient for a society to achieve this via early programs and interventions, targeting childhood age, compared to later investments in adolescence and adulthood.

Different skills are formed and shaped at various stages of an individual's life cycle (Shonkoff & Phillips, 2000). Research shows that when the opportunities for the formation and development of skills in certain stages are missed, remediation can be costly and even impossible (Knudsen et al., 2006). Therefore, investment in human capital should be distributed over the life cycle (Heckman, 2006). Figure 1 summarises the significant findings of a stream of literature dedicated to this topic. It plots the rate of return to human capital at

different life cycle stages for a person of given abilities. The horizontal axis represents age as a surrogate for the individual's stage in the life cycle of skill formation. The vertical axis represents the rate of investment return, assuming the same amount of investment is made at each age. According to this figure, *ceteris paribus*, the rate of return to a Dollar of investment made while a person is young is higher than the rate of return to the same Dollar invested at a later age. Families and schools affect the formation of skills and abilities, but they differ in their malleability over the life cycle (Cunha et al., 2006). Family income and background initiate differences in the levels of cognitive and non-cognitive skills in early years that persist (Cunha et al., 2006). Schooling widens these gaps, with the main gaps emerging before schooling begins. Such gaps continue to be found in adulthood (Cunha et al., 2006).

Heckman (2006) shows that investment in cognitive and non-cognitive skill formation has higher economic returns for early childhood years in socially disadvantaged children. In other words, educational programs in the adolescent and young adult years are much more costly in producing the same level of skill attainment in adulthood (Cunha et al., 2006; Heckman, 2006). Notably, the advantages gained from effective early interventions are sustained best when they are followed by continued high-quality learning experiences (Cunha et al., 2006).

Cunha and Heckman (2008) estimate models of the evolution of cognitive and noncognitive skills and explore the role of family environments in shaping these skills at different stages of the child's life cycle. They show that parental investments are generally more effective in raising noncognitive skills. Cunha and Heckman (2008) further show that noncognitive skills foster the acquisition of cognitive skills by making children more adventuresome and open to learning. However, in most model specifications, cognitive skills do not promote the formation of noncognitive skills. Additionally, parental inputs have different effects at different stages of the child's life cycle, with cognitive skills affected more at early stages and noncognitive skills affected more at later stages (Cunha & Heckman, 2008). This also refers to the notion of *sensitive periods* Cunha and Heckman (2008), where such periods of viability for developing various skills may differ, further emphasising the multi-stages of childhood development (Cunha & Heckman, 2010).

However, Cunha and Heckman (2010) recognise three important constraints of Heckman et al.'s life cycle model that further point to the importance of interventions as educational programs. "The first constraint is the inability of a child to choose its parents. This is the fundamental constraint imposed by the accident of birth. Second is the inability of parents to borrow against their children's future income to finance investments in them. The third constraint is the inability of parents to borrow against their own income to finance investments

in their children." (Cunha & Heckman, 2010, p.2).

Policy implications of the life cycle skill development model point to the importance of early programs and interventions targeted towards the disadvantaged to be more effective and efficient than later programs and interventions. Cognitive and noncognitive skills directly affect participation in schooling, crime, teenage pregnancy, drug use, smoking, and other deviant activities (Cunha et al., 2006). Cunha et al. (2006) also suggest that the distinction between genetically determined abilities and acquired skills is a myth. They indicate that abilities and skills are both acquired, and they are influenced both by genes and the environment.

Additionally, different abilities can be manipulated at different ages (Cunha et al., 2006). Thus, while factors affecting IQ deficits need to be addressed at very early ages for interventions to be effective, there is evidence that later interventions in the adolescent years can affect noncognitive skills and the knowledge measured by achievement tests (Cunha et al., 2006). Finally, the optimal timing of investment depends on the outcome being targeted. The optimal intervention strategies depend on the stage of the life cycle and endowments at each stage (Cunha & Heckman, 2010). Optimal investment should be tailored to the specifics that create adversity and the productivity of investment for different configurations of disadvantage. As research on the economics of capability formation matures, economists will better understand how to foster successful people (Cunha & Heckman, 2010).

To conclude, the life cycle skill formation theory and related research indicate that developing entrepreneurial skills via education and training might be most effective and efficient when addressing very young age groups, including preschool programs. However, it also highlights that skills beget skills and that programs and interventions in adolescence can be effective and efficient, particularly when they are built on earlier skill development and promotion in childhood. It also highlights that those programs and interventions purely addressing adulthood (e.g., entrepreneurship education and training in higher education institutions) might be less effective and efficient for society if a person's earlier skill development is neglected. In other words, even the best entrepreneurship education and training tailored for adults might fail to promote high skill levels if the developmental basis of such skills, achieved and developed during the early sensitive period, is absent. One could also infer that entrepreneurship education and training targeting adults have to be particularly intense (and costly) to achieve similar effects (e.g., a successful entrepreneurial career) than a less severe (and expensive) early program or intervention. This would mean that promoting entrepreneurial skill development in adolescence should receive at least similar attention in educational policies and strategies than

later measures in adulthood. But it also indicates that a person's entrepreneurial development does not start in adolescence, and particularly skill development before the adolescent years needs to be considered as well (e.g., as a particularly effective and efficient method, but also as a developmental basis relevant for the promotion of skill in adolescence).

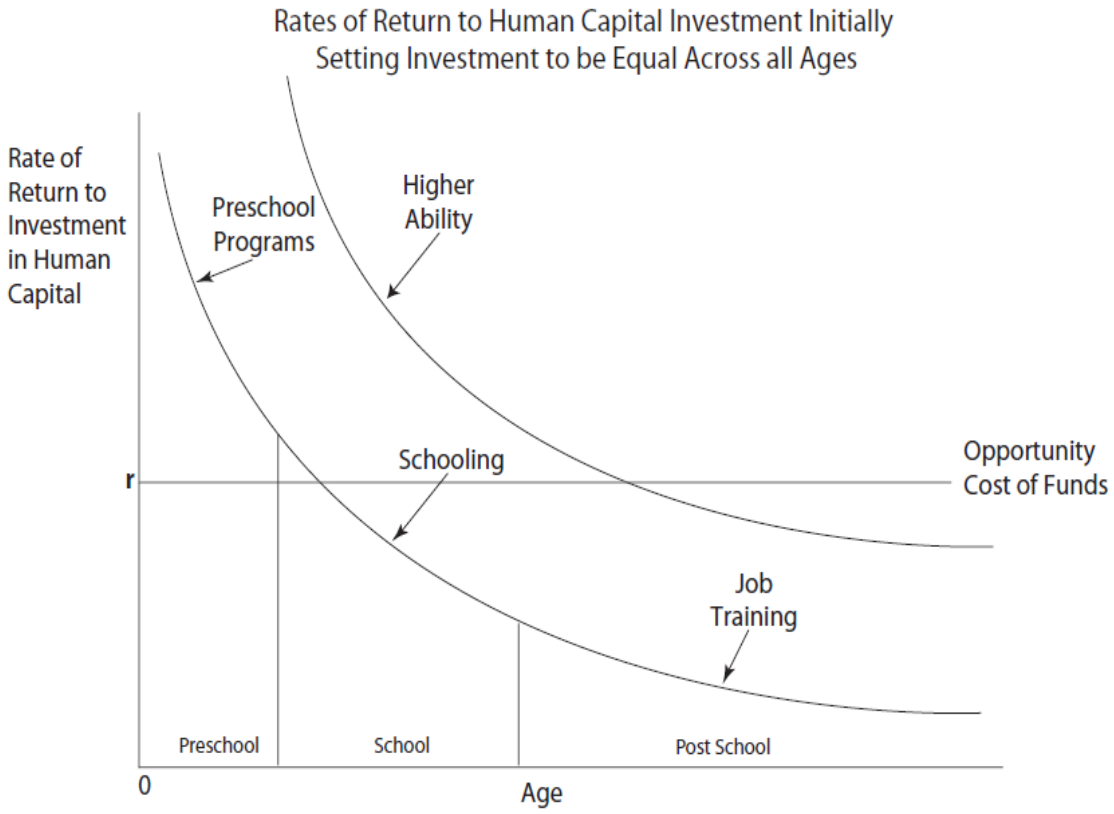

Figure 1. Rates of return to human capital investment (initially setting investment to be equal across all ages) (source Heckman et al., 2004).

3.3. Balanced Skills Theory

As noted above, traditional measures of human capital appear to deliver relatively low correlations with entrepreneurial outcomes. Does that mean that human capital is relatively unimportant for entrepreneurs (or has opposing effects, van der Sluis et al., 2008)? One answer could lie in the conceptualisation of human capital applied in such studies (e.g., studying the effect of a person's isolated, single human capital features, with the underlying notion that the more of such a single skill, the better for entrepreneurial outcomes such entrepreneurial career choice and success). A fundamentally different approach is to look at the variety of a person's skills instead of the depth of a single skill. Even if a person does not have high levels in any given single skill (not an expert in a specific field), the person can still have a wide variety of relevant skills

(balanced skills). This is comparable to the jack-of-all-trades view ("jack of all trades, master of none").

Entrepreneurs have to deal with various tasks such as identifying a business opportunity, developing a business model, interacting with stakeholders, and working in teams and leading them. Lazear (2005), therefore, argues that entrepreneurs should have a significant variety of skills to succeed (jack of all trades) compared to more profound expertise in a single domain (domain expert). Skill variety is defined as "having a varied set of skills and knowledge that are task-specific, and thus highly relevant, for entrepreneurship" (Krieger, Block, et al., 2022, p.5). Lazear (2005) defined jack-of-all-trades as individuals "who need not excel in any one skill but are competent in many" (p.649). Lazear (2004)'s jack-of-all-trades theory suggests that studying a varied curriculum, switching jobs, and working in different fields can lead to the accumulation of balanced skills, compared to deeper human capital investments in one single domain. A growing range of empirical research findings suggests that individuals with a balanced skill set are indeed more likely to become (successful) entrepreneurs than those with a specialised skill set (e.g., Aldén et al., 2017; Chen & Thompson, 2016; Lazear, 2005). For example, the importance of a balanced skill set for entrepreneurs has been tested and shown in nascent entrepreneurs in Germany (Stuetzer et al., 2013), Swedish military enlistment (Aldén et al., 2017), and founders in Canada and the United States (Chen & Thompson, 2016).

It is argued that such varied skills are developed over time and through training and education but might not be independent of a person's dispositions (e.g., personality). Stuetzer et al. (2013) show, for example, that balanced skills' origins could be innate and/or acquired. From an investment perspective, Stuetzer et al. (2013) argue that a balanced skill set results from an individual's investment strategy, such as developing an early interest in an entrepreneurial career and prior (varied) work experience in young and small companies. From an endowment perspective, Stuetzer et al. (2013) also support that entrepreneurs' personality traits (i.e., the Big Five traits) could be seen as origins of balanced skill sets. Early variety orientation in adolescence has been discussed as a precursor of entrepreneurial human capital in adulthood. Krieger, Stuetzer, et al. (2022)'s findings indicate that skill variety in adulthood has its roots in the adolescent years. Empirical results suggest that establishing and benefiting from an early variety orientation in adolescence is an essential developmental mechanism in entrepreneurial careers and gives those with an entrepreneurial personality an early head start in their vocational entrepreneurial development (Krieger, Stuetzer, et al., 2022). Therefore, targeting younger ages for entrepreneurship education programs by engaging them *in a broader variety* of activities might have a positive impact on the development of entrepreneurial skills.

Regarding gender and balanced skills development, some studies' findings suggest a lower skill variety development in women than men (e.g., Lechmann & Schnabel, 2014; Spanjer & van Witteloostuijn, 2017). Krieger, Block, et al. (2022) find that women do not have less variety in school; quite the opposite, as they have more than men. Their findings suggest that the gap in skill variety, with women scoring lower than men on that, starts to open up in tertiary education and widens in the labour market. Specifically, Strohmeyer et al. (2017) find strong and robust results that due to educational backgrounds in mostly female-dominated fields, female entrepreneurs are likely to exhibit a lower degree of resemblance with jack-of-all-trades having acquired various educational skills. Additionally, research on sex-based occupational segregation reveals that women are underrepresented in managerial positions in industry, government, or academia (Blau et al., 2013). Therefore, female entrepreneurs might be less likely to have acquired managerial experience to develop a more balanced skill profile.

To conclude, entrepreneurship research has generated considerable evidence for the validity of the balanced skill approach. Entrepreneurs who can rely on a relatively balanced skill set often achieve better entrepreneurial success than those with a less balanced skill set (including those with high skill levels in separated/isolated fields but very low skill levels in other fields, resulting in low skill variety). This is a significant result in the entrepreneurship literature that needs to be considered when designing and implementing early entrepreneurship education and training programs. Such measures could also target skills, for example, that help adolescents apply a variety of orientations when learning new skills (e.g., skills that enable and motivate adolescents to learn the basics in various fields and disciplines). On the other hand, from an ethics perspective, one cannot simply "force" all adolescents to become the jack of all trades since (the acquisition of) domain expertise is significant for other jobs and occupations and is often part of a person's adaptive vocational development (Hartung et al., 2005). This highlights a particular dilemma because if societies invest only in promoting balanced skills, young generations might not be prepared for jobs and occupations requiring deep domain expertise.

On the other hand, if societies only invest in deep, exceptional domain expertise, entrepreneurship might be suppressed. Hence, if the balanced skill research indicates that investments in balanced skills should be prioritised in early entrepreneurship education (mid-level skills in a broad range of fields), it could produce significant costs for society due to the simultaneous disregard of the promotion of expert skill levels, and thus less effective education and training for jobs and occupations where experts are needed. This is currently a research frontier in entrepreneurship research. Hence, we have no empirical evidence for or against the societal benefits of focusing on balanced skills in early entrepreneurship education and training.

3.4. Expectancy–Value Model of Achievement-Related Choices

Entrepreneurship can be interpreted as a person's achievement-related choice. In educational psychology, Eccles et al.'s *model of achievement-related choices* (Eccles et al., 1983) is widely regarded as one of the most influential theoretical frameworks explicating the relevant factors and processes shaping such choices (Schoon & Eccles, 2014). For example, the model is often used to examine gender differences in academic and occupational choices. Such theories in the field of education explain how gender differences and individual differences within each gender influence the differences in an individual's expectations for success and subjective task value.

Expectancies refer to how confident an individual is in her ability to succeed in a task. In contrast, task values refer to how important, useful, or enjoyable the individual perceives the task. According to this theory, an important feature for understanding the gender differences in educational and vocational decisions is an individual's perceptions of the field of viable options and their impact on expectations and subjective value tasks. For instance, empirical findings show women are likely to have lower expectations for success than men in various occupations (Eccles, 1994). Traditionality and male dominance in career fields contribute to women's lower self-efficacy than men in those fields (Bandura et al., 2001).

Such theories point to the importance of a person's values and beliefs (e.g., beliefs about the likelihood of a successful outcome and the potential opportunity costs) through which more distal factors such as a person's socialisation and personality, but also relevant abilities and skills, can affect an entrepreneurial career choice and entrepreneurial behaviour. Hence, even if a person forms the relevant entrepreneurial skills (or a balanced skill set reflective of entrepreneurial human capital), these skills might not translate into (successful) entrepreneurial behaviour if relevant cognitions directly underlying decision-making processes and entrepreneurial actions are less entrepreneurial or less optimistic/favourable (although skills might shape such values and beliefs to a certain degree). This underscores the relevance of cognitive theories and approaches for studying and promoting entrepreneurial skills and related entrepreneurial outcomes (Frese, 2009).

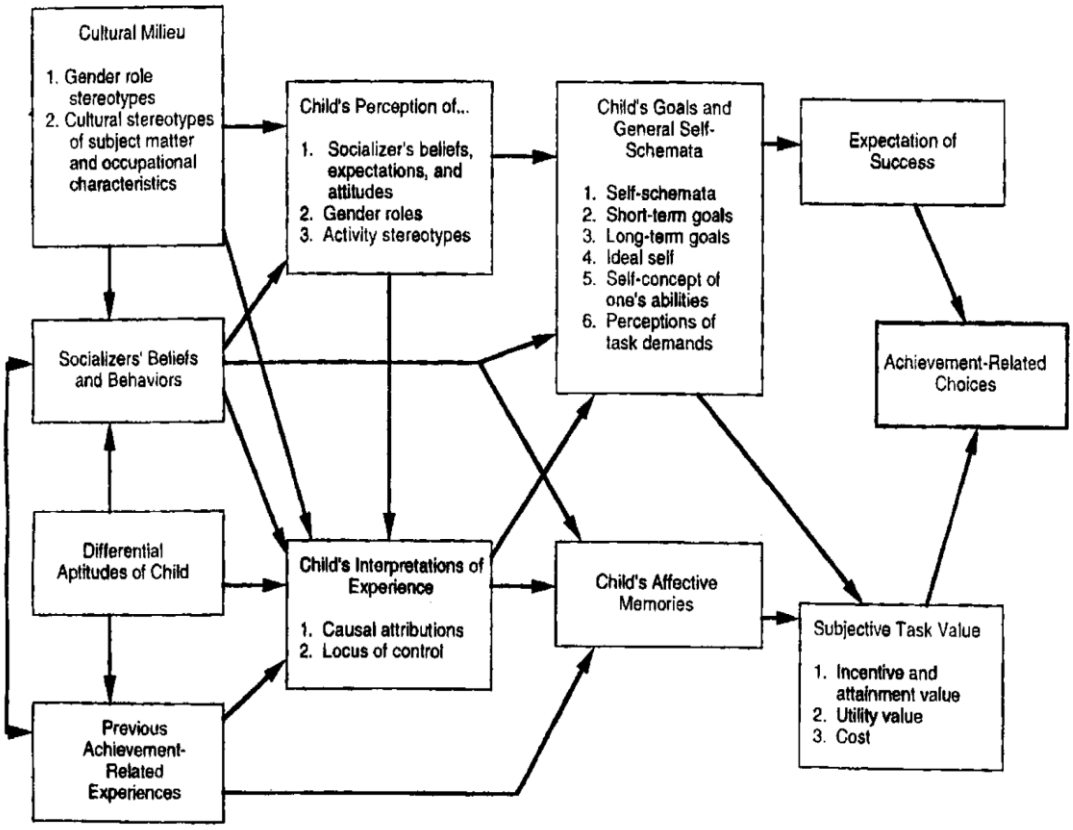

Figure 2. Eccles et al.'s expectancy-value model of achievement-related choices (source Wigfield & Eccles, 2000)

3.5. Stereotype Activation Theory

Another theory that is often used for research on the role of gender in entrepreneurship is the stereotype activation theory. The basic notion of this theory is that if a stereotype is made cognitively accessible (stereotype activation) in certain situations, it will influence attitudes and behaviours (Marx et al., 1999). Through this perspective, Sweida and Reichard (2013) propose that gender roles and stereotyping negatively impact women's entrepreneurial self-efficacy and intention to start a high-growth business (see also Sweida & Reichard, 2013). Gupta et al. (2008) highlight that "the masculine attributes ascribed to entrepreneurs can be made cognitively accessible either implicitly or explicitly by presenting people with relevant stereotypical information about entrepreneurs" (p. 1054). Laguía et al. (2019) tested a "think entrepreneur – think male" stereotype pattern and found that entrepreneurship is perceived by non-entrepreneurs as strongly associated with task orientation (which is mainly seen as a male feature) than with relationship orientation (mainly seen as a female feature). Such stereotypes and stereotype activation can bias investor decisions, for example, in venture capitalists investing in startups. For example, Balachandra et al. (2019) found that investors are biased

against the display of feminine-stereotyped behaviours by entrepreneurs, and the implicit associations with the entrepreneur's business competency. To help overcome such stereotyping effects, Sweida and Reichard (2013) provide practical implications for entrepreneurship education.

3.6. Developmental Lifespan Model of Entrepreneurship

Research, particularly conceptual work, on the early development of an entrepreneurial mindset and entrepreneurial skills and related subsequent skill growth is relatively scarce. One of the elaborate theoretical models in this field is Obschonka's (2016) model of entrepreneurial development, which emphasises the early formative years in childhood and adolescence (compared to other theories and approaches that focus more on developmental phases in adulthood). This model and underlying research were informed by developmental psychology, particularly by approaches from vocational development and human development in context. The following provides a relatively elaborate overview of this model (shown in Figure 3) and underlying theories and research based on (Obschonka, 2016).

The model follows basic principles from the life span perspective of human development in context. The lifespan perspective of human development concerns constancy and change in behaviour and developmental contexts across the lifespan. The basic frame here is the understanding of human development as driven by a life-long exchange between changing people and their changing environment. As a scholarly field of investigation, the life span perspective of human development represents a well-established and elaborated approach in the social sciences, e.g., in psychology (Baltes, 1987; Baltes et al., 2006; Overton et al., 2006) and sociology (Elder, 1998; Elder & Shanahan, 2006). According to Baltes (1987), the historical precursors of the life span perspective reach back to Tetens (1977), Carus (1809), and Quelelet (1835). Still, systematic empirical research in this field only began around 50 years ago (see also Lerner, 2018 for a historical overview). As a meta-approach, it offers a well-defined framework for conducting research on very different aspects of human nature. For example, the life span perspective contributed to our understanding of personality development (Block, 2014; McAdams & Pals, 2006) as well as adaptive behaviours such as work success (Elder & Crosnoe, 2002; Masten et al., 2010; Schoon, 2001; Vaillant & Vaillant, 1981) or well-being (Csikszentmihalyi & Csikszentmihalyi, 2006), and maladaptive behaviours such as delinquency (Sampson, 2009) or psychopathology. One emphasis of the life span approach is placed on the early formative years' role in adult life outcomes (Clausen, 1991; Harris, 2011). Further emphases are the notions of plasticity in human development (at virtually each life stage there is potential for change and growth, Baltes et al., 2006; Jones et al., 2006; Li, 2003), of individuals as active producers of their

own development (Lerner & Busch-Rossnagel, 1981; Lerner & Walls, 1999), and of the importance of the *ecology* of human development (e.g., the influence of intertwined developmental contexts and of historical and social change as well as the interplay between human behavior and historical context along the individual life-course, Bronfenbrenner, 1979; Elder, 1998; Nesselroade & Von Eye, 2013; Schoon, 2006; Silbereisen & Chen, 2010). One illustrative example of these key propositions of the life span perspective is Elder's (1998) seminal work on the lives of the children of the Great Depression. Analysing longitudinal datasets collected by the University of California at Berkeley, the author showed that the historical time and place in which childhood and adolescence development is embedded in leave a lasting imprint in the individual life-courses well into adulthood. Moreover, he found human agency (active construction of one's own life-course within the opportunities and constraints of historical and social circumstances) to play a key role in life span development.

One consequence of the plenty of research conducted from a life span perspective of human development is that it has become a truism to view adult life achievements as a developmental outcome (e.g., Sroufe, 1997). For example, adult behaviour and success in work (e.g., occupational choice, status, and attainment) is an outcome of vocational development over the life span (Shanahan & Porfelli, 2002; Super, 1980). Following the fundamental propositions of the life span perspective, scholars in the field of vocational development emphasise (a) the importance of the formative years (Hartung et al., 2005; Schoon & Parsons, 2002; Schoon & Silbereisen, 2009), (b) the role of plasticity in vocational development (e.g., as illustrated in the interplay between personality development on the one hand and selection in and socialization through work experiences on the other, Kohn, 2015; Kohn & Schooler, 1982; Roberts et al., 2003), (c) the role of human agency (Heinz, 2003), and (d) the relevance of the changing ecology in which vocational development over the life span takes place (Schoon et al., 2007; Silbereisen, 2002; Vondracek, 2001; Vondracek et al., 2019)

The field of entrepreneurship research, as a specific kind to investigate human behaviour in the context of work, has begun to study adults' entrepreneurship as a developmental outcome and to draw from the rich knowledge and elaborated approaches to the life span perspective of human development. Over the past twenty years, several empirical studies were published investigating vocational development over the life span in the context of entrepreneurship (Falck et al., 2012; Obschonka, Duckworth, et al., 2012; Obschonka et al., 2010; Obschonka, Silbereisen, & Schmitt-Rodermund, 2011; Obschonka, Silbereisen, Schmitt-Rodermund, et al., 2011; Obschonka, Silbereisen, et al., 2012; Schmitt-Rodermund, 2004, 2007; Schmitt-Rodermund & Vondracek, 2002; Zhang & Arvey, 2009). This stream of research is interested in the role of the formative

years (e.g., childhood and adolescence) for subsequent entrepreneurial behaviour and success in adulthood. Another focus is on the role of dispositional personality traits in vocational development towards entrepreneurship, extending the traditional trait approach of entrepreneurship with a human development framework.

However, understanding adults' entrepreneurship as a result of developmental processes reaching back to the formative years and incorporating individual characteristics and behaviour as well as the developmental ecology is not an entirely new research focus (Blanchflower et al., 2001; Carroll & Mosakowski, 1987; Dyer, 1995). For example, McClelland (1961) and Weber (1904) theorised that parental influences on child and adolescent development (e.g., exerted through parenting style) shape entrepreneurial mindsets (e.g., a need for achievement, McClelland, 1965) from early developmental stages on, and thus the enterprising occupational career during the subsequent working life. Nonetheless, these theoretical considerations on the nexus between life span development and individual entrepreneurship remained empirically untested for a long time. Schmitt-Rodermund (2004, 2007) tested some of McClelland's (1961) considerations on vocational development over the life span of entrepreneurship. According to this research, entrepreneurship during the occupational career is a function of age-appropriate early entrepreneurial competence (for example, indicated by assumed leadership roles and inventive and commercialisation activities) and early entrepreneurial interest (e.g., an interest in business). Having acknowledged the central importance of adolescent competence and interest, the model also makes a statement on factors influencing the formation of such early entrepreneurial competence and interests. On the one hand, early entrepreneurial competence and interest is seen as an expression of dispositional personality traits (e.g., the Big Five). On the other hand, an early stimulating environment (authoritative parenting, early entrepreneurial role models such as self-employed parents) should foster the formation of such competence and interest. In other words, this approach assumes an early stimulating environment and dispositional personality traits to affect entrepreneurial activity in adulthood by forming specific adolescent competence and interests relevant to entrepreneurship.

Empirical support for this central role of early entrepreneurial competencies in a person's entrepreneurial development comes from prospective and retrospective life span studies and intervention studies. With respect to prospective longitudinal results, Schmitt-Rodermund (2007) presented empirical evidence for her model using data from male study subjects from the famous Terman study on the lives of gifted children (IQ > 130) born around 1910 in California, USA (Terman, 1926; Terman & Oden, 1959). She found an entrepreneurial career in adulthood related to early entrepreneurial competence and interest in adolescence via entrepreneurial career goals

in young adulthood. Moreover, her results showed early entrepreneurial competence in adolescence as a function of the adolescent Big Five profile and an early stimulating environment (authoritative parenting). These relationship patterns between personality traits, adolescent development, and entrepreneurship in adulthood were also found in retrospective life span studies investigating the vocational development of adult business founders (Schmitt-Rodermund, 2004). Finally, an intervention study yielded results consistent with the model, as they indicate that the crystallisation of enterprising interests among adolescents is influenced by both a stimulating environment and personality traits (Schroder & Schmitt-Rodermund, 2006). In a series of studies (Obschonka, Duckworth, et al., 2012; Obschonka et al., 2010; Obschonka, Silbereisen, & Schmitt-Rodermund, 2011; Obschonka, Silbereisen, Schmitt-Rodermund, et al., 2011; Obschonka, Silbereisen, et al., 2012) could replicate Schmitt-Rodermund's approach with a particular focus on age-appropriate entrepreneurial competences in adolescence (e.g., early leadership roles, early commercial activities, early inventive behaviours) as a developmental precursor of age-appropriate entrepreneurial skills and self-efficacy beliefs in adulthood, which in turn foster entrepreneurial activity and success. Hence, this supported the notion that early entrepreneurial skills beget later entrepreneurial skills via age-appropriate expressions.

These research insights supported the view according to which the development of entrepreneurial skills (e.g., in adolescence) can be understood as embedded in, and an expression of, a person's entrepreneurial development, which one can broadly define as those successive and systematic changes, occurring across a person's life course, that make a (successful) entrepreneurial career more likely. In Figure 3, a developmental model of entrepreneurship is presented, based on (Obschonka, 2016). This model is an elaboration of Schmitt-Rodermund's approach discussed above. The model was inspired by a modern understanding of developmental science and life span psychology, according to which human development, which is a lifelong process characterised by the orchestration of gains and losses, is understood as a complex system involving biological, psychosocial, behavioural, and contextual factors that interact (Baltes et al., 2006; Lerner, 2018; Overton et al., 2006). The model acknowledges that there could be different possible developmental trajectories leading to (successful) entrepreneurship in adulthood, which is consistent with two basic principles of human development, namely equifinality (different starting points in development can lead to the same outcome) and multifinality (the same starting point can lead to various developmental outcomes). The model is further based on the rich research in vocational development across the life span, which emphasises (a) the importance of the formative years, (b) plasticity in vocational development, (c) human agency, and (d) the relevance of the changing ecology in which vocational development over the life span takes place. The concrete empirical foundation of this particular model comes from entrepreneurship studies

discussed above (e.g., from prospective longitudinal data following the participants through childhood, adolescence, and adulthood, or retrospective longitudinal data, for example, surveying established business founders and following back their developmental history). These findings indicate the relevance of a developmental-contextual perspective on entrepreneurship, with a particular focus on (1) the formative years, (2) life-stage appropriate development and developmental tasks, and (3) the interplay between biological, psychosocial, behavioural, and contextual factors. While the model is relatively broad in that it attempts to capture the major "forces" in a person's entrepreneurial development, it can be applied to the specific case of adolescents' entrepreneurial skills (which would belong to the early characteristic adaptions in the model).

The model understands entrepreneurship as a developmental outcome in that it describes the effect of biologically based propensities (e.g., genetic make-up, temperament, broad personality traits, Rothbart, 2011) and ecological opportunities and constraints (e.g., stimulating early environments such as promotive early role models, parenting, and peer interactions in the formative years, Harris, 1995, or promotive external business conditions or role models in the occupational career; Scherer et al., 1989; Schmitt-Rodermund, 2004) on the development of an entrepreneurial mindset across childhood, adolescence, and adulthood. In other words, biologically based propensities, ecological opportunities, and constraints can be seen as "major forces" in a person's entrepreneurial development. A central part of the model is early characteristic adaptations in childhood/adolescence as a precursor of an entrepreneurial mindset in adulthood, through which biologically based propensities and ecological conditions exert an effect. Consistent with McAdams and Pals (2006), they are called characteristic adaptations because they arise from interactions with the context (e.g., parents or peers) via processes of adaptation, but these interactions occur in a typical manner because they are influenced by relatively stable and biologically based characteristics (e.g., temperament, broad personality traits). Examples of such early characteristic adaptations are age-appropriate early "entrepreneurial" competencies and skills (e.g., leadership, invention, and commercial skills, Obschonka et al., 2010; Obschonka, Silbereisen, & Schmitt-Rodermund, 2011; Schmitt-Rodermund, 2004; Schmitt-Rodermund, 2007) and motivational aspects (e.g., self-efficacy beliefs, self-esteem, values, goals, aspirations, and expectancies). Consistent with talent research (Bloom, 1985; Csikszentmihalyi et al., 1997), such early characteristics and achievements, in turn, build the developmental basis for the shaping of an entrepreneurial mindset in adulthood (e.g., via competence growth and deliberate practice, Ericsson & Charness, 1994). Such a mindset in adulthood is also influenced by biologically based propensities and ecological conditions present in adulthood (e.g., adult personality make-up; availability of role models), but these biological and ecological factors also reach back to the

formative years. For example, biological factors show stability (but also certain degrees of plasticity across the life span, e.g., in personality development or with respect to epigenetic processes such as differential gene expression, Meaney, 2010). The ecological opportunity structure should also show some stability and continuity across time, for example in terms of financial background in the family of origin and related cumulative (dis)advantage over the life course. Entrepreneurship education programs could be seen as part of the ecological opportunity structure (e.g., opportunities to learn and train entrepreneurial skills). Hence, the formation of entrepreneurial skills due to such entrepreneurship education programs are characteristic adaptations (how and what the student learns and how this becomes an integrative part of an entrepreneurial mindset).

Consistent with life span psychology stressing that at virtually each life stage, there is potential for change and growth (Baltes et al., 2006), the model also acknowledges that entrepreneurial development does not stop in adulthood but is, in principle, an ongoing process of learning and adaptation. For example, numerous studies demonstrated that people do not only select (or get selected into) their work environments according to their characteristics (e.g., competencies, interests, personality make-up). They also get socialised through work experiences (Frese, 1982) (e.g., entrepreneurs learn by doing, Cope, 2005), which, in our case, involves mutual transactions between the entrepreneurial mindset and entrepreneurial behaviour over time. Acknowledging the fundamental relevance of *early* socialisation, we argue that the most crucial periods in entrepreneurial development are the formative years (childhood and adolescence). Such an early development may affect, for example, how entrepreneurs learn by doing (Krueger, 2007). This emphasis on the early years is consistent with (1) developmental stage theories, locating fundamental aspects of successive personality and cognitive development (e.g., identity formation) in childhood and adolescence (e.g., Abrahams et al., 2019; Erikson, 1959; Havighurst, 1972; Super, 1980), (2) research hinting at early critical and sensible phases in skill growth (e.g., Heckman, 2006), and (3) theories stressing that entrepreneurial thinking and acting in adulthood involves "deep" cognitive structures that develop early in life (Krueger, 2007; McClelland, 1961). By pointing to the interplay between selection and socialisation, studies further indicate that work experiences deepen and sustain those personal characteristics that led to those experiences in the first place. Roberts et al. (2003) interpret such findings as suggesting that "work experiences … make us more of who we already are" (p. 592).

Moreover, one must acknowledge that human development is very complex; along the culturally framed age-graded developmental tasks (Havighurst, 1972), it involves manifold interactions and even transactions at (and between) biological, neurological, behavioural, and environmental

levels (Gottlieb, 2003). For example, for clarity and simplicity, the model does not explicitly specify interactions between biologically based propensities and contextual structures, but such links and dynamics might be relevant, too. For example, Schmitt-Rodermund (2007) showed that a subsequent entrepreneurial career in adulthood, as a developmental outcome, was particularly likely when both came together during adolescence, with an entrepreneurial personality structure and a supportive (authoritative) parenting style as a stimulating environment. More research is needed to explore such potential interactions and transactions.

Of particular interest for this work are adolescent precursors of entrepreneurship (which can be termed early characteristic entrepreneurial adaptations in adolescence). Numerous longitudinal studies showed career outcomes (e.g., occupational choice and attainment) rooted in childhood and adolescence, such as adolescent competencies and subsequent growth (Clausen, 1991; Masten et al., 2010). This seems to underline that the early formative years are a crucial developmental phase in the vocational development of a person (e.g., because this is a sensitive phase for the formation of basic skills and interests as well as for the development of the occupational self-concept and identity, Savickas, 1985). This would also be consistent with Heckman's (2006) life cycle skill formation approach discussed above, and one could assume that such skills do not form spontaneously in adolescence but are built on earlier skill formation and growth in childhood. Following Heckman's logic, developing age-appropriate entrepreneurial skills in adolescence builds on age-appropriate, underlying skills formed in childhood. For example, suppose a child lacks basic age-appropriate social skills (e.g., basic social communication skills). In that case, it might have more difficulty learning age-appropriate entrepreneurship-related social skills in adolescence (e.g., early leadership and commercial skills) than another child with better basic social skills (Obschonka et al., 2012a).

Moreover, as highlighted above, a central notion in Heckman's model is that societies that underestimate the importance of investments in early skill formation in childhood might bear higher costs when focussing on skill formation and growth programs targeting older age groups (e.g., adolescence and adulthood). Such programs' effectiveness (and efficiency) might be lower if these adolescents cannot rely on appropriate earlier skill formation and growth during childhood. It might be more costly for societies to overcome such "delayed" skill formation (Figure 1) when these inventions are implemented later in the skill formation age curve.

Growing evidence suggests that age-appropriate entrepreneurial competencies and interests in adolescence function as a developmental precursor of the entrepreneurial mindset in adulthood because these early factors are likely to develop and elaborate into work-related entrepreneurial skills, knowledge, motivation, and networks (early skills beget later skills). Hence, from this

perspective, the effective promotion of such early skills (e.g., via school programs) should indeed be beneficial for a person's subsequent entrepreneurial development over the lifespan. Interestingly, several studies indicate that a latent skill factor comprised of early leadership, inventive, and commercial skills are particularly indicative of age-appropriate entrepreneurial competence in adolescence (e.g., Obschonka et al., 2010, 2011a, 2011b; Schmitt-Rodermund, 2004). In other words, adolescents showing a competence pattern that indicates better skills across all three domains (leadership, inventions, commercial activities) at the same time appear to be more entrepreneurial. This is reminiscent of the balanced skills approach (Lazear, 2004, 2005) discussed above. Indeed, a common theme in a person's entrepreneurial development, and the formation and growth of entrepreneurial skills in particular, could be a specific variety focus (e.g., variety in interests and skills). In other words, entrepreneurial skills (in adolescents but also later in adulthood) are comparable to an orchestra where it is also essential that the single components (e.g., single skills as the single instruments in the orchestra) can harmonise and interact with each other in entrepreneurial ways (e.g., using an invention in commercial ways via leadership). What might matter for studying and promoting entrepreneurial skills could be a focus on the intraindividual dynamics between various relevant skills and interests.

Besides that variety focus and the research on a latent factor comprised of the three specific skills, another research indicates that a particularly relevant early competence domain beneficial for an entrepreneurial career appears to be social skills. Drawing upon a development-contextual approach, in a longitudinal study of 6116 young people born in the UK from birth to age 34, Schoon and Duckworth (2012) show that becoming an entrepreneur was associated with better social skills (and entrepreneurial intentions) demonstrated at age 16. Another analysis, using data from the British Cohort Study and the German Thuringian Founder Study, supported this finding by showing that early social skills in childhood and adolescence can predict entrepreneurial activity in adulthood and also entrepreneurial success (e.g., earnings) (Duckworth et al., 2012; Obschonka, Duckworth, et al., 2012; Schoon & Duckworth, 2012). Entrepreneurship studies found that social skills are a crucial aspect of the entrepreneurial mindset in adulthood (Baron & Tang, 2009), for example, because entrepreneurs often have to interact in social environments where reciprocal trust and effective social interaction and communication skills are essential (e.g., in interaction with customers, employees, investors, team founders, etc.). While more research is clearly needed, the existing developmental research indicates that entrepreneurs often differ from other people in their early social development as they exhibit better social skills than non-entrepreneurs in childhood and adolescence. The development of social skills has been described as a cornerstone of positive youth development in general (Abrahams et al., 2019), and entrepreneurship studies indicate

that this mainly applies to a person's entrepreneurial development.

Interestingly, research further indicates that entrepreneurs often additionally show some kind of, at first glance, "problematic" rule-breaking behaviour in their biography, for example, often in their adolescent years. Hence, the developmental pathway to successful entrepreneurship in adulthood is not just a story of developing and elaborating good entrepreneurial skills (e.g., early leadership skills, early inventive skills, early commercial skills) and social competencies; it also seems to be a matter of canalizing certain rule-breaking tendencies into a productive agency that is valuable for society because it creates jobs and develops innovations.

As already stressed by one of the fathers of entrepreneurship research, Joseph A. Schumpeter (Schumpeter, 1934), entrepreneurship often requires some productive rule-breaking and "creative destruction" (e.g., regarding innovation, competition, and creativity) (see also Pidduck & Tucker, 2022). Such productive rule-breaking tendencies, as a form of "positive deviance at work" (Sharma & Chillakuri, 2022), relate to a certain non-conformism and thinking out of the box. Biographies of famous entrepreneurs such as Steve Jobs provide plenty of stories of rule-breaking behaviour in their younger years. Indeed, in a recent retrospective study, Zhang and Arvey (2009) found entrepreneurs to show a stronger mild rule-breaking tendency in their adolescent behaviour but without drifting into law-breaking and criminal tendencies (severe rule-breaking). This retrospective result was then replicated for the male children of a longitudinal cohort study from Sweden, which were followed throughout their working life in adulthood (Obschonka, Andersson, et al., 2013). Those male study participants who showed manifest mild rule-breaking behaviour in their teenage years at home (e.g., ignoring parents' prohibitions, staying out late without permission), at school (cheating in an exam, truanting), and during leisure time (smoking hashish, getting drunk, shoplifting, loitering in town in the evening), had a higher likelihood of becoming entrepreneurs during the subsequent career than others. Another longitudinal study from the US could show that such early, mild rule-breaking behaviours do not only predict an entrepreneurial career but also entrepreneurial success, particularly when coupled with better intelligence and creativity (Levine & Rubinstein, 2013). Hence, one can conclude that the link between adolescent (mild) rule-breaking tendencies and subsequent entrepreneurship in adulthood appears to be quite well established in the literature (Randolph et al., 2022; Robert Neale et al., 2022; Yu et al., 2023; Zhu et al., 2022).

Such a "breaking the rules but not the law" attitude in the biographies of many entrepreneurs might also be mirrored in their school motivation during their school and college years. Anecdotal evidence seems to imply that many successful entrepreneurs were school/college dropouts, and a longitudinal study by Saw and Schneider (2012) using a representative sample from the US

indicates that budding entrepreneurs are mild rule-breakers in that they often have only modest school motivation levels (without however having a strong dropout intention). However, much more research is needed in this space.

A particularly relevant question for this literature review concerned with developing entrepreneurial skills refers to the drivers and mechanisms of how such early skills emerge. As explained above, one can approach this question by applying a biopsychosocial framework of human development that connects biological levels with psychosocial and various context levels of human development, with a particular focus on the human agency of the developing individual and how early entrepreneurship education interacts with these developmental mechanisms. For example, Schroder and Schmitt-Rodermund (2006) found the effect of a career development program designed to help adolescents explore and develop their entrepreneurial career interests to depend on whether the participating adolescents had an entrepreneurial family background (self-employed parents or close relatives). The program had a powerful, stimulating effect on the formation of entrepreneurial career interests in those adolescents who did not come from an entrepreneurial family background but had an entrepreneurial personality makeup (those teenagers who exhibited biologically based propensities but did not enjoy supportive developmental contexts so far). Such proximal ecological opportunities and constraints also concern the socioeconomic environment the child grows up in, as this may determine the learning and stimulation opportunities for early entrepreneurial development.

Furthermore, the model shown in Figure 3 assumes the early characteristic adaptations (the early psycho-social developmental precursors of the entrepreneurial mindset in adulthood) to affect identity formation processes, such as forming an entrepreneurial self-concept between adolescence and adulthood (where entrepreneurial work roles fit one's self-identity). This development of the entrepreneurial self-concept is also driven by the long-term interplay between the biologically related propensities and the ecological opportunities and constraints (see also Obschonka et al., 2015).

Both the early characteristic adaptions and the early developing occupational self-concept build the developmental basis of the entrepreneurial mindset in adulthood due to competence growth processes embedded in the person's general developmental timetables (Masten et al., 2010). These growth processes also concern the active self-selection and co-creation of relevant learning environments (e.g., specific courses in college, circle of friends, occupational specialisations, etc.). The entrepreneurial mindset in adulthood, which is directly relevant for successful entrepreneurial behaviour, then comprises the biologically related propensities (which are pretty stable across the lifespan but can also show some degrees of plasticity, like the Big Five

personality traits), and the developed characteristic adaptations and self-concepts factors. However, the development of the entrepreneurial mindset does not stop in young adulthood since the entrepreneurial development of a person is a lifelong process. For example, on-the-job learning while working as an entrepreneur should shape and elaborate the entrepreneurial mindset in adulthood. Numerous studies demonstrated that work experiences and conditions can shape how people think and behave (Kohn & Schooler, 1982), which can even be transmitted to the children of working adults via corresponding parenting practices (Crouter, 1993). The learning processes while conducting entrepreneurial tasks (e.g., starting and growing one's own innovative business) should, however, be based on the earlier learning and developmental history with the early precursors in childhood and adolescence (e.g., they deepen and elaborate early acquired entrepreneurial skills, but they do not really "conjure up" entrepreneurial skills out of the blue). This would again illustrate the crucial importance of early developmental processes in an entrepreneurial mindset over the lifespan.

Finally, while proximal developmental contexts are particularly important in the early entrepreneurial development of a person (where daily interactions and learning processes take place; for example with parents but also peer groups, Harris, 1995), more distal context levels, such as the regional level and also the broader macro-cultural level also matter, as they indirectly affect the development of early characteristic adaptions via the biologically related propensities and the proximal contexts. Research showed, for example, that personality factors such as the Big Five (e.g., the entrepreneurial Big Five profile) show systematic regional variation (Obschonka, Schmitt-Rodermund, et al., 2013). Hence, local populations differ in their biologically related propensities relevant to entrepreneurial development. Furthermore, distal contexts might shape children and adolescents' proximal learning and developmental environments via institutional factors and culture-specific norms and attitudes. Hence, the model shown in Figure 1 also explains the observation that entrepreneurial activity sometimes shows substantial differences across regions and countries worldwide.

The question of whether entrepreneurial development, as described in Figure 3 and the formation and growth of entrepreneurial skills in adolescents, particularly, shows systematic gender differences is not well researched. Some research findings point to the universality of the model (e.g., Schmitt-Rodermund et al., 2019). In contrast, other studies indicate that different early skills might predict subsequent entrepreneurship in female vs. male adolescents (e.g., Obschonka, Andersson, et al., 2013). This also concerns the question of potential gender differences in the entrepreneurial career outcomes themselves (e.g., the type of entrepreneurial activity, Link & Strong, 2016) because different entrepreneurial career outcomes might also have other early

developmental precursors (e.g., early rule-breaking might be particularly predictive of "rule-breaking" innovative, growth-oriented entrepreneurship, whereas early prosocial skills and attitudes might be particularly predictive of more socially-oriented entrepreneurship such as starting and running a social enterprise). However, these are speculations at this point. As highlighted by cognitive models of achievement-related choices like the Eccles et al. model discussed earlier, one should also consider beliefs and values and, more generally, the individual self-concept (partly shaped by actual skills but also by other "forces") that might help explain potential gender differences in developmental trajectories and mechanisms in the context of a person's entrepreneurial development and the role of (adolescent) skills for this development and related individual decision making.

Moreover, there is a growing literature on the critical role of work values for career development and outcomes (Parry & Urwin, 2011), including entrepreneurship (Chatterjee et al., 2021; Hirschi & Fischer, 2013; Lechner et al., 2018). Gender differences in work values could play an important role in gender differences in entrepreneurial career outcomes (Lechner et al., 2018). While the potential relationship and dynamics between skills development and values have been occasionally discussed in the broader literature (Cennamo & Gardner, 2008; From, 2017; McClelland, 1985), it is currently not very clear how skill development and work values are related in the context of entrepreneurial development.

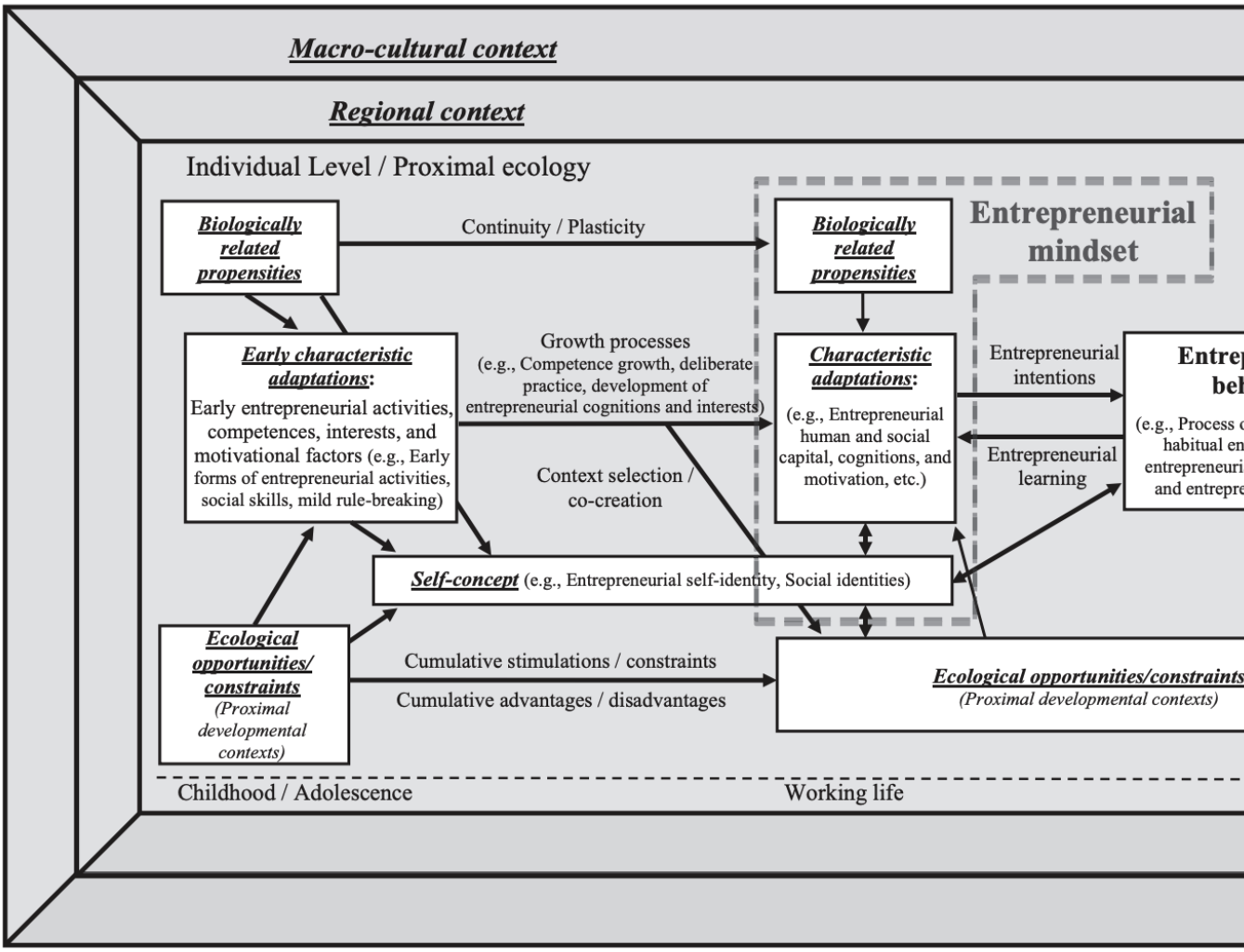

Figure 3. Developmental lifespan model of entrepreneurial development (with a focus on characteristic adaptions and self-concept and their relationships with biological factors and contexts). A person's entrepreneurial development is embedded in regional factors and processes as well as the broader macro-cultural context (source Obschonka, 2016)

The model in Figure 3 highlights proximal contexts as a central shaper of early characteristic adaptions, such as entrepreneurial skills in adolescents. An interesting question is what type of proximal developmental contexts matter for a person's early entrepreneurial development and, thus, for forming entrepreneurial skills in adolescence. While one can focus on institutions of education (e.g., school curriculum), it is essential to highlight that human development and skill growth are also shaped by other developmental contexts (Lerner, 2018), such as peer influence/socialisation (Harris, 1995, 2011) or the family context. Hence, compared to other developmental contexts, one can ask how relevant the educational context is for the formation and growth of entrepreneurial skills in adolescence.

It seems advisable to consider a holistic perspective that does not overemphasise the role of one particular context while neglecting the potential influence of other contexts. For example, more research is needed to test the hypothesis that early entrepreneurial skills are, to a substantial degree, a result of peer interactions and peer socialisation (e.g., an adolescent interacting and learning with and from their peers), and this could happen to a substantial degree outside of formal educational contexts and the family context (see also Harris, 1995; Harris, 2011). Bronfenbrenner's (1979) influential model of human development in context could serve as theoretical guidance for such research endeavours since it presents a well-elaborated scheme of relevant developmental contexts and their levels (e.g., micro, meso, exo, and macro contexts) as well as the relationship between the developing individual and the various context, and the relationships between the contexts themselves (see Figure 4). If one interprets entrepreneurial skills in adolescents as a developmental outcome (Obschonka et al., 2010), it would be advisable to consider such context-minded developmental theories specifying the person as embedded in and interacting with relevant developmental contexts as a system (Bronfenbrenner & Morris, 2007; Lerner & Damon, 2012; Vondracek et al., 2014).

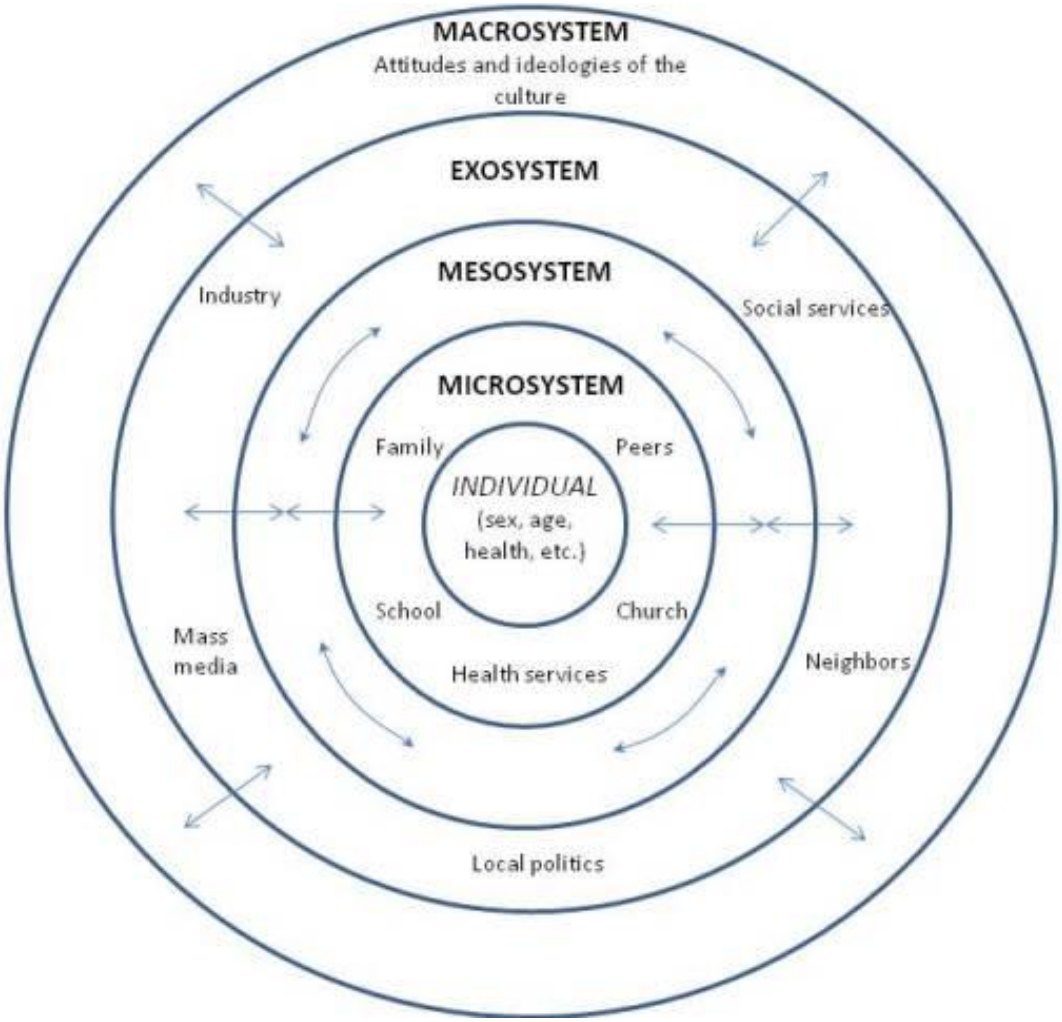

Figure 4. Ecological systems theory (Bronfenbrenner, 1979; Bronfenbrenner & Morris, 2007).

Finally, it should be noted that the development of entrepreneurial skills in adolescence can also be approached from a positive youth development perspective (Burkhard et al., 2019; Larson, 2000; Lerner et al., 2009). In this branch of developmental psychology, scholars are particularly interested in a person's positive thriving and (realisation of) personal potential. Entrepreneurial development has been linked to such positive youth development because it is an important component of adaptive vocational development in today's societies and their various challenges and opportunities (Geldhof et al., 2014; Silbereisen & Lerner, 2007). Central to such a positive youth development approach is the human agency perspective, according to which individuals are also active producers of their own positive development and not only passive recipients (e.g., of the various developmental contexts) (Heckhausen, 1997; Lerner & Busch-Rossnagel, 1981). From this perspective, one can ask to what degree entrepreneurial skills in adolescents are also the product of the human agency of children and adolescents, their own actions and attempted control over the environment. Such

entrepreneurial skills might not only be a result of biologically related propensities (e.g., personality) and stimulating developmental contexts (e.g., school context, or peers and family) but also the result of the choices and actions by the developing individual (e.g., choosing peers and how to interact with them, choosing hobbies and learning environments during leisure time, developing interests and preferences for certain vocational themes). Moreover, from this perspective many children and adolescents might face barriers preventing them from showing, and benefiting from, such own human agency as part of their entrepreneurial development (e.g., barriers undermining their human agency such as lack of favourable opportunity structure and resources).

One concrete example of such barriers is childhood adversity (e.g., concrete socioeconomic hardship due to macro-level crises and shocks such as war, famine, or significant economic depression), which has become a hot topic in contemporary entrepreneurship research (Churchill et al., 2021). Again, childhood and adolescence are critical and foundational developmental periods shaping the formation of cognitive and non-cognitive skills relevant to entrepreneurial work over the occupation career. It is highlighted, for example, that "scholars of adolescent development show that such hardship forces individuals to become more self-reliant, resilient, and resourceful, each of which is a quality that explains and predicts the propensity for entrepreneurship" (Cheng et al., 2021, p.2). This led to the working hypothesis that early hardship can promote psychological resilience and related skills, which can affect later entrepreneurial career outcomes (Yu et al., 2022). In psychology and sociology, there is a myriad of research indicating that such crises and shocks experienced in childhood/adolescence can, despite their immediate short-term negative effect, foster specific personal resources such as resilience as a long-term effect, which then shapes the developmental trajectories of these individuals in characteristic ways (Elder & Shanahan, 2006; Elder, 1974; Masten, 2001). In a recent study, Yu et al. (2023) find indications that childhood adversity hampers the development of abilities beneficial for entrepreneurship (e.g., self-efficacy and human capital) while (particularly in male subjects) it seems to stimulate rule-breaking tendency that increases the likelihood for an entrepreneurial career. Another concrete example of early adversity is the refugee crisis. Research indicates that, beside many other effects, this can affect the personal agency in those affected (e.g., young adult refugees), and that it is important to restore such personal agency (e.g., proactive entrepreneurial thinking and activities in refugees) to leveraging their entrepreneurial skills (Obschonka & Hahn, 2018).

4. Systematic Review

Following a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) design (Liberati et al., 2009), this section reviews the available literature regarding entrepreneurship education and adolescent entrepreneurial skills development. By systematically reviewing the literature, we also aim to address potential bias (Fineout-Overholt et al., 2010), which may transpire in a non-systematic literature review (Mulrow, 1994).

4.1. Method

Under the PRISMA guidelines (Liberati et al., 2009), we developed a review protocol with the following steps: Development of the research question (see Figure 1), Identification of search databases, Definition of scope, inclusion, and exclusion criteria, Definition of a search term, A systematic search for information, Screening and selection of studies, Review of selected articles, and Summarizing of findings.

4.1.1. Search Databases

We identified relevant papers through searches in Scopus (www.scopus.com) on the 02nd of March 2021, Web of Science (www.webofknowledge.com) on the 03rd of March 2021 and ProQuest (www.proquest.com) on the 04th of March 2021.

4.1.2. Literature Search Criteria

Our search focused on peer-reviewed journal articles in English, which provide data-driven evidence. The applied exclusion criteria were: not being relevant to enterprise education or entrepreneurial education, theoretical discussions, unsupported conclusions, missing evaluations, work related to universities and evaluation from a perspective other than adolescent end-users (i.e., older than 22 years of age). For the current study, an adolescent, as per the UN definition (UNICEF, 2011), is a young person between 10 and 19 years of age. However, we included research on adolescents up to age 21-22, given that high school students can be older in some developing countries.

4.1.3. Search Term

The search term deployed in Scopus was:

(TITLE-ABS-KEY (entrepreneur OR enterpris*) AND TITLE-ABS-KEY (program* OR learning OR training OR intervention OR project) AND TITLE-ABS-KEY (adolescent* OR young* OR youth*) AND NOT TITLE-ABS-KEY (universit*))*

The search term deployed in Web of Science was:

#1: TI=(entrepreneur OR enterpris*) OR AB=(entrepreneur* OR enterpris*) OR AK=(entrepreneur* OR enterpris*)*

#2: TI=(program OR learning OR training OR intervention OR project) OR AB=(program* OR learning OR training OR intervention OR project) OR AK=(program* OR learning OR training OR intervention OR project)*

#3: TI=(adolescent OR young* OR youth*) OR AB=(adolescent* OR young* OR youth*) OR AK=(adolescent* OR young* OR youth*)*

#4: TI=(universit) OR AB=(universit*) OR AK=(universit*)*

#5: #1 AND #2 AND #3 NOT #4

The search term deployed in ProQuest was:

(TI(entrepreneur OR enterpris*) OR AB(entrepreneur* OR enterpris*) OR IF(entrepreneur* OR enterpris*)) AND (TI(program* OR learning OR training OR intervention OR project) OR AB(program* OR learning OR training OR intervention OR project) OR IF(program* OR learning OR training OR intervention OR project)) AND (TI(adolescent* OR young* OR youth*) OR AB(adolescent* OR young* OR youth*) OR IF(adolescent* OR young* OR youth*)) NOT (TI(universit*) OR AB(universit*) OR IF(universit*))*

4.1.4. Search and Screening Results

The search in Scopus returned 2,351 records. The output was limited to documents in English, which reduced the number of papers to 2,169. Limiting the search to peer-reviewed journals as a source and relevant science fields (Social sciences, Business management and accounting, Economics econometrics and finance, Psychology, Arts and Humanities, Computer science, Decision sciences and Multidisciplinary) left 1,169 records. We limited the search to these science fields as these are typical areas for entrepreneurship research. Those records were limited to document-type articles and reviews, which left 1,143 titles to be screened for relevance. Out of those, 235 documents were selected for abstract review. After the abstract screening, 90 papers were marked for further processing.

The search on the Web of Science returned 1,397 records. Those records were limited to document-type articles, reviews, and early access, leaving 948 titles to be screened for relevance. Out of those, 115 documents were selected for abstract review. After the abstract screening, 62 papers were marked for further processing.

The initial search in ProQuest returned 34,630 records. The results were limited to peer-reviewed, reducing the count to 1,549 records. Limiting to English further reduced the number of papers to 1,432. Subsequently, the output was limited to articles, reviews, literature reviews, reports, data reports and undefined document types, leaving 1,155 titles to be screened for relevance. Out of those, 114 documents were selected for abstract review, with 55 marked for further processing.

All papers marked for further processing were imported into an Excel sheet to allow for the removal of duplicates. One hundred thirty-eight articles remained after duplicates were removed. Their full texts were downloaded for review. While 101 studies were found not to comply with our inclusion criteria, an additional 14 articles were identified through snowballing. Thus, 51 papers were retained to be included in the qualitative synthesis (see Figure 5).

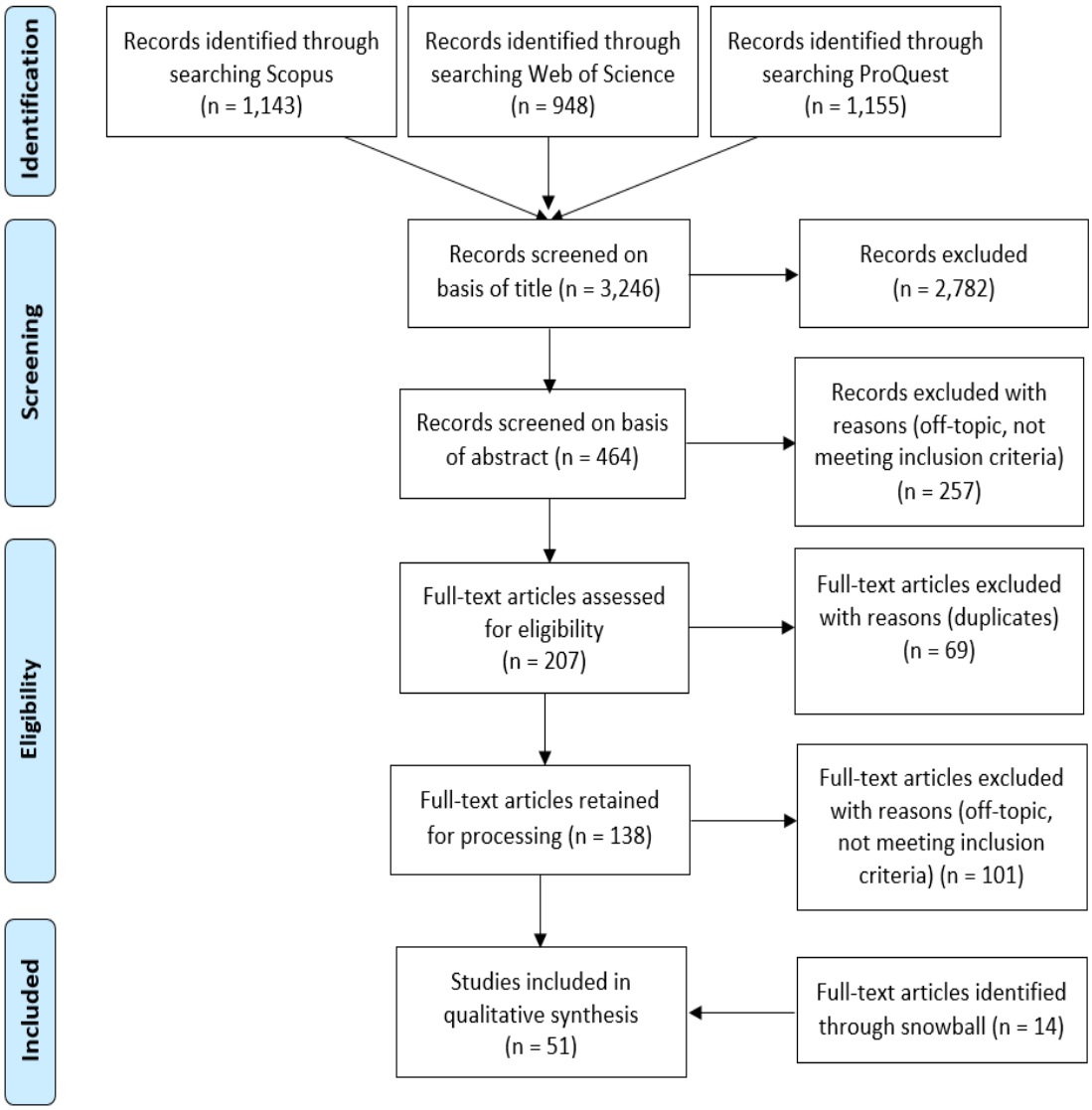

Figure 5. Data extraction flowchart based on the PRISMA statement.

5. Findings

Entrepreneurship education articles that fit our selection criteria started appearing in 1997 (see Figure 6). Despite the small number of publications per year, the trend was upward and picked up during the last decade. The highest number of works (n=9) was published in 2020.

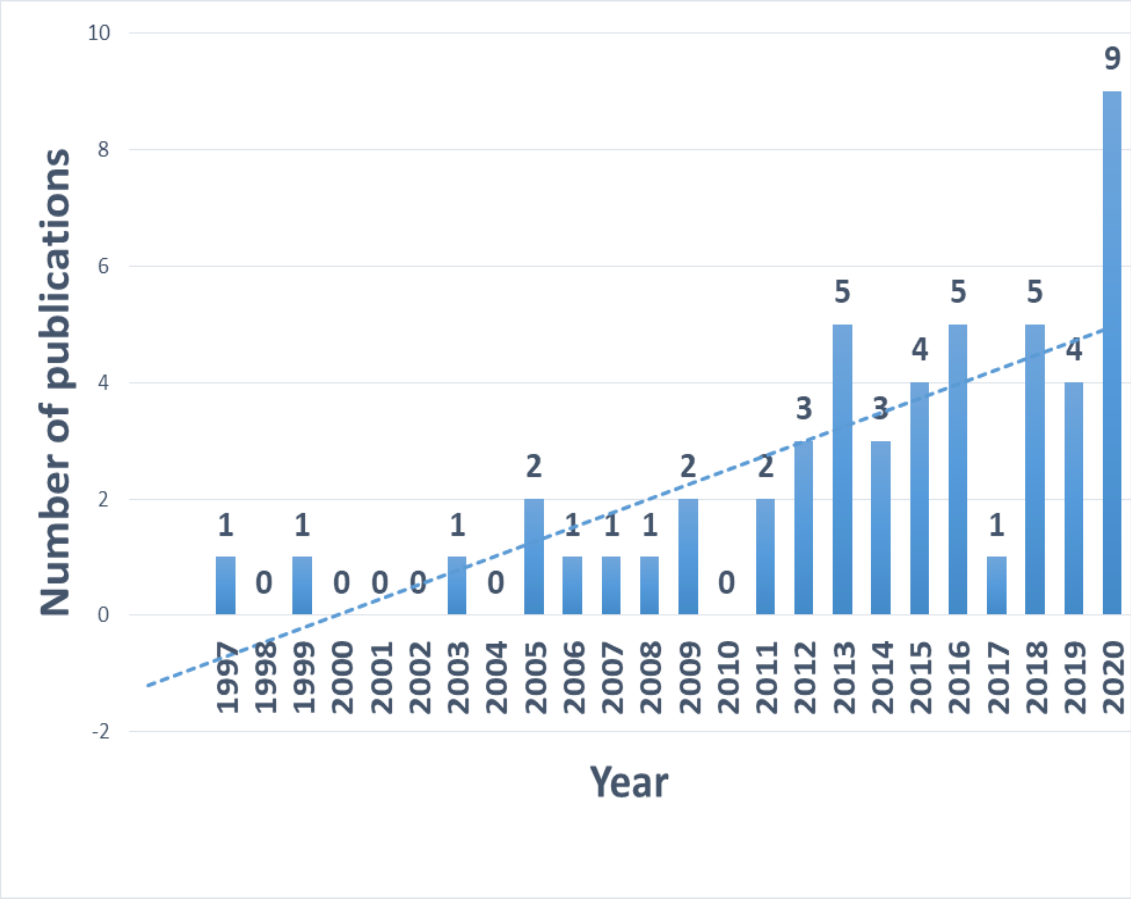

Figure 6. Number of identified publications per year

A breakdown of articles according to the empirical data contexts reveals the number of studies focusing on urban areas (n=23) was over three times more than rural areas (n=7) (see Table 1). Studies were executed in both developed and developing countries (Table 1). A synthesis of the reviewed studies is presented in Table 2.

The studies' in-depth analysis revealed the investigated interventions' variability and reported results (see Table 6 in Annex I). For example, to a greater or a lesser extent, all articles contained a theoretical discussion. However, many (n=26) did not ground their work in a specific theory. Of the ones that did, Ajzen (1991)'s Theory of Planned Behaviour (TPB) was the most widely used (n=8) (e.g., Aljaouni et al., 2020; Boukamcha, 2015; do Paço et al., 2015; Marques et al., 2012; Sánchez, 2013; Thompson & Kwong, 2016; Turner & Lapan, 2005; Williams, 2015). The

TPB is not a theory on skill development but rather a framework identifying the most important and proximal predictors of planned behaviour (such as an entrepreneurial career choice) and underlying behavioural intentions (such as entrepreneurial intentions). It focused on attitudes, norms, and control beliefs as the central predictors of intentions leading to behaviour. Second to TPB were the closely related Attitude theory (n=3) (e.g., Robinson et al., 1991) and Social-cognitive theory (n=3) (Bandura, 1986). Additionally, ten other theories were referred to, such as Human Capital theory (Volery et al., 2013), Skill Formation theory by Cunha and Heckman (2007) (e.g., Huber et al., 2014), Social Support theory (e.g., Ferguson, 2018a; Ferguson, 2018b), Action-regulation theory (e.g., Gielnik et al., 2016), Experimental Learning theory (e.g., Grewe & Brahm, 2020; Kourilsky & Esfandiari, 1997; Williams, 2015), Social Cognitive theory (e.g., Heinrichs, 2016; Ho et al., 2018), theory of Occupational Aspirations (e.g., Turner & Lapan, 2005), Apprenticeship theory (Leffler & Svedberg, 2005), Vocational theory (e.g., Schroder & Schmitt-Rodermund, 2006), and Project-based Learning (Rodriguez & Lieber, 2020).

Table 1. Synthesis of articles.

	No. of studies
Rural	7
Urban	23
n.a.	21
General Primary	7
General Secondary	25
Vocational Secondary	2
n.a.	16
USA	7
Germany	4
UK	4
Portugal	3
Tanzania	3
China (Hong Kong)	2
Israel	2
Netherlands	2
Norway	2
Spain	2
Sweden	2
Australia	1
Botswana	1
Canada	1
Jordan	1
Korea	1
Lesotho	1
Mexico	1
Nigeria	1
Singapore	1
Slovenia	1
South Africa	1
Switzerland	1
Tunisia	1
Uganda	1
n.a.	3
Sum of articles	51

Breakdown of articles according to empirical data contexts.

Table 2. The number of studies that report positive, negative, or insignificant results of the entrepreneurship education programs on outcomes.

		+	-	o
Non-cognitive skills	Ent awareness	2	0	0
	Ent attitude/ orientation	4	0	0
	Credit demand/financial decision-making	1	1	0
	Profit making capacity	1	0	0
	Enterprise potential	2	0	0
	Autonomy	2	0	2
	Initiation	3	0	0
	Ent self-efficacy/ self-esteem	8	1	5
	Ent knowledge	11	0	1
	Leadership	0	0	2
	Cooperation	1	0	0
	Project management skills	2	0	0
	Social-emotional skills	1	0	2
	Ent ambitions/ desire for achievements	4	0	4
	Business knowledge	11	0	1
	Ent mindset	1	0	1
	Ent desirability	4	1	1
	Ent feasibility	5	0	0
	Perceived Behaviour Control	0	0	1
	Innovativeness/ creativity	6	0	3
	Locus of Control	4	0	1
	Propensity to Risk	2	0	3
	Tolerance of Ambiguity	1	0	1
	tolerance of failure	2	0	0
	School performance	0	0	1
	Ent opportunity identification	5	0	2
	Proactiveness	1	0	0
	Career development and planning	1	0	0
Cognitive skills		2	0	0
Other entrepreneurial outcomes	Entrepreneurial intentions	6	1	4
	Job creation/ Ent behaviour	7	0	1
	Ent income	1	0	0
	Firm survival	0	0	1

Key: (+) Positive effect. (−) Negative effect. (o) ambiguous effect/not enough empirical evidence.

5.1. Study Design and Final Sample Constitution

Table 3 includes details of the study design, final samples, and settings for each study. The studies differed in their research designs, with some (n=3) using a mixed design approach (i.e., Barba-Sánchez & Atienza-Sahuquillo, 2016; Cheung, 2008; Santini et al., 2020). A qualitative-only design was applied by four studies (i.e., Assan, 2012; Fitzgerald, 1999; Iseselo et al., 2019; Leffler & Svedberg, 2005), with the rest using some form of a quantitative investigation. Those quantitative studies included randomised controlled trials (RCTs) with ex-ante and ex-post data collection (n=9) and quasi-experiments with ex-ante and ex-post (n=8) or only with ex-post data collection (n=2). The largest group (n=14) used some other form of quantitative ex-ante/ex-post data collection, while another big group (n=11) used only ex-post data.

The recruited samples varied as well. One study did not provide any information about the number of its participants (i.e., Fitzgerald, 1999), while two others included census data in their analysis, reporting samples of 16,343 (Thompson & Kwong, 2016) and 211,754 (Elert et al., 2015). When those three studies were excluded as outliers, the average reported sample size was 453 participants, ranging from 20 (Assan, 2012) to 2,413 (Huber et al., 2014).

Irrespective of the sample sizes, the investigated studies can be considered gender-equal. Despite that 16 studies did not report gender distribution and could not be assessed, females' participation in the remaining 35 ranged from 0%, i.e., all-male (Bano, 2018; Iseselo et al., 2019) to 100%, i.e., all-female (Berry et al., 2013). With those three extreme cases removed, the average female participation was 50%.

Similar to gender, age was not reported in all studies, with 11 omitting that information. Nevertheless, the remaining studies, in their totality, covered all ages of adolescents, e.g. 8 to 12 (Barba-Sánchez & Atienza-Sahuquillo, 2016; Cárcamo-Solís et al., 2017; Huber et al., 2014), 13 to 16 (Halilović et al., 2014; Ho et al., 2018; Tingey et al., 2020), 16 to 20 (Berzin et al., 2018; Johansen & Foss, 2013; Kim et al., 2020) and above 20 (Berry et al., 2013; Ferguson, 2018a; Santini et al., 2020).

Table 3. Effects of an education program on a range of skills and other entrepreneurial outcomes (Articles' selection arranged by first author's last name)-summary for each study is included in this table.

		Authors	Aljaouni et al. (2020)	Alzua et al. (2020)	Assan (2012)	Athayde (2012)	Athayde (2009)	Barba-Sánchez and Atienza-Sahuquillo (2016)
		Study design	Ex-post		Qualitative	RCT ex-ante/ex-post	Ex-post cross-sectional	Mixed
		Final sample (% female, age range)	1630 (45%, n.a.)	555 (82%, 18-35)	20 (n.a., 18-39)	276 (45%, 15-18)	249 (51%, 15-20)	49 (n.a., 8-12)
		Settings (Country, Rural/Urban, Educational level and system)	Jordan, Urban, General Secondary	Uganda, Urban, n.a. n.a.	Botswana, Rural, n.a. n.a.	UK, Urban, General Secondary	UK, Urban, General Secondary	Spain, Rural, General Primary
Impact on…	**Non-cognitive skills**	Ent awareness	+					
		Ent attitude/ orientation	o					
		Credit demand/financial decision-making		-				
		Profit making capacity			+			
		Enterprise potential				+	+	
		Autonomy						+
		Initiation						+
		Ent self-efficacy/ self-esteem						
		Ent knowledge						
		Leadership						
		Cooperation						
		Project management skills						
		Social-emotional skills						
		Ent ambitions/ desire for achievements						
		Business knowledge						
		Ent mindset						
		Ent desirability						
		Ent feasibility						
		Perceived Behaviour Control						
		Innovativeness/ creativity						
		Locus of Control						
		Propensity to Risk						
		Tolerance of Ambiguity						
		tolerance of failure						
		School performance						
		Ent opportunity identification						
		Proactiveness						
		Career development and planning						
	Cognitive skills							
	Other entrepreneurial outcomes	Entrepreneurial intentions	-					+
		Job creation/ Ent behaviour			+			
		Ent income						
		Firm survival						

Note: (+) Positive effect (−) Negative effect (o) No impact

		Authors	Bano (2018)	Bergman et al. (2011)	Berry et al. (2013)	Berzin et al. (2018)	Bjorvatn et al. (2020)	Boukamcha (2015)
		Study design	RCT ex-ante / ex-post	Quasi-experimental ex-ante / ex-post	Ex-ante / ex-post	Ex-post	Quasi-experimental ex-post	Ex-ante / ex-post
		Final sample (% female, age range)	1042 (0%, 14-25)	266 (52%, 12-17)	40 (100%, 17-22)	129 (49%, 16-20)	2132 (55%, av. 18)	240 (37%, 85% 20-30)
		Settings (Country, Rural/Urban, Educational level and system)	Nigeria, Rural, General Primary	Israel, n.a., General Secondary	Lesotho, n.a., n.a. n.a.	n.a., Urban, n.a. n.a.	Tanzania, Urban, General Secondary	Tunisia, n.a., n.a. n.a.
Impact on…	**Non-cognitive skills**	Ent awareness						
		Ent attitude/ orientation						
		Credit demand/financial decision-making						
		Profit making capacity						
		Enterprise potential						
		Autonomy						
		Initiation						
		Ent self-efficacy/ self-esteem		o		+		+
		Ent knowledge		o	+			
		Leadership				o		
		Cooperation						
		Project management skills				+		
		Social-emotional skills				o		
		Ent ambitions/ desire for achievements					+	
		Business knowledge					o	
		Ent mindset					o	
		Ent desirability						+
		Ent feasibility						+
		Perceived Behaviour Control						
		Innovativeness/ creativity						
		Locus of Control						
		Propensity to Risk						
		Tolerance of Ambiguity						
		tolerance of failure						
		School performance						
		Ent opportunity identification						
		Proactiveness						
		Career development and planning						
	Cognitive skills							
	Other entrepreneurial outcomes	Entrepreneurial intentions	+			o	+	+
		Job creation/ Ent behaviour						
		Ent income						
		Firm survival						

		Authors	Cárcamo-Solís et al. (2017)	Cheung (2008)	do Paço et al. (2015)	do Paço and Palinhas (2011)	Elert et al. (2015)	Ferguson (2018b)
		Study design	Ex-ante / ex-post	Mixed (ex-ante / ex-post, no control group)	Ex-post	Ex-post	Ex-post, 16 years after the training	RCT ex-ante / ex-post
		Final sample (% female, age range)	254 (n.a., 11-12)	50 (n.a., n.a.)	1015 (72%, 11-16)	620 (n.a., 6-8)	211754 (49%, 17-19)	48 (17%, 16-24)
		Settings (Country, Rural/Urban, Educational level and system)	Mexico, n.a., General Primary	China (Hong Kong), Urban, General Secondary	UK, Urban, Vocational Secondary	Portugal, n.a., General Primary	Sweden, n.a., General Secondary	USA, Urban, n.a. n.a.
Impact on…	**Non-cognitive skills**	Ent awareness						
		Ent attitude/ orientation		+				
		Credit demand/financial decision-making						
		Profit making capacity						
		Enterprise potential						
		Autonomy						
		Initiation						
		Ent self-efficacy/ self-esteem			o			
		Ent knowledge	+			+		
		Leadership						
		Cooperation						
		Project management skills		+				
		Social-emotional skills		+				
		Ent ambitions/ desire for achievements			o			
		Business knowledge	+	+				
		Ent mindset						
		Ent desirability						
		Ent feasibility						
		Perceived Behaviour Control			o			
		Innovativeness/ creativity			o			
		Locus of Control			+			
		Propensity to Risk			o			
		Tolerance of Ambiguity			o			
		tolerance of failure						
		School performance						
		Ent opportunity identification						
		Proactiveness						
		Career development and planning						
	Cognitive skills							+
	Other entrepreneurial outcomes	Entrepreneurial intentions			o			
		Job creation/ Ent behaviour					+	
		Ent income					+	
		Firm survival					o	

		Authors	Ferguson (2018a)	Fitzgerald (1999)	Gargouri and Naatus (2019)	Gielnik et al. (2016)	Grewe and Brahm (2020)	Halilović et al. (2014)
		Study design	RCT ex-ante / ex-post	Qualitative (outcome analysis, interviews)	Ex-ante / ex-post	RCT ex-ante / ex-post	Quasi-experimental ex-ante / ex-post	Ex-ante / ex-post
		Final sample (% female, age range)	48 (17, 16-24)	n.a. (n.a., n.a.)	22 (n.a., n.a.)	178 (n.a., n.a.)	100 (54%, 13-20)	146 (62%, 14-15)
		Settings (Country, Rural/Urban, Educational level and system)	USA, Urban, n.a. n.a.	USA, Urban, General Secondary	n.a., n.a., n.a., n.a.	Uganda, Urban, Vocational Secondary	Germany, Urban, General Secondary	Slovenia, n.a., General Primary
Impact on…	**Non-cognitive skills**	Ent awareness						
		Ent attitude/ orientation			+			
		Credit demand/financial decision-making						
		Profit making capacity						
		Enterprise potential						
		Autonomy						
		Initiation						
		Ent self-efficacy/ self-esteem			-		o	
		Ent knowledge						
		Leadership						
		Cooperation						
		Project management skills						
		Social-emotional skills						
		Ent ambitions/ desire for achievements			+			
		Business knowledge					+	+
		Ent mindset						
		Ent desirability						
		Ent feasibility						
		Perceived Behaviour Control						
		Innovativeness/ creativity			+			+
		Locus of Control			+			
		Propensity to Risk						
		Tolerance of Ambiguity						
		tolerance of failure						
		School performance		o				
		Ent opportunity identification				+	o	
		Proactiveness						
		Career development and planning						
	Cognitive skills							
	Other entrepreneurial outcomes	Entrepreneurial intentions						
		Job creation/ Ent behaviour	o			+		
		Ent income						
		Firm survival						

		Authors	Heilbrunn and Almor (2014)	Heinrichs (2016)	Ho et al. (2018)	Huber et al. (2014)	Iseselo et al. (2019)	Johansen (2013)
		Study design	Quasi-experimental ex-ante / ex-post	Ex-ante / ex-post single group	Quasi-experimental ex-ante / ex-post	RCT ex-ante / ex-post	Qualitative	Ex-post
		Final sample (% female, age range)	630 (37%, av. 14)	55 (60%, 20-77)	328 (72%, 13-16)	2413 (50%, 11-12)	36 (0%, 18-35)	1171 (45%, 17-18)
		Settings (Country, Rural/Urban, Educational level and system)	Israel, n.a., General Secondary	Germany, Urban, n.a., n.a.	Singapore, Urban, General Secondary	Netherlands, n.a., General Secondary	Tanzania, Urban, n.a., n.a.	Norway, n.a., General Secondary
Impact on…	**Non-cognitive skills**	Ent awareness						
		Ent attitude/ orientation						
		Credit demand/financial decision-making						
		Profit making capacity						
		Enterprise potential						
		Autonomy						
		Initiation						
		Ent self-efficacy/ self-esteem	+	+	+	+		
		Ent knowledge	+	+		o	+	
		Leadership						
		Cooperation						
		Project management skills						
		Social-emotional skills						
		Ent ambitions/ desire for achievements				+		
		Business knowledge					+	
		Ent mindset						
		Ent desirability	o					
		Ent feasibility	+					
		Perceived Behaviour Control						
		Innovativeness/ creativity				+		
		Locus of Control						
		Propensity to Risk				+		
		Tolerance of Ambiguity						
		Tolerance of failure						
		School performance						
		Ent opportunity identification				+		
		Proactiveness						
		Career development and planning						
	Cognitive skills							
	Other entrepreneurial outcomes	Entrepreneurial intentions				o		
		Job creation/ Ent behaviour						+
		Ent income						
		Firm survival						

			Authors	Johansen and Foss (2013)	Kim et al. (2020)	Kourilsky and Esfandiari (1997)	Krause et al. (2016)	Leffler and Svedberg (2005)	Marques et al. (2012)
			Study design	Ex-post	Quasi-experimental ex-ante / ex-post	Quantitative (ex-post control group)	Ex-ante / ex-post	Qualitative (observations, interviews, written material)	Ex-post
			Final sample (% female, age range)	1187 (44%, 16-19)	1934 (45%, 16-20)	95 (n.a., n.a.)	434 (n.a., 15-26)	169 (n.a., n.a.)	202 (n.a., n.a.)
			Settings (Country, Rural/Urban, Educational level and system)	Norway, n.a., General Secondary	Korea, n.a., General Secondary	USA, Urban, General Secondary	Tanzania, n.a., n.a., n.a.	Sweden, Rural, n.a., n.a.	Portugal n.a., Vocational Secondary
Impact on…	**Non-cognitive skills**		Ent awareness						
			Ent attitude/ orientation		+				
			Credit demand/financial decision-making				+		
			Profit making capacity						
			Enterprise potential						
			Autonomy						
			Initiation					+	
			Ent self-efficacy/ self-esteem						
			Ent knowledge	+		+			
			Leadership						
			Cooperation					+	
			Project management skills						
			Social-emotional skills						
			Ent ambitions/ desire for achievements						
			Business knowledge	+	+		+		
			Ent mindset						
			Ent desirability						
			Ent feasibility						
			Perceived Behaviour Control						
			Innovativeness/ creativity		+			+	
			Locus of Control						
			Propensity to Risk						
			Tolerance of Ambiguity						
			tolerance of failure						
			School performance						
			Ent opportunity identification	+	+				
			Proactiveness						
			Career development and planning						
	Cognitive skills								
	Other entrepreneurial outcomes		Entrepreneurial intentions	+	+				o
			Job creation/ Ent behaviour		+				
			Ent income						
			Firm survival						

		Authors	Oosterbeek, Van Praag, et al. (2010)	Pepin and St-Jean (2019)	Peterman and Kennedy (2003)	Pinho et al. (2019)	Rodriguez and Lieber (2020)	Sánchez (2013)
		Study design	RCT ex-ante / ex-post	Quasi-experiment ex-post	Ex-ante / ex-post	Ex-ante / ex-post	Quasi-experimental ex-ante / ex-post	Quasi-experimental ex-ante / ex-post
		Final sample (% female, age range)	250 (45%, <19->21)	359 (57%, 10-12)	220 (59%, 15-18)	48 (50%, 8-10)	269 (46%, n.a.)	710 (57%, 14-16)
		Settings (Country, Rural/Urban, Educational level and system)	Netherlands, Urban, General Secondary	Canada, Urban, General Primary	Australia, n.a., General Secondary	Portugal, Urban, General Primary	USA, Urban, General Secondary	Spain, n.a., n.a. Secondary
Impact on…	**Non-cognitive skills**	Ent awareness				+		
		Ent attitude/ orientation				+		
		Credit demand/financial decision-making						
		Profit making capacity						
		Enterprise potential						
		Autonomy	o					
		Initiation						
		Ent self-efficacy/ self-esteem	o					+
		Ent knowledge						
		Leadership		o				
		Cooperation						
		Project management skills						
		Social-emotional skills	o					
		Ent ambitions/ desire for achievements	o	o				
		Business knowledge				+		
		Ent mindset					+	
		Ent desirability			+			
		Ent feasibility			+			
		Perceived Behaviour Control						
		Innovativeness/ creativity	o	o				
		Locus of Control		o				
		Propensity to Risk	o					+
		Tolerance of Ambiguity						
		tolerance of failure						
		School performance						
		Ent opportunity identification						
		Proactiveness						+
		Career development and planning						
	Cognitive skills							
	Other entrepreneurial outcomes	Entrepreneurial intentions	-					+
		Job creation/ Ent behaviour						
		Ent income						
		Firm survival						

			Authors	Santini et al. (2020)	Schroder and Schmitt-Rodermund (2006)	Thompson and Kwong (2016)	Tingey et al. (2020)	Turner and Lapan (2005)
			Study design	Mixed	Ex-ante / ex-post	Ex-post	RCT ex-ante / ex-post	Quasi-experimental ex-ante / ex-post, non-equivalent groups
			Final sample (% female, age range)	33 (52%, 18-29)	623 (47%, 14-26)	16343 (n.a., 18-45)	394 (58%, 13-16)	160 (47%, av. 12.5)
			Settings (Country, Rural/Urban, Educational level and system)	Germany, Italy and Slovenia, n.a., n.a., n.a.	Germany, n.a., General Secondary	U.K., n.a., n.a. General Secondary	USA, Rural, n.a., n.a.	USA, n.a., General Secondary
Impact on…	**Non-cognitive skills**		Ent awareness					
			Ent attitude/ orientation					
			Credit demand/financial decision-making					
			Profit making capacity					
			Enterprise potential					
			Autonomy					
			Initiation					
			Ent self-efficacy/ self-esteem	+				
			Ent knowledge				+	
			Leadership					
			Cooperation					
			Project management skills					
			Social-emotional skills					
			Ent ambitions/ desire for achievements		+			
			Business knowledge					
			Ent mindset					
			Ent desirability		+			
			Ent feasibility					
			Perceived Behaviour Control					
			Innovativeness/ creativity					
			Locus of Control		+			
			Propensity to Risk		+			
			Tolerance of Ambiguity					
			tolerance of failure					
			School performance					
			Ent opportunity identification					
			Proactiveness					
			Career development and planning					+
	Cognitive skills			+				
	Other entrepreneurial outcomes		Entrepreneurial intentions			o		
			Job creation/ Ent behaviour					
			Ent income					
			Firm survival					

		Authors	van der Westhuizen and Goyayi (2020)	Volery et al. (2013)	Williams (2015)	Yu and Man (2007)
		Study design	Ex-ante / ex-post non-experimental, not controlled	Ex-ante / ex-post	Ex-ante / ex-post	Ex-ante / ex-post
		Final sample (% female, age range)	109 (53%, 17-55)	291 (46%, av. 19.3)	32 (n.a., n.a.)	490 (n.a., n.a.)
		Settings (Country, Rural/Urban, Educational level and system)	South Africa, Rural, n.a., n.a.	Switzerland, n.a., n.a., Secondary	n.a., n.a., n.a., n.a.	China (Hong Kong), Urban, General Secondary
Impact on…	**Non-cognitive skills**	Ent awareness				
		Ent attitude/ orientation				
		Credit demand/financial decision-making				
		Profit making capacity				
		Enterprise potential				
		Autonomy		o	+	
		Initiation			+	
		Ent self-efficacy/ self-esteem		o		
		Ent knowledge		+		+
		Leadership				
		Cooperation				
		Project management skills				
		Social-emotional skills				
		Ent ambitions/ desire for achievements		o	+	
		Business knowledge			+	+
		Ent mindset				
		Ent desirability		+		-
		Ent feasibility		+		+
		Perceived Behaviour Control				
		Innovativeness/ creativity			+	+
		Locus of Control			+	
		Propensity to Risk		o		
		Tolerance of Ambiguity			+	
		tolerance of failure			+	+
		School performance				
		Ent opportunity identification		o	+	
		Proactiveness				
		Career development and planning				
	Cognitive skills					

	Other entrepreneurial outcomes	Entrepreneurial intentions		o		
		Job creation/ Ent behaviour	+	+		
		Ent income				
		Firm survival				

5.2. Delivery Settings

The most significant number of studies came from the USA (n=6), followed by the UK and Germany, each with four studies. Other European countries were also represented, such as Portugal (n=3), Sweden (n=2), the Netherlands (n=2) and Spain (n=2). Canada and Australia, from the industrialised non-European countries, contributed one study each. China, as an Asian representative, contributed two studies, and Korea with 1 study.

African countries had a relatively large representation in our sample (n=13). Single studies were identified in Botswana (Assan, 2012), Jordan (Aljaouni et al., 2020), Lesotho (Berry et al., 2013), Nigeria (Bano, 2018), South Afrika (van der Westhuizen & Goyayi, 2020) and Tunisia (Boukamcha, 2015). Israel (Bergman et al., 2011; Heilbrunn & Almor, 2014) and Uganda (Alzua et al., 2020; Gielnik et al., 2016) are represented in our sample by two studies each. The most significant contribution of the three studies came from Tanzania (Bjorvatn et al., 2020; Iseselo et al., 2019; Krause et al., 2016).

Three studies did not provide information about the country of implementation. Nearly half of the identified articles (n=21) did not provide information about whether the evaluated entrepreneurship education intervention occurred in a rural or urban environment. Of those who reported such data, 23 identified with urban, while the remaining seven identified with rural.

Most of the studies (n=25) were implemented at the secondary, including vocational (n=2) level of education. Primary school was the setting in 7 cases. Such information was not provided in 16 of the papers. The educational system was identified as general in 29 cases, vocational in 3, and not specified in the remaining 19 cases.

5.3. Reported Impact of the Entrepreneurship Education Programs

The analysis of the 51 articles identified through the systematic review process helps to find answers to the research questions of this paper. In the following, we will provide an analysis of each research question based on a synthesis of the relevant findings.

5.3.1. Results Regarding the Second Research Question

As our second research question, we asked: *Can entrepreneurship education programs, especially in developing countries and rural contexts, help to foster enterprising behaviours and entrepreneurial alertness in adolescents? If so, why, how and to what extent?*

As documented in Table 3, we investigated the reported impact of entrepreneurship education programs on 1) non-cognitive skills, 2) cognitive skills, and 3) other entrepreneurial outcomes. Annex I provides more information about the different variables included in each study in those dimensions when applicable. When an impact was reported, we presented the information in Table 3 under a positive (+), no impact (o), or negative (-) label, indicative of the direction of the impact. Due to the diverse range of non-cognitive skills, we documented details of the specific studied skills (i.e., 28 variables) in Table 3. Because there was no sufficient information on the actual effects sizes of the impact of a program across the 51 studies, we do not summarise and compare them here.

A majority of the studies (n=43) examine the impacts of entrepreneurship education programs on non-cognitive skills, with 30 reporting a positive impact, one a negative impact, and the rest with mixed findings of positive, negative, and non-significant results. Studies also examined the impact of entrepreneurship education programs on other entrepreneurial outcomes such as entrepreneurial intentions (n=14), entrepreneurial behaviour and job creation (n=8), entrepreneurial income (n=1), and firm survival (n=1). Seven studies found positive, two negative, and five non-significant impacts on entrepreneurial intentions. Seven studies found a positive impact of entrepreneurship education programs on entrepreneurial behaviour and job creation, with one non-significant result.

Overall, these studies indicate a certain effectiveness of such entrepreneurship education programs. Also, the results align with the notion that non-cognitive entrepreneurial skills can be developed early (Huber et al., 2014). Boukamcha (2015), in a study on a sample of students in Tunisia, reports positive influences of such programs on the trainees' entrepreneurial desirability, perceived entrepreneurial feasibility and, subsequently, entrepreneurial intentions. Athayde (2012), in a study of 276 students who attended a Young Enterprise (YE) Company Program in London, found that participation does have a positive impact on young people's enterprise potential. However, this is moderated by attending a non-selective school, having a black ethnic background, and being a male. Such findings about how adolescents' contextual factors can affect educational programs' effectiveness is useful for policy makers and program designers by indicating who currently benefits the most from enterprise programs, and which groups could benefit even more. Overall,

the findings emphasis the need for sensitivity in the deployment of early entrepreneurship education, and caution against a one-size-fits-all approach (see for example Lindner, 2020).

Such considerations are even more emphasised in rural contexts since the benefits of developing entrepreneurial skills and motivation in adolescence can help create jobs in local communities and retain their population from migration to cities. Barba-Sánchez and Atienza-Sahuquillo (2016) report successful results of entrepreneurship education programs on the entrepreneurial intentions of a sample of primary school students in rural areas of Spain. However, in the marginalised and rural contexts, in gauging the long-term effectiveness of such entrepreneurship programs for adolescents, the availability and accessibility of resources should also be considered. For instance, Bano (2018) studied a large sample of male Muslim youth in Northern Nigeria who attended a 6-month Technical and Vocational Education and Training program. Their findings show while the entrepreneurial intentions of the group who participated in the program increased threefold, the responses in a follow-up survey revealed no differences between the control and treatment groups in terms of starting up a business. This shows in impoverished areas. Further considerations must be considered when designing entrepreneurship education programs in terms of providing linkages with the employment market or access to seed capital (Bano, 2018).

In addition to the availability of seed capital for the successful implementation of entrepreneurship education programs and their effectiveness, Cárcamo-Solís et al. (2017) findings show the significant influence of the tutors and advisors for exploitation of business opportunities existing in the communities where entrepreneurial programs were offered to students in primary schools in Mexico. Specifically, they showed the number of advisors and the number of tutors per mini-company (i.e., a micro-company that is organised in the same way as real small and microenterprises, and the underlying purpose is to allow youngsters to learn how to create, organise and manage a business) positively and significantly predicted the percentage of successful mini-companies in each state of Mexico that received seed funding. Therefore, structuring entrepreneurship education programs where advisors and tutors are assigned to small teams of students that closely monitor their experiential learning, encourage their communication and self-confidence, and strengthen their decision-making skills can influence the effectiveness of such programs (Sarasvathy, 2009). On a similar note but taking a different approach, Blimpo and Pugatch (2021) studied the effects of entrepreneurship programs designed to train and support secondary school entrepreneurship teachers in Rwanda. Despite some mixed results, their results demonstrable pedagogical change (e.g., using instructional techniques specific to the

entrepreneurship curriculum, such as role play and group discussion) and increased student engagement in business activities more than two years after the program began.

Another important consideration in designing entrepreneurship education programs for adolescents is the emphasis on experiential learning. Elert et al. (2015) examined the long-term effects of the Junior Achievement Company Program (JACP) program, which was provided to Swedish high school students in the mid-1990s, in a longitudinal study with a relatively large sample. JACP is a practical program with the objective of providing high school students with the chance to train and develop entrepreneurial skills by experiencing the whole lifecycle of a company through a "learning-by-doing" approach (Elert et al., 2015). Their results showed that JACP participation increased the probability of starting a firm (measured 11 years after graduation) and entrepreneurial income for those running a firm.

According to some research findings, designing a practical entrepreneurship training program based on traditional credits and standardised grading might be less effective (Souitaris et al., 2007). For example, Gielnik et al. (2016) suggest that entrepreneurship training needs to be flexible and provide an open setting that allows trainees to fail and go back and forth in the entrepreneurial process. Gielnik et al. (2016) followed an evidence-based entrepreneurship approach to develop Student Training for Entrepreneurship Promotion (STEP) in Africa. STEP program emphasises the importance of action for the promotion of entrepreneurship. Action is a goal-directed behaviour based on the action-regulation theory (Frese, 2009). In order to take action to achieve a goal, two aspects are essential, namely, action sequence (i.e., which consists of the different steps involved in taking action. These steps are setting goals, seeking information, forming action plans, executing and monitoring the action, and, eventually, seeking feedback.), and operative mental model (i.e., that is the cognitive representation of action. It comprises people's knowledge about relevant actions, about how to perform the actions, and about the environment in which people operate.). A long-term evaluation of STEP demonstrates its impact on participants' entrepreneurial action regulation and their subsequent success in entrepreneurship (Gielnik et al., 2015). Studying a sample of students who attended STEP in Uganda, Gielnik et al. (2016) find that STEP has a positive impact on trainees' business opportunity identification and entrepreneurial action. Considering embedding entrepreneurship learning in various subjects at school instead of formalised, stand-alone interventions, it is noteworthy to mention programs such as Youth Start-Entrepreneurial Challenges as a European policy experimentation project. One noteworthy aspect of this educational initiative is its integration of entrepreneurship education directly into teachers'

regular curricula. This is achieved through well-organised and standardised instructional units that can be seamlessly incorporated into various subjects, while remaining aligned with broader learning objectives. By adopting this approach, the initiative ensures that entrepreneurial skills and mindset development become an integral part of students' everyday learning experiences, rather than an isolated or optional aspect of their education. Research findings from large RCTs with a large number of high school students show that participation in the program led to higher entrepreneurial self-efficacy and intentions for students (Streicher et al., 2019). Interestingly, however, the results were not as strong for students from families where parents had lower educational attainments (Streicher et al., 2019).

The impact of entrepreneurship education programs on cognitive skills is reported in 2 studies, both reporting positive effects (e.g., Ferguson, 2018b; Santini et al., 2020). Santini et al. (2020) studied the impact of an educational program that linked mentors from older adult entrepreneurs with mentees of young people neither in employment nor education and training (NEETs) in Germany, Italy, and Slovenia. In most cases, mentees acquired cognitive competencies (e.g., the ability to reproduce, recognise, and understand contents, the ability to exercise, identify, and apply knowledge, and the ability to use, transfer and analyse knowledge) as well as metacognitive competencies (e.g., the ability to check, try out and recognise their knowledge processes, the ability to process knowledge, compare it to the situation, transform the knowledge content and to explain it, the ability to design, estimate, evaluate and interpret their way of acquiring new knowledge). The process also enhanced the mentoring competencies of the mentors. Such intergenerational learning programs provide opportunities not only for adolescent employment but also facilitate the transfer of knowledge from the experiences of older entrepreneurs. It also provides mentors and mentees with the basis for developing a critically essential and enduring attitude, i.e., the desire to continue learning at any age (Latchem, 2014).

We now focus on non-significant outcomes of entrepreneurship education programs. For instance, Grewe and Brahm (2020) studied 100 students in Germany who attended an entrepreneurial education program and found that compared to the students in the regular economic class, students who participated in the mini-company program did not develop differently regarding entrepreneurial competencies in the personal or team level. Nevertheless, they found that students who attended the program significantly differed regarding their development of economic competencies (i.e., “understanding economic concepts”, “working strategically and action-oriented”, “developing strategies and business concepts”, and “calculating and managing risks”).

Grewe and Brahm (2020) interpret their results by unwrapping the experiential learning approach to the developed program, which helps learn factual information, and experiential learning techniques foster definitional knowledge, such as applying concepts to specific tasks and applying economic knowledge rather than reflecting on working in teams.

Huber et al. (2014) studied the effects of a leading entrepreneurship education program (i.e., BizWorld) on a sample of primary students in the Netherlands. While they find a positive and significant impact of the program on the non-cognitive skills of students (i.e., risk-taking, creativity, need to achievement, self-efficacy, social orientation, pro-activity, analyzing, and motivating), they do not find support for the impact of the program on students' persistence, entrepreneurship knowledge, and their entrepreneurial intentions. They suggest that the program does not seem to have an intended effect on developing entrepreneurship knowledge. They also suggest measuring children's entrepreneurial intentions at 11 or 12 is challenging, and the current measurements are mainly developed for more mature respondents. Marques et al. (2012) also did not find a significant impact of entrepreneurship education on the entrepreneurial intentions of 202 middle school students in Portugal. While somewhat surprising, the results are not unprecedented. Pepin and St-Jean (2019) also find participating in an entrepreneurship learning program does not significantly impact the students' entrepreneurial attitudes. Oosterbeek, Van Praag, et al. (2010) report even negative effects of such programs on the entrepreneurial intentions of college students. However, this decline in entrepreneurial intentions might be a preferred response to the programs, as Von Graevenitz et al. (2010) suggest. It is because providing children with a more realistic view of what becoming an entrepreneur entails, lets only the students with the higher entrepreneurial ability choose an entrepreneurship career. However, other factors could also contribute to such insignificant and negative results. For instance, the program participants may simply have disliked the program. Other contributing factors might be compulsory participation, the demanding time and effort with little achieved credit for attendance, a hampered active involvement due to a large number of students in class, and not following the guidelines by the teachers (Oosterbeek, Van Praag, et al., 2010; Pepin & St-Jean, 2019). Related research findings in underdeveloped settings also point to the influence of offering financial support for transportation and food to such vocational programs, which can substantially enhance the program's effectiveness, hinting at the potential obstacles individuals may face due to resource constraints when considering entrepreneurial training that might require transportation (Barrera-Osorio et al., 2020).

Finally, Thompson and Kwong (2016) suggest that the central role of entrepreneurship education

programs must be to create a sustained and enduring interest rather than a situational one. This can be achieved by providing diverse, continuous and repetitive exposure to nurture the entrepreneurial interests of the participants until they are technically and mentally ready to engage in entrepreneurial activities (Thompson & Kwong, 2016). Accordingly, Thompson and Kwong (2016) show that compulsory school-based entrepreneurship education has the potential to generate sustained interest in entrepreneurial activity. They show that it does not directly influence entrepreneurial activity and attitudes but operates through increased voluntary engagement with university-based enterprise education and government training schemes. Therefore, a holistic approach to engaging students from a young age can increase the effectiveness of entrepreneurship education impact. University courses need to follow the efforts of earlier educational stages to ensure they are effective in providing skills, knowledge, and confidence that builds entrepreneurs (Thompson & Kwong, 2016).

5.3.2. Results Regarding the Third Research Question

As our third research question, we asked *whether entrepreneurship education programs have the same impact on female and male adolescents in developing perceptions of entrepreneurial competencies and intentions. If not, what are the differences?*

To answer this research question, we re-analysed the 51 articles in our sample to find studies that had explicitly addressed gender effects in their modelling and analysis. This revealed that 16 of the studies had included gender as a control variable in their analysis but did not focus on it in their results and implications. We found ten articles that investigated gender effects as a central research question. Table 4 presents these articles to summarise their structure, hypotheses, analysis, and findings. While 8 of these studies had the same treatment for males and females (e.g., the same type of entrepreneurship education program), do Paço et al. (2015) and Berry et al. (2013) focused on the impact of gender-specific entrepreneurship education programs for girls.

Table 4. A summary of the studies focused on gender differences in entrepreneurship education outcomes.

Article	Research Question	Descriptive of sample(s)	Same treatment or gender-specific treatment?	Gender hypotheses	Results	Interpretations
Heinrichs (2016)	How the participants perceived a developed Entrepreneurship Education Course (EEC) by authors and how it worked based on findings on an evaluation study.	Sample size=55, 60% female, 20-77 age	same treatment	n.a.	Data suggest a significant increase in both entrepreneurial self-efficacy and knowledge. Women seem to make more progress than men do by joining the intervention. Comparing the pre-test and post-test ratings for entrepreneurial self-efficacy, only women showed impressive improvement with large effect size and high power. Among males, there was no significant treatment effect for knowledge or self-efficacy. Similarly, women who participated in the blended learning course significantly increased their entrepreneurial knowledge from pre-test to post-test, while men did not.	Engaging in active learning environments is advantageous for female entrepreneurship.

do Paço et al. (2015)	Which of the two forms of socialisation (formal education or gendered socialisation) most influence entrepreneurial characteristics and intentions?	Sample size=1015, 72% female, 11-16 age	gender-specific treatment only for the female respondents	This study seeks to compare the psychological attributes and behaviours associated with entrepreneurship and entrepreneurial intentions among girls attending a business school and boys attending a sports school. It was expected that the scores recorded for entrepreneurial behaviour and intentions would be higher at the girls' business school, where entrepreneurship education is deeply incorporated into the curriculum.	Despite not receiving any entrepreneurship education, the boys at the neighbouring sports school tended to have a greater intention of starting a business.	Entrepreneurship education facilitates the creation of new businesses but is insufficient to explain successful entrepreneurship. The authors suggest educators should promote a female vision of entrepreneurial success (fighting against stereotypes), especially among women.

Berry et al. (2013)	Whether a Girls Empowerment Program (GEP) Camp effectively transmitted entrepreneurial or income-generating knowledge more broadly to a purposively selected cohort of rural women in Lesotho, Africa.	Sample size=40; 100% female, 11-22 age	gender-specific treatment	n.a.	The findings suggest that the income-generating activities module significantly impacted the camp participants' knowledge about income-generating activities.	The camp module and follow-up training encouraged the formation of cooperative efforts. However, the authors suggest there is a deficit in accessible programs. Further, this brief process evaluation suggests that even a half-day module on income-generating activities may enhance the knowledge and skills needed to develop a small home-based enterprise. Therefore, short programs like this may be a more sustainable and feasible approach to helping women become economically empowered.

Johansen and Foss (2013)	The main aim is to assess whether a European entrepreneurship program called the "Company Program" (CP) promotes start-up activity. RQ1. Are former participants in CP more likely to be involved in start-up activity as compared to non-participants? RQ2. Does CP affect women and men to the same degree concerning start-up activity?	Sample size=1171; 45% female, 16-18 age	same treatment	n.a.	Although the results indicate that CP positively influences start-up activity, the impact of CP on start-up activity is more remarkable for men than women. The results show significant differences regarding involvement in start-up activity between male and female respondents, whether or not they participate in CP.	One important factor that might explain the results is based on the results that show females feel less confident and capable of initiating start-up activity than males. Perceived levels of competencies and qualifications are more important than actual levels of competencies and qualifications. Another factor is that the fear of failure is more important for women than men (Wagner, 2007). Thus, shaping confidence and increasing perceived competency in entrepreneurial skills among women through EE could effectively increase female entrepreneurship. In addition, EE needs to focus on raising awareness of the available institutional support and how to secure financing since lack of support is a notable barrier to female start-up activity (Shinnar et al., 2012).

Turner and Lapan (2005)	To investigate the effects of a computerised career intervention for middle school adolescents designed to increase their career awareness, their efficacy in engaging in career planning and exploration, their efficacy in engaging in educational planning for specific occupations, and their vocational interests in non-traditional careers.	Sample size=160; 47% female, 12.5 on average age	same treatment	H1: there would be significant differences at pre-test in the career interests and efficacy of adolescents as a function of gender. H2: there would be significant increases at post-test in career planning and exploration efficacy and educational and vocational development efficacy for both boys and girls in the experimental group but not in the control group. H3: there would be significant increases at post-test in non-traditional career interests for both boys and girls in the experimental group but not in the control group	The results partially supported Hypothesis 1. H2: supported. The results mostly support Hypothesis 3.	These results were found after only 1 to 112 hours of participation, confirming Luzzo's and Pierce's (1996) observation that computer-assisted career guidance systems can bring about positive gains in a short time among young adolescents and substantiating the effectiveness of Mapping Vocational Challenges (MVC) in accomplishing the purpose for which it was designed. In addition, this current study extends the results of earlier studies by (a) engaging adolescents in career exploration both before and after the assessment of their interests, (b) using a computerised interest inventory that produces a visual map of the relationships between an individual's career interests and their sex-typing of occupations; (c) encouraging adolescents to explore those non-traditional careers that they identified rather than those that the researchers predetermined; and (d) assisting them in exploring those educational pathways that could lead to entry into specific non-traditional careers.

Bergman et al. (2011)	Our main objective was to test the impact of an entrepreneurship training program on young entrepreneurs, aiming, in particular, to identify whether the training program enhances its participants' entrepreneurial self-efficacy and entrepreneurial knowledge, and whether it has a differential effect on boys and girls.	Sample size=266; 52% female, 12-17 age	same treatment	The effect of the entrepreneurship training program on entrepreneurial self-efficacy will be moderated by gender, with a stronger positive effect on boys than girls.	The results showed that training had a different effect on entrepreneurial self-efficacy for males than females, supporting Hypothesis 3. The controlled variable (age) had no significant effect on entrepreneurial self-efficacy.	Though previous research suggests that women have lower entrepreneurial self-efficacy than men (e.g., Chowdhury and Endres, 2005; Kourilsky and Walstad, 1998), in our study, girls who chose to participate in the entrepreneurship training program had higher scores of entrepreneurial self-efficacies at the beginning of the program than did boys. This may suggest that girls need higher confidence levels in their entrepreneurial competencies than boys to enrol in the program.

Ho et al. (2018)	(1) Does systematic entrepreneurship training could effectively account for changes in secondary school students' entrepreneurial alertness and efficacy? (2) Do active/experiential and passive learning activities differentially improve entrepreneurial competencies and efficacy?	Sample size=328; 72% female, 13-16 age	same treatment	n.a.	The significant finding of gender as a covariate aligns with the gender gap commonly noted in entrepreneurship research. In our results, we also observed that female students who attended the program scored lower than male students in all dimensions of entrepreneurial self-efficacy and alertness.	It has previously been suggested that the masculine discourse surrounding entrepreneurship (Ahl and Marlow, 2012) and societal stereotypes of entrepreneurship as predominantly masculine (Gupta et al., 2008) may lead to females being less likely to identify themselves as entrepreneurs, regardless of the types of activities in which they have been involved (Verheul et al., 2005). Other authors have found that for females, having a role model can help boost their entrepreneurial self-efficacy (Barnir et al., 2011). The study provides further support to account for gender heterogeneity in future work (Westhead and Solesvik, 2016).
Athayde (2009)	The main focus of the study was the attempt to measure the effect of participation in a Young Enterprise (YE) Company Program on young people's attitudes toward starting a business and on their enterprise potential.	Sample size=249; 51% female, 15-20 age	same treatment	Young men and women will differ in their desire for business ownership.	Gender was not significant overall, though for each of the three options of being self-employed, working for a small firm, or being employed in a professional occupation, boys were more likely to make a positive choice than girls.	The desire for self-employment was found to be related to demographic characteristics, such as ethnic background, gender, and having a self-employed parent.

Johansen (2013)	Does entrepreneurship education have the same impact on women and men with regard to perceptions of business skills, career preferences and belief in local business opportunities?	Sample size=1187; 44% female, 16-19 age	same treatment	n.a.	Differences between male and female respondents on all four dependent variables are significant, whether or not they participated in CP.	Overall, females are underrepresented when compared with males in all dimensions investigated. This tendency holds true even when receiving the same education (CP) and coming from similar backgrounds. To be more effective towards encouraging potential female start-up activity, one could argue that CP should become more focused on exploring women's particular needs and more seriously considering their questions and concerns with starting a business.

van der Westhuizen and Goyayi (2020)	The research examines the development of entrepreneurial self-efficacy (ESE) among South African youth in business tech startups. It advances knowledge of youth entrepreneurship development by adopting an action research design to analyse the impact of technology in stimulating entrepreneurial activities among youth. While the primary aim of this investigation was to determine the development of ESE in an online business scenario, further interest was in seeking to understand the moderating effect of demographic factors such as age, gender, race and education.	Sample size=109; 53% female, 17-55 age	same treatment	n.a.	The results showed differences between the change of ESE for men and women.	Contrary to several prior studies, including Mueller and Dato-On (2008) and Spagnoli and Caetano (2015), that found little or no significant difference in ESE changes among men and women, the study found a significant difference between male and female respondents.

The studies indicate that the effect of entrepreneurship educational programs is overall positive on the non-cognitive skills of both girls and boys, such as on the knowledge development about income-generating activities (Berry et al., 2013), entrepreneurial knowledge and self-efficacy (Heinrichs, 2016), career planning and exploration efficacy, and educational and vocational development efficacy (Turner & Lapan, 2005), as well as other important entrepreneurial outcomes such as start-up activities (Johansen & Foss, 2013). However, there seem to be differences in the degree of effectiveness of such programs between girls and boys.

Focusing on non-cognitive skills, Heinrichs (2016) showed that girls who attended an entrepreneurship education course in Germany showed significant improvements in entrepreneurial self-efficacy and knowledge. In contrast, boys who attended the same program did not show such significant improvement. Likewise, Johansen and Foss (2013) found that female students who participated in an entrepreneurship education program in Norway improved their perceptions of business skills, while there was no such impact on males' business skills who attended the same program. One explanation might be that access to entrepreneurship education is more important for women than men in increasing their levels of self-efficacy and, ultimately, their interest in starting their own ventures. For women, *perceived* levels of competencies and qualifications are more important than *actual* levels of competencies and qualifications (Wilson et al., 2007). Women need an expectation of success and the self-confidence to participate in entrepreneurial activities (Scherer et al., 1990). So, women may need targeted educational programs to confirm their entrepreneurial competencies rather than just developing them (Krueger, 1993). Providing entrepreneurial training for girls at an early age is therefore potentially important to shape their entrepreneurial self-efficacy and prevent entrepreneurial career options from being overlooked by them in their early lives (Johansen & Foss, 2013).

do Paço et al. (2015) predicted that there might be significant differences between girls and boys regarding their entrepreneurial intentions. They tested their hypotheses on two samples: girls attending a single-sex International Business and Enterprise College and boys studying at a separate but nearby single-sex specialist Sports College in England. Surprisingly, they found that despite not receiving any entrepreneurship education, the boys at the neighbouring sports school tended to have a greater entrepreneurial intention. This is while girls attending the business school received entrepreneurship education incorporated into all curriculum levels. However, do Paço et al. (2015) administered their questionnaire only at one time and at the end of the semester. So, their results cannot suggest the effectiveness of the entrepreneurial courses on female entrepreneurial

intentions since they have not collected data about preexisting intentions. Neither of their results can compare the effects of entrepreneurship education programs on boys and girls since only girls received the treatment. However, their findings may suggest that having an entrepreneurship education is not enough to promote female entrepreneurship (Dutta et al., 2011). Entrepreneurial education programs are shown to benefit from the diversity of educational experiences, such as studying abroad for one or two semesters, interning with a non-profit organisation, etc. (Dutta et al., 2011).

Additionally, entrepreneurial programs targeting female students may benefit their students more by considering their specific needs, such as fighting against stereotypes by introducing and engaging more successful female entrepreneurs in the delivery of their programs (do Paço et al., 2015). Using female role models in the entrepreneurship education programs has been recognised in the literature (see Moberg, 2020). To enhance the effectiveness of such programs for women, a combination of in-person and online entrepreneur role models should be considered, with a particular focus on extending these opportunities to the most disadvantaged female cohorts (Moberg, 2020).

Bergman et al. (2011) studied the entire contingent of high-school students participating in the YE – Israel training program in the 2006–2007 school year, mostly from grade nine but also from lower and higher grades (roughly 2,500 children) by collecting data at the beginning of the program, T1, and at the end of the program, T2. The sample contained the training condition, consisting of participants in the YE training program, and the control condition, consisting of matched students of the same class level (age) who did not participate in the program. While entrepreneurial self-efficacy significantly improved for males in the training group from T1 to T2, for females in the training group, it significantly declined. In the control group, no significant change occurred from T1 and T2 for either males or females. In the training condition, females had higher entrepreneurial self-efficacy than males in the initial phase of T1. Still, at T2, the levels of entrepreneurial self-efficacy of females and males in the training condition did not differ significantly. Using the mixed model procedure, they tested for the three-way interaction effect of training by time and gender while controlling for the effects of age and gender. The three-way training by time by gender interaction was significant, which means that training had a different effect on entrepreneurial self-efficacy for males than for females, supporting the hypothesis that the effect of the entrepreneurship training program on entrepreneurial self-efficacy will be moderated by gender, with a stronger positive effect on boys than girls. The controlled variable

(age) had no significant effect on entrepreneurial self-efficacy. Bergman et al. (2011) repeated the tests on entrepreneurial knowledge as the outcome variable. For females, entrepreneurial knowledge significantly improved from T1 to T2 for both the training and control groups. For males, in the control group, entrepreneurial knowledge showed a significant improvement from T1 to T2 but less than the significant improvement in the training group. The three-way interaction effect of training by time and gender was marginally significant. The controlled variable (age) had no significant effect on entrepreneurial knowledge.

Following a similar experimental and longitudinal research design as Bergman et al. (2011), Ho et al. (2018) studied students from five secondary schools in Singapore who registered for an entrepreneurship training program (treatment group) and who did not (control group). They also showed that female students in the same entrepreneurship education program scored lower than male students in all tested dimensions of entrepreneurial self-efficacy and alertness (i.e., entrepreneurial skillset, entrepreneurial mindset, and three dimensions of entrepreneurial alertness). To interpret the declining self-efficacy of girls in their sample from the beginning to the end of attending the programs compared to boys, Bergman et al. (2011) point to the highly competitive nature of the entrepreneurship program (i.e., the training program of Young Entrepreneurs) having prestigious awards. They explain that, while providing equal opportunities, such structures may affect male and female participants' outcomes differently. In their experimental study, Gneezy et al. (2003) find that women may be less effective than men in competitive environments, even if they can perform equally in non-competitive environments.

Additionally, they find that increasing the competitiveness of the environment leads to a significant increase in performance for men but not for women. Interestingly, Gneezy et al. (2003) also show that this effect is stronger when women have to compete against men than in single-sex competitive environments. This suggests that designing entrepreneurship education programs that are gender-specific for female-only groups might be more beneficial in supporting female entrepreneurship with higher chances of developing non-cognitive skills and entrepreneurial intentions and behaviour in a less competitive setting.

Finally, Berry et al. (2013) studied the effectiveness of a female-only and half-day entrepreneurial education program on a small sample of 40 participants in the African nation of Lesotho by administrating a questionnaire before and after the program. Their overall findings suggest that the income-generating activities module significantly impacted the camp participants. Specifically, a

follow-up study after six months shows that even a half-day module on income-generating activities may enhance the knowledge and skills needed to develop a small home-based enterprise and lead to actual entrepreneurial behaviour. Berry et al. (2013) suggest such skills and financial independence are essential to enable rural girls to complete their secondary schooling (in a fee-based educational system) and to pursue a career, as well as to help them further be less susceptible to transactional sex and its significant risks. Berry et al. (2013) also point to community involvement in the success of entrepreneurship education programs for females in rural and developing countries. Therefore, in designing such gender-specific programs, educating and involving the community might provide further support for female entrepreneurship and lead to more successful results (Berry et al., 2013).

Table 5. A summary of key take-away points from our analysis in answering the research questions

1st Research Question: *How and when are entrepreneurial mindsets and enterprising behaviours formed during the individual's lifespan? What are their potential impacts on the individual's work and social life and the potential effects on the labour market outcomes and social behaviours?*
• The human skill formation process (including cognitive and non-cognitive skills) is governed by a multistage process where skills produced at one stage augment the skills attained at later stages. Research findings show if a society wants to promote the general skills level (e.g., in disadvantaged children), it is more economical and efficient for a society to achieve this through early programs and interventions targeting childhood and adolescent ages, compared to later investments in adulthood. • Biologically based propensities, ecological opportunities, and constraints can be seen as "major forces" in a person's entrepreneurial development across childhood, adolescence, and adulthood. According to the life span model, early characteristic adaptations are central in childhood/adolescence as a precursor of an entrepreneurial mindset in adulthood, through which biologically based propensities and ecological conditions exert an effect. Entrepreneurship education programs could be considered part of the ecological opportunity structure (e.g., opportunities to learn and train entrepreneurial skills). Hence, the formation of entrepreneurial skills due to such entrepreneurship education programs are characteristic adaptations (how and what the student learns and how this becomes an integrative part of an entrepreneurial mindset). • Growing evidence suggests that age-appropriate entrepreneurial competencies and interests in adolescence function as a developmental precursor of the entrepreneurial mindset in adulthood because these early factors are likely to develop and elaborate into work-related entrepreneurial skills, knowledge, motivation, and networks (early skills beget later skills). Hence, from this perspective, the effective promotion of such early skills (e.g., via school programs) should indeed be beneficial for a person's subsequent entrepreneurial development over the lifespan. Interestingly, several studies indicate that a latent skill factor comprised of early leadership, inventive, and commercial skills is particularly indicative of age-appropriate entrepreneurial competence in adolescence. • Research suggests that entrepreneurs should have a significant variety of skills to succeed (jack of all trades), compared to deeper expertise in a single domain (domain expert). Therefore, targeting younger ages for entrepreneurship education programs by engaging them in a broader variety of activities can positively impact the development of entrepreneurial skills. • Numerous longitudinal studies showed career outcomes (e.g., occupational choice and attainment) to be rooted in childhood and adolescence, which seems to underline that the early formative years are a crucial developmental phase in the vocational development of a person. • Recent findings indicate that women have more variety in school than men. However, the gap between genders widens in tertiary education and the labour market. Individual perceptions of viable options, expectations, and subjective value tasks may influence gender differences in educational and vocational decisions. This means that even if someone possesses entrepreneurial skills, they may not translate into successful entrepreneurial behaviour if their underlying decision-making processes and actions are less entrepreneurial or optimistic.

2nd Research Question: *Can entrepreneurship education programs, especially in developing countries and rural contexts, help to foster enterprising behaviours and entrepreneurial alertness in adolescents? If so, why, how and to what extent?*
• The reviewed studies suggest that entrepreneurship education programs can effectively develop non-cognitive entrepreneurial skills at an early age, supporting the idea that such skills can be nurtured and cultivated in young students. Also, overall, the reviewed studies indicate a certain effectiveness of such entrepreneurship education programs in both developed and underdeveloped contexts. However, the findings emphasise the need for sensitivity in the deployment of early entrepreneurship education and caution against a one-size-fits-all approach. • In the marginalised and rural contexts, in gauging the long-term effectiveness of such entrepreneurship programs for adolescents, the availability and accessibility of resources should also be considered. In impoverished areas, further considerations must be considered when designing entrepreneurship education programs in terms of providing linkages with the employment market or access to seed capital. • The success of entrepreneurship education programs depends on seed capital availability and the significant impact of tutors and advisors. Structuring programs with assigned advisors and tutors closely monitoring students' experiential learning, encouraging communication and self-confidence, and strengthening decision-making skills can positively influence program effectiveness. • Emphasizing experiential learning in entrepreneurship education for adolescents can positively affect their likelihood of starting a business and their entrepreneurial income. "Learning-by-doing" approaches offer valuable opportunities for students to develop and apply entrepreneurial skills, fostering their entrepreneurial potential beyond graduation. • Research findings suggest that traditional entrepreneurship training programs based on credits and standardised grading might be less effective. Flexible and action-oriented programs, like Student Training for Entrepreneurship Promotion (STEP) in Uganda, have positively impacted participants' entrepreneurial action regulation and subsequent success in entrepreneurship. Emphasizing action sequences and operative mental models can enhance trainees' business opportunity identification and overall entrepreneurial actions. • Findings also suggest that the central role of entrepreneurship education programs must be to create a sustained and enduring interest rather than a situational one. This can be achieved by providing diverse, continuous and repetitive exposure to nurture the entrepreneurial interests of the participants until they are technically and mentally ready to engage in entrepreneurial activities. • Some programs may not have an intended effect on developing entrepreneurship knowledge. Contributing factors might be compulsory participation, the demanding time and effort with little achieved credit for attendance, a hampered active involvement due to a large number of students in class, and not following the guidelines by the teachers and mentors.
3rd Research Question: *Do entrepreneurship education programs have the same impact on female and male adolescents in developing perceptions of entrepreneurial competencies and intentions? If not, what are the differences?*
• The studies indicate that the effect of entrepreneurship educational programs is overall positive on the non-cognitive skills of both girls and boys. However, there seem to be differences in the effectiveness of such programs between girls and boys. • Women may need targeted educational programs to confirm their entrepreneurial competencies rather than just developing them. Providing entrepreneurial training for girls

at an early age is therefore potentially important to shape their entrepreneurial self-efficacy and prevent entrepreneurial career options from being overlooked by them in their early lives.

- Entrepreneurial programs targeting female students may benefit their students more by considering their specific needs, such as fighting against stereotypes by introducing and engaging more successful female entrepreneurs in the delivery of their programs.
- Designing gender-specific entrepreneurship education programs for female-only groups might be more beneficial in supporting female entrepreneurship with higher chances of developing non-cognitive skills and entrepreneurial intentions and behaviour in a less competitive setting.
- Some studies also point to community involvement in the success of entrepreneurship education programs for females in rural and developing countries. Therefore, in designing such gender-specific programs, educating and involving the community might provide further support for female entrepreneurship and lead to more successful results.

6. Conclusion

In this work, we first summarised definitions and theories directly or indirectly addressing the development of entrepreneurial skills in adolescence and then provided a systematic literature review regarding entrepreneurship education programs and the development of entrepreneurial skills in adolescence. We addressed three basic research questions related to 1) the entrepreneurial mindset and enterprising behaviour, 2) the impact of entrepreneurship education programs, and 3) the role of gender in the effect of these programs. In the following, we will discuss several important concluding remarks. A summary of our key findings can be seen in Table 5.

First, one can conclude that the theoretical advances in the field (and adjacent fields) and the empirical body of studies included in our literature review are largely, still relatively detached. Many empirical studies examined in the literature were not grounded on theory, and important theories (e.g., balanced skill set) were not integrated. The clear focus of many of these studies was on the measurement of the actual program impact, which is typical for program evaluation studies. It became clear that future education programs could emphasise relevant theories in the field of (entrepreneurial) skill development. Such theories can come from different disciplines (e.g., education, psychology, economics, management) and often reflect interdisciplinary approaches.

Second, from a scientific rigour perspective, it must be highlighted that many of these studies employed research designs that do not allow for causal analysis. Hence, it is crucial to keep in mind that many of these results need to be interpreted as anecdotal evidence rather than as direct, representative evidence that can guide policies with concrete scientific insights. For example, one cannot rule out a potential file drawer bias where most studies with positive results get published. In contrast, the actual prevalence of null or negative effects could be much higher (non-published results). At the same time, one must acknowledge that it is not easy to set up a causal experiment in such educational contexts. However, if there is no adequate control group, this could lead to wrong conclusions about the attributions of the training outcomes. Many confounders need to be controlled for (e.g., sample selection bias), and there are also ethical considerations that need to be kept in mind (e.g., whether one can establish a control group with randomised assignment in such a study context).

Moreover, the long-term effect (e.g., over the occupational career in adulthood) of such programs targeting adolescents, which is particularly interesting, is often difficult to assess (particularly in research designs allowing for causal interpretations). It would be advisable, though, that future

research integrates longitudinal approaches that follow study subjects over a longer period of time. Compared to research on the long-term effects of other types of early interventions (e.g., Heckman et al., 2013; Kagitcibasi et al., 2001), research on early entrepreneurship programs still lags behind when it comes to available longitudinal datasets and rigorously designed research projects. This requires improvement, given the critical importance of entrepreneurship in modern societies around the globe.

Finally, it is often unclear how meaningful the reported effects are (e.g., in terms of standardised effect sizes), which also limits deeper interpretations of the results. Further recommendations about the design of such program evaluation studies are provided elsewhere (European Commission, 2017; Newcomer et al., 2015; Posavac, 2015). Notable examples of particularly rigorously designed evaluation studies included in our literature review are Huber et al. (2014) and Oosterbeek, Van Praag, et al. (2010). Additionally, many studies in the sample have not clearly explained the pedagogical approach used in the cases analysed, as well as the quality of teaching, the learning environment, the culture and the educational system. This methodological issue would make it difficult to draw conclusions when comparing the results of implementation of similar programs across different contexts or countries.

Third, besides these limitations about theoretical underpinning and scientific rigour, the existing body of research indicates that non-cognitive skills (compared to cognitive skills) are a significant target of such educating programs, often with a specific educational success – a reported increase in these skills. This is consistent with a general consensus in the entrepreneurship and adjacent academic fields (e.g., economics or education), according to which non-cognitive skills should be particularly relevant for entrepreneurs and their entrepreneurial activities, compared to mere intelligence, as highlighted earlier in this document.

Overall, our results indicate that such programs can indeed promote entrepreneurial (non-cognitive) skills (but as noted above, one needs to be careful with such conclusions due to potential research biases). This would be consistent with various foundational theories (e.g., skill formation cycle or the developmental lifespan model) that deem the early formative years particularly important for skill formation and growth. Adolescence and childhood are particularly critical phases where the developing individual goes through sensitive phases where significant learning and, thus, skill formation and growth occur. At this point, one should again emphasise that skill growth is, in all likelihood, a successive process, so skill development in adolescents builds on earlier skill

development in childhood. In other words, it could well be that preexisting skill levels in childhood could be a powerful moderator neglected in the reviewed studies and our review. The effectiveness (and efficiency) of entrepreneurship education programs for adolescents could depend to a certain degree on relevant prior skill development in childhood (Heckman, 2006; Masten et al., 2010; Obschonka, 2016). This underscores the usefulness of a developmental lifespan perspective (compared to a pure program impact perspective that does not consider a developmental standpoint) when studying and promoting entrepreneurial skills. It is embedded in a person's developing entrepreneurial mindset, where such skills also interact with other components of this mindset (including personality features, identity and self-concept, and human agency). Moreover, such development does not occur in a vacuum but is embedded in various developmental contexts and their interplay.

Our results and such theories are also consistent with results from another review on the topic (European Commission, 2015), which concluded that: "countries which offer entrepreneurship education at several educational levels (e.g. Denmark, Norway, and the Netherlands), and providers which offer a broad range of programmes for different age levels (e.g. JA-YE network) observed that effects tend to cumulate and lead to acceleration: - those who participate in a higher number of measures benefit more over time, - with the number of entrepreneurship classes, courses and programmes, attended, the likelihood increases that alumni will turn their acquired entrepreneurial knowledge, skills and attitudes into action, - the number of actions started will make a school or university more attractive to investors, stakeholders, high-profile students and staff members – in short: Entrepreneurship leads to more entrepreneurship" (p. 87-88).

Fourth, as indicated by the reviewed studies for answering the second research question, paying attention to the contextual factors by the entrepreneurship education programs designers and executives is important for several reasons. For example, as several studies emphasised, there is no one-size-fits-all approach. The programs need to be tailored to the needs of their attendees, which can be related to the location or personal socioeconomic features (Lindner, 2020). For instance, comparing programs developed and provided in rural versus urban settings suggests that targeting the entrepreneurial knowledge and intentions of the participants might not necessarily lead to entrepreneurial action unless the available local infrastructure with its institutions is considered. Moreover, because of the more limited resources available for the participants in rural and developing country contexts, the program development could put a particular focus, for example, on resource acquisitions and entrepreneurial strategies to leverage limited resources (Baker &

Nelson, 2005; Shepherd et al., 2020). Such programs could also consider differences between (the external opportunity structure for) necessity vs. opportunity entrepreneurship (Coffman & Sunny, 2021; Eijdenberg et al., 2021).

Fifth, our review also indicates a number of conclusions that can be applied to findings regarding the third research question. As discussed in section 5.3.2, and also predicted by theories explaining gender difference effects in entrepreneurial antecedents and outcomes, the entrepreneurship education programs may have different impacts based on the participants' gender. However, research on gender-specific effects in this literature is still very limited. This is indicated in the number of studies we included in Table 4 and their relatively recent publication dates. Therefore, our review encourages policymakers and other stakeholders to invest in supporting new research studies and designing entrepreneurship education programs that take potential gender differences in the effectiveness of such programs into account. Given the often-cited gender gap in entrepreneurship, where women are less represented than men in national populations of entrepreneurs around the globe (Kelley et al., 2011), particular attention should be given to the effective promotion of entrepreneurial skills in females within the respective sociocultural local contexts (Ojong et al., 2021). However, it is important to note that such efforts also need to consider the substantial body of theoretical and empirical research indicating that often this gender gap cannot be explained by mere (objective) skill level differences but (also) by gender differences in beliefs, values, and other types of cognitions and self-concept components, besides various other mechanism (e.g., stereotypes, social capital restrictions, and family responsibilities). For example, research indicates that an important psychological mechanism behind this gender gap is entrepreneurial self-efficacy beliefs (Wilson et al., 2007). Such gender differences in the individual belief in one's own capability as an entrepreneur can be relatively independent of the actual, objective skill level. It is well documented that many entrepreneurs show some level of cognitive overconfidence in that they overestimate their abilities and capabilities (Kraft et al., 2022). Furthermore, it is discussed in the entrepreneurship literature to what extent such cognitive aspects of entrepreneurship that are relatively detached from the actual objective skill levels are adaptive and conducive to (ambitious) entrepreneurship (Engelen et al., 2015; Szerb & Vörös, 2021).

Finally, one can also look at the broader effects of such early skill development and entrepreneurship education programs, for example, at the school or societal level, and how this is linked to economic transformation. On the one hand, human capital theory (e.g., Becker, 1962; Becker, 2009) would predict that effective skill development at the individual level can contribute to a more

entrepreneurial economy and related outcomes, such as more startups and related job creation, innovation, and growth (see also Marvel et al., 2016; Schumpeter, 1934). On the other hand, it could contribute to institutional changes, for example, collectively among teachers and in schools, with a stronger appreciation for entrepreneurship and potentially also a more entrepreneurial approach in teaching methods (which could contribute to the development of entrepreneurial skills and mindsets in addition to the concrete entrepreneurship education programs, for example when teachers use entrepreneurial teaching methods also for other school subjects across their teaching portfolios). One should also not underestimate the importance of teacher's entrepreneurial mindsets and teaching methods as a powerful catalyst in developing entrepreneurial skills and mindsets in the student population. This should also concern collective effects, for example, on the entrepreneurial climate and attitude at the school and even regional level. The development of an individual's entrepreneurial mindset is embedded in broader macro-contexts (Obschonka, 2016). In other words, the promotion and more comprehensive implementation of early entrepreneurship education programs could boost entrepreneurial skills in adolescence via two pathways: First, direct, micro-level effects on skill levels in students as examined in this literature review, and second, via "macro-effects" via institutions such as school and region-level stimulation, appreciation, and amplification of such entrepreneurial skills (e.g., when the school and region value an entrepreneurial climate and norms, Bergmann et al., 2018; Stuetzer et al., 2016). This could be particularly relevant for economically deprived regions or regions with a relatively non-entrepreneurial historical imprint (e.g., via a persisting industrial imprint of the local historical industry structure in the region that values non-entrepreneurial thinking and behaviour, Stuetzer et al., 2016; see also Fritsch & Storey, 2014). Policymakers around the world put a special focus on such deprived regions, and on regions with a relatively non-entrepreneurial cultural imprint, but often with disappointing results, despite substantial investments in local economic and structural change (Huggins et al., 2021; Rodríguez-Pose, 2018). One reason for this inefficacy of such policies could be the disregard of deeper psychological roots of a region' entrepreneurial vitality, spirit, and competencies (e.g., the development and promotion of entrepreneurial skills and mindsets not only in adulthood, for example in higher education institutions, but also more broadly and earlier during the particularly important formative years in childhood and adolescence, Heckman, 2006).

Limitations and Future Research

This study is not without limitations, which are associated with the methodology used. First, despite our extensive efforts, the literature search may have failed to capture all relevant papers. It is because, most likely, not all results are published as peer-reviewed research papers, authorship is skewed towards English-speaking countries in search engines, and the choice of words in the title/key topics plays a role. In particular, we excluded contributions such as chapters in edited books or working papers. We also excluded articles written in languages other than English, such as Spanish or French. Additionally, despite every precaution taken, the researchers recognise their subjectivity regarding the classification of papers.

Second, another limitation of this paper is related to the generalizability of the findings from the systematic review. While the review followed rigorous methodologies, the included studies exhibited some heterogeneity regarding populations, interventions, and settings. Additionally, the potential presence of publication bias may impact the overall applicability of the results. Moreover, the context-specific nature of the studies and the temporal relevance of the research may limit the direct transferability of the findings to real-world settings. Therefore, when interpreting and applying the results to specific situations, it is essential to consider the unique characteristics of the target population and the potential influence of contextual factors.

Future research using more comprehensive and diverse search strategies, such as including non-English sources and non-peer-reviewed publications, could enhance the inclusiveness of the study and provide a broader understanding of the topic. To address the subjectivity in paper classification, employing multiple researchers or expert reviewers to categorise the papers independently could help ensure more objective and consistent results.

Another consideration missing from the reviewed papers in the observation period is the impact of digitalisation and technology on the effectiveness of entrepreneurship education programs designed for adolescents. A powerful wave of entrepreneurship has emerged amid the continuous evolution of digital technologies. Innovations like 5G, big data, and blockchain have fostered unprecedented connectivity and reshaped the dynamics between various players in the entrepreneurial ecosystem. Entrepreneurship has witnessed a remarkable transformation in this digital era, providing people, especially the young, with a wealth of untapped opportunities. Although a few recent studies have explored the impact of digitalisation on entrepreneurship education programs, primarily focusing on college students (e.g., Long et al., 2021; Xiang et al.,

2022), there remains a fruitful opportunity for future research to extend this perspective to study entrepreneurship education in primary and high schools.

7. References

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Annex I

Table 6. Evaluated entrepreneurship programs listed by the first author's last name.

Evaluated program title	Form of delivery, duration and program facilitators	Short description	Studied dependent variables	Summary of results
Financial literacy program (FLP) (Aljaouni et al., 2020)	School-based, n.a., Teacher	Formal curriculum	entrepreneurial intention, awareness and attitude	The FLP students showed significantly lower entrepreneurial intention and higher entrepreneurial awareness than those who had not participated in the program.
Business clinics for young entrepreneurs (Alzua et al., 2020)	Extra-curricular, 2 days, Counsellors	Twofold goal: inform young entrepreneurs about credit opportunities and help them design an investment plan to obtain credit.	credit demand	The young people showed increased awareness about credit risks after the training, which resulted in lower credit demand.
Brigades' vocational training (Assan, 2012)	Extra-curricular, 3 months, Mentors	Trades training opportunities for school-leavers.	job creation	The training contributed to job creation in Tutume and increased profit-making from the youth-owned enterprises.
Young Enterprise Company Program (Athayde, 2012)	School-based, 9 months, n.a.	Provide personal experience of how business works, understand its role in providing employment, create prosperity, and be inspired to improve own prospects.	attitudes towards starting a business, enterprise potential	The participation positively impacted the young people's enterprise potential, a result moderated by gender, ethnicity, socio-economic background, and type of school attended. Males reported a significantly higher increase in attitude scores than females. However, gender did not play a role in the desire to run a business.

Young Enterprise Company Program (Athayde, 2009)	School-based, n.a., n.a.	Experiential and problem-based learning techniques.	Enterprise potential (measured in terms of achievement, personal control, creativity, and leadership.)	Company Program participants displayed greater enterprise potential than nonparticipants (no gender effects). Participation fostered positive self-employment attitudes.
n.a. (Barba-Sánchez & Atienza-Sahuquillo, 2016)	School-based, 3 terms, Teacher	Term 1: Establishment of the cooperative venture with its articles of association, minutes, capital, name and corporate image. Term 2: a selection of products, manufacture and finance. Term 3: labelling, price, sale and results.	entrepreneurial competency (in terms of autonomy, initiation), entrepreneurial intentions	The intervention improved entrepreneurial competencies and the future potential for business start-ups.
n.a.(Bano, 2018)	School-based, 6 months, Community trainer	Workshops for skills training.	entrepreneurial intentions	Participation increased entrepreneurial aspirations among marginalised youth.
Young Entrepreneurs Israel (Bergman et al., 2011)	School-based, 1 year, Teacher	Student teams establish mini-companies to learn and practice entrepreneurship from the business's initial conceptualisation through market research and to plan capital raising, operation and management, production, marketing, and sales.	entrepreneurial self-efficacy, entrepreneurial knowledge	There was no effect on the participants' entrepreneurial self-efficacy and knowledge. No significant gender and age effects were observed.
Girls Empowerment Programme (Berry et al., 2013)	Extra-curricular, 3 weeks, n.a.	Life skills and income-generating training.	entrepreneurial knowledge	The income-generating activities had a significant impact on the camp participants.
n.a. (Berzin et al., 2018)	Extra-curricular, n.a., n.a.	n.a.	financial literacy (i.e., confidence in the knowledge of the definition of	The participants showed higher financial literacy, including business knowledge, budgeting, and skills, e.g., project

			entrepreneurship, budgeting, and writing a business plan), project management, social-emotional skills (i.e., identity reflection, goal setting, problem-solving, emotional regulation, community, and link to work and college), future orientation (i.e., entrepreneurial intentions), leadership	management, community interactions, and taking charge. The only social-emotional skill associated with the intervention was a higher reported level of community connection.
Ruka Juu (Bjorvatn et al., 2020)	Extra-curricular, 11 weeks, Television	Weekly episodes built up around six young entrepreneurs (three females and three males). The small-scale business owners competed for a prize of 5 million Tsh (around US $3,100 at the time).	entrepreneurship ambitions, business knowledge and entrepreneurial mindset (in terms of taking risks, patience, willingness to compete)	There is a treatment effect on the ambition index for both male and female participants, i.e. making the viewers more interested in entrepreneurship and business. No evidence was found for the treatment effect on knowledge and mindset, only suggestive evidence of the female viewers becoming more entrepreneurial in their willingness to take risks.
Creation des Entreprises et Formation des Entrepreneurs (CEFE) (Boukamcha, 2015)	Extra-curricular, 20 days, Coaches	A set of workshops led by different coaches in business creation, marketing strategies, financial management and technical and legislative aspects.	entrepreneurial intention, perceived self-efficacy, entrepreneurial desirability, entrepreneurial feasibility	Evidence of CEFE triggering the trainee's cognitions, which, in turn, enhanced their entrepreneurial intention.
My first enterprise: Entrepreneurship by playing (Cárcamo-Solís et al., 2017)	School-based, n.a., Advisor	Three stages: 1) entrepreneurship training, 2) new venture development, and 3) running a small business.	entrepreneurial knowledge, entrepreneurial values (in terms of honesty, self-confidence, integrity, creativity, autonomy, tenacity, responsibility, willingness to	The participants showed a significant improvement in administrative knowledge and entrepreneurial skills and reinforced business values.

			accept risks, leadership, teamwork, solidarity, convincing others and adapting to others) and skills (in terms of taking advantage of new ideas, making business decisions, providing respectful customer service, delegating responsibilities, solving managerial problems, listening to others, accepting others' comments, contributing to the advancement of the new company, collaborating to solve the company's problems, responding to others' requests, and flexibility)	
New year stalls (Cheung, 2008)	Extra-curricular, n.a., Teacher	Operation of a kiosk before the Chinese New Year	Entrepreneurship skills (i.e., 1. work-related skills, which are generic skills such as analytical and critical thinking, problem-solving and creativity; 2. interpersonal skills, including communication, social networking and negotiation; and 3. management skills, which include time management, staff management, and leadership skills.) and work attitudes	Evidence for encouraging skills and attributes development, such as teamwork, commitment and flexibility, and practical knowledge and understanding of business and working life.
Business School curriculum (do	School-based, Full	In a single-sex business school program for girls, Enterprise Day, every last Friday of each month, the	Entrepreneurial intention, perceived behaviour control, personal attitudes, subjective	The results showed that, despite not receiving any entrepreneurship education, the boys at the neighbouring sports school

Paço et al., 2015)	curriculum, Teachers	students run their mini-companies, sell products, or raise awareness about their social enterprise.	norms, locus of control, the propensity to risk, self-confidence, need for achievement, tolerance of ambiguity and innovativeness	tended to have a greater intention of starting up a business.
Youth Enterprise (do Paço & Palinhas, 2011)	School-based, 2 years, Teacher	Practical, experiential and problem-based program.	entrepreneurial knowledge	An increase in the number of correct answers was observed, showing that the Family and Community programmes' aims were being achieved, i.e. there was a transmission of knowledge.
Junior Achievement Company Program (JACP) (Elert et al., 2015)	School-based, n.a., Mentors and teachers	Practical, pupils set up a "JACP" company under guidance.	probability of starting a new firm (i.e., entrepreneurial behaviour), entrepreneurial income, company survival	While JACP participation increased the long-term probability of starting a company and entrepreneurial incomes, there was no effect on firm survival.
Social Enterprise Intervention (SEI) (Ferguson, 2018b)	Extra-curricular, 20 months, Peer mentors and staff	Participants identify specific vocational and business skills to learn to support them in starting and maintaining a business.	self-esteem, ADHD problems, inattention problems, hyperactivity problems, antisocial personality disorder problem, depressive problem	There were no statistically significant interactions between condition (SEI vs. alternative intervention) and time (baseline and follow-up). Despite both groups changing significantly over time, they were not changing in different ways over time on mental health and housing outcomes.
Social Enterprise Intervention (Ferguson, 2018a)	Extra-curricular, 20 months, Peer mentors and staff	Four stages: 1) vocational skill acquisition (4 months), 2) small business skill acquisition (4 months), 3) SEI formation and product distribution (12 months), and 4) clinical/case-management services.	employment outcome	No statistically significant differences were detected across the whole sample or between groups on primary or secondary employment outcomes.
Youth Enterprise Network	Extra-curricular,	Operating school-based enterprises.	school performance	Although two of the three schools were quite satisfied with the program's implementation, it was difficult to

(Fitzgerald, 1999)	n.a., Teacher			document improvements in student outcomes.
n.a. (Gargouri & Naatus, 2019)	n.a., 1 semester, n.a.	n.a.	entrepreneurial attitude in terms of achievement, innovation, personal control, self-esteem	The impact of entrepreneurial education on the participants' entrepreneurial attitude score, comprising the scores for innovation, achievement, personal control and self-esteem, was positive.
Student Training for Entrepreneurial Promotion (Gielnik et al., 2016)	School-based, 12 weeks, Lecturers	STEP modules: 1) identifying business opportunities, 2) marketing, 3) leadership and strategic management, 4) the psychology of planning and implementing plans, 5) financial management, 6) persuasion and negotiation, 7) acquiring starting capital, 8) networking, 9) accounting, 10) personal initiative, 11) business planning, and 12) legal and regulatory issues.	business opportunity identification, entrepreneurial action	The entrepreneurship training positively impacted youth entrepreneurship, creating jobs and leading to income-generating activities. Thus, there was a positive and significant effect on entrepreneurial action and opportunity identification.
Mini-company programme (Grewe & Brahm, 2020)	Extra-curricular, 9 months, Teacher	Five steps: idea creation and the founding of the company, organisation of different departments, acquisition of seed capital, execution and administration of production, marketing and sales and finally, the closing of the company.	entrepreneurial competencies on three levels: 1. economic level (economic thinking and acting, visions, using resources, planning, security and risk awareness, creativity, ethical and sustainable thinking), 2. personal level (initiative, motivation and perseverance, learning experience, self-awareness and self-efficacy), 3. team level (spotting opportunities, inspiring others, protecting	The results showed expansion of the students' entrepreneurial competencies on an economic level but limited personal and team level developments. Students who participated in the mini-company programme did not develop differently regarding entrepreneurial competencies on individual or team levels compared to the students in the regular economics class. Nevertheless, they significantly differed regarding their development of economic competencies.

			concepts, capacity for teamwork)	
n.a.(Halilović et al., 2014)	School-based, 1 year, External staff and teachers	n.a.	innovative behaviour (attitudes towards novelty, ability to create new ideas, ability to realise ideas), entrepreneurial knowledge (entrepreneurship, entrepreneur, business opportunities, entrepreneurial ideas, entrepreneurial process, and business plan)	A statistically significant improvement was observed in entrepreneurial workshops' students in innovative behaviour and entrepreneurial knowledge.
"Doing Business" program (Heilbrunn & Almor, 2014)	Extra-curricular, 1-year, Teacher	Pupils establish business ventures, learning and practising the entrepreneurial process from initial business concept to implementation, including how to operate and manage the business, work as a team, raise capital, choose a product, conduct a market survey, write a business plan, and engage in production, marketing, and sales.	entrepreneurial self-efficacy, perceived feasibility, perceived desirability, entrepreneurial knowledge	The program effectively encouraged middle- and upper-class adolescents to become more entrepreneurial but was detrimental to pupils from lower socio-economic environments. Such pupils valued themselves with less self-efficacy and saw entrepreneurship as less feasible and desirable when they finished the program.
n.a. (Heinrichs, 2016)	Extra-curricular, 1 day, Teacher	A day of simulating an entrepreneur's working life week, followed by a distance learning period.	self-efficacy, entrepreneurial knowledge	Females significantly increased their entrepreneurial knowledge and self-efficacy from the pretest to the posttest, while males did not.
n.a. (Ho et al., 2018)	School-based, 5 months, Trainers	A structured curriculum of 15 to 21 sessions for students to acquire four skills—interpersonal/personal, innovative thinking, financial, and marketing communications.	entrepreneurial alertness, entrepreneurial efficacy	Even with gender effects accounted for, the higher entrepreneurial alertness and efficacy levels in the treatment group were partly due to passive and active/hands-on program elements.

BizWorld (Huber et al., 2014)	School-based, 5 days, Teacher & Entrepreneur	A practical orientation, leading the participating pupils through a firm's business cycle from start-up to liquidation.	Entrepreneurial skills (i.e., risk-taking, creativity, need for achievement, self-efficacy, social orientation, pro-activity, persistence, analyzing, motivating), entrepreneurship intention, entrepreneurship knowledge	There was a significant positive change in the treatment group on the non-cognitive variables compared with the control group, nonsignificant for entrepreneurial knowledge and negative for intentions, with evidence that the development of entrepreneurship knowledge and some non-cognitive entrepreneurial skills are distinct for males and females.
n.a. (Iseselo et al., 2019)	Extra-curricular, n.a., n.a.	There are four arms of the intervention: health only, entrepreneurship and health, beekeeping and health, and all three combined.	entrepreneurial skills, customer care, financial management	The customer care training seemed to have influenced the participants to a notable entrepreneurial behaviour change.
Company programme (CP) (Johansen, 2013)	School-based, 1 year, Teacher and volunteer business advisers	CP is education “through” and “for” entrepreneurship, intended to promote business knowledge and skills, raise young people’s interest in self-employment, and encourage valuable qualities and attitudes, such as social skills, creativity, self-esteem and initiative	start-up activity	Results from econometric analyses indicated a positive correlation between participation in CP and start-up activity. The analyses also indicated that CP had a greater impact on males' start-up activity than females.
Company programme (CP) (Johansen & Foss, 2013)	School-based, 1 year, Teacher and volunteer business advisers	Pupils establish, run and close a mini-enterprise during a school year.	entrepreneurial intentions, entrepreneurial knowledge, perceptions of business skills, entrepreneurial opportunity identification	CP had: 1) a positive impact on females' business skills perception but no impact on males', 2) a positive impact on males’ preference for self-employment but no impact on females, and 3) no impact on beliefs in local business opportunities.
Entship School & Hero School	School-based, 12 to	Entship improves students’ creative and problem-solving capacity by enhancing their industrial environment	opportunity discovery, opportunity exploitation, entrepreneurial orientation,	Evidence that the two programs positively influenced students’ entrepreneurial competencies such as opportunity

(Kim et al., 2020)	20 hours, Instructors	understanding. Hero includes a self-exploration class and a mini-project, encouraging students to generate ideas and create value.	creativity capacity, problem-solving, entrepreneurial intention	discovery, opportunity exploitation, entrepreneurship, creativity capacity, social problem solving, and entrepreneurial intention. Entship for middle-school students did not significantly influence opportunity discovery, opportunity exploitation, entrepreneurship, and entrepreneurial intention. Hero for high-school students did not influence entrepreneurship.
New Youth Entrepreneur (Kourilsky & Esfandiari, 1997)	School-based, 1 semester, Teacher	Twelve modules: opportunity recognition and proposal of business solutions; identification of market segments and target markets; competitive analyses for student product and service ideas; the projection of start-up costs, balance sheets, and income statements for candidate business ideas; and the development of comprehensive business plans for the actual pursuit of market opportunities identified by students.	entrepreneurship knowledge, advanced entrepreneurship knowledge including 1. comprehension, 2. application, and 3. analysis	The treatment group' variables' scores were higher (82%) than the control group' (42%) and the two Gallup survey groups' (44% and 42%).
U-Learn programme (Krause et al., 2016)	Extra-curricular, 9 months, n.a.	Focus on knowledge, vocational and life skills development intended to lead to employment, self-employment or further education.	employment knowledge, financial literacy	Strong positive effects were observed on key intermediate employment outcomes: savings ability, employment confidence and personal finance.
Enterprise in Schools (Leffler & Svedberg, 2005)	n.a., n.a., Teacher	An active-learner platform for shared problem-solving together with a more skilled partner.	entrepreneurial skills (i.e., cooperation, initiative, creativity, activity)	There is a significant imbalance in the skilled-partners-apprentices relationships in the practices.
Entrepreneurship-related themes	School-based, Full	Vocational course programmes	entrepreneurship intention	The probability of the students becoming entrepreneurs is significant irrespective of

(Marques et al., 2012)	curriculum, Teacher			the type of study programme. A multi-group structural equations model analysis registered no variance between the two study programmes.
Junior Achievement Young Enterprise student mini-company program (Oosterbeek, Praag, et al., 2010)	School-based, 1 year, Lecturers	Curriculum: Business economics, tax law, economics, finance, financial accounting. Practised competencies: communication, integrity, presentation, and customer-mindedness.	Entrepreneurship intention, need for achievement, need for autonomy, need for power, social orientation, self-efficacy, endurance, risk-taking propensity, market awareness, creativity, and flexibility.	The results showed the program was not producing the intended effects. The effect on students' self-assessed entrepreneurial skills was insignificant. The effect on entrepreneurship intention was negative.
Quebec Entrepreneurship Contest (Pepin & St-Jean, 2019)	School-based, n.a., Teacher	Entrepreneurial projects	entrepreneurial potentials in terms of leadership, creativity, achievement, personal control	Data showed no difference between the two groups. The private and public schools control group students showed significantly greater leadership scores than the experimental group. In-depth analyses showed that increasing the number of entrepreneurial projects significantly impacted three of the four attitudes assessed, although negligibly.
Young Achievement Australia (YAA) (Peterman & Kennedy, 2003)	Extra-curricular, n.a., Advisors	A cross-disciplinary enterprise education program offering young people a practical introduction to business to develop and demonstrate key competencies and enterprise skills in a supportive and challenging learning environment.	perceived desirability, perceived feasibility of starting a business	YAA participants had higher perceptions of desirability but not of feasibility in comparison with the control group.
Youth Start Social Entrepreneurshi	School-based, n.a., Teacher	A program aimed at encouraging the assumption of social responsibility and	entrepreneurial awareness, entrepreneurial knowledge, entrepreneurial attitude	Through the program, the pupils mobilised personal and social competencies relevant to developing their personalities, such as

p Program for Kids (Pinho et al., 2019)		enhancing the sense of social and civic belonging.		respect for their colleagues, the tasks to be performed, the responsibility of knowing how to think and what to do, and the motivation to learn more.
n.a. (Rodriguez & Lieber, 2020)	School-based, 1 year, Teacher	Multiple entrepreneurship courses are offered through an interactive digital platform grounded in project-based learning and lean start-up principles.	entrepreneurial mindset	A statistically significant increase in students' entrepreneurial mindset (e.g. communication, collaboration, opportunity recognition, critical thinking and problem-solving) with a positive association with perceptions of future career success.
E Vitamin (Sánchez, 2013)	School-based, 8 months, n.a.	Four components: 1) accounting, finance, marketing, and management; 2) self-efficacy, proactiveness, and risk-taking; 3) business plan; and 4) interaction with practice, i.e. practitioners' presentations and networking events.	entrepreneurial competencies (in terms of self-efficacy, proactiveness, risk-taking), entrepreneurial intentions	Treatment group students increased their self-employment competencies and intention, while control group students did not.
Intergenerational entrepreneurship training (Santini et al., 2020)	Extra-curricular, 5 months, Mentors	Mentees met mentors about 20 times for two hours, half in one-to-one and half in group sessions.	cognitive competencies, agency competencies, metacognitive competencies, sociorelational competencies, self-esteem	The mentoring improved mentees' entrepreneurial capabilities and self-efficacy, helping them acquire socio-relational competencies.
Who wants to become an Entrepreneur? (Schroder & Schmitt-Rodermund, 2006)	School-based, 15 hours, Teacher	10 modules: introduction, leadership, creativity, problem-solving, perspective-taking, risk-taking, convincing others, achievement orientation, entrepreneurship, and economics.	enterprising interest, achievement orientation, social dominance, risk-taking, internal locus of control	Personality and family background predicted different patterns of enterprising interest development. After participation, significantly more students changed their enterprising interest towards a high or low-interest level than control group students.
School curriculum	School-based, Full	Various subjects	entrepreneurial intention	The direct influence of school-based enterprise education on career choices and

(Thompson & Kwong, 2016)	curriculum, Teacher			how this might be limited as entrepreneurial intentions dissipate over time.
Arrowhead Business Group entrepreneurship education program (Tingey et al., 2020)	Extra-curricular, 6 months, Apache entrepreneurs and elders	16 lessons delivered through a residential summer camp, followed by 6 monthly follow-on workshops, 4 to 6 hours in length, to develop business plans.	entrepreneurship knowledge	Observed effects on entrepreneurship knowledge, economic empowerment, and connectedness, supplemented by the experiences and changes in Native American communities.
Mapping Vocational Challenges Career Development Program (Turner & Lapan, 2005)	School-based, 2 hours, Group leader	3 modules: Career Exploration, Career Mapping, and Interpretation. The Career Exploration Module features job cards on the computer screen. The Career Mapping Module consists of a two-dimensional level of interest by occupational gender-typing grid upon which an occupational ‘‘map’’ of an individual's interests is constructed. As each occupation is rated, the associated scores are entered automatically into a computer database and used for the computer generation of the Interpretation Module report.	career interests, career planning, career development efficacy	Results demonstrated significant increases in career planning and exploration efficacy and educational and vocational development efficacy among experimental group participants. Gender effects were observed with regard to the chosen type of career.
Business Summer School (van der Westhuizen & Goyayi, 2020)	Extra-curricular, 5 days, n.a.	A business tech-startup process simulation.	entrepreneurial behaviour	After exposure to the opportunities and the potential of technology-related businesses, the participants showed a significant change in entrepreneurial self-efficacy.
Swiss Federal Office for Professional Education and Technology	Various, 6–12 months, n.a.	Three different programmes	entrepreneurial personality traits (i.e., need for achievement, entrepreneurial self-efficacy, need for autonomy, risk-taking),	The assessed programs statistically impacted beliefs, the capacity to exploit an opportunity and entrepreneurial knowledge. However, no significant effect on entrepreneurial intention was observed.

program, Young Enterprise Switzerland Company Program, and Learn to undertake (Volery et al., 2013)			entrepreneurial knowledge, entrepreneurial intention, entrepreneurial beliefs (i.e., perceived feasibility, perceived desirability), entrepreneurial competencies (i.e., opportunity recognition, opportunity exploitation)	
SimVenture (Williams, 2015)	n.a., Two terms, Teacher	SimVenture is a business simulation game developed by entrepreneurs for entrepreneurs.	development of business skills (i.e., marker analysis, product costing, learning from the competition, financial analysis), entrepreneurial attitude (i.e., initiative, seeing things through, locus of control, networking, strategic thinking, future focus, failure tolerance, uncertainty tolerance), entrepreneurial values (i.e., independence, sense of ownership, achievement motivation), generic entrepreneurial skills (i.e., opportunity recognition, creative thinking, idea generating, persuasion)	SimVenture developed the students' business and management skills and entrepreneurial attitudes and values.
Teen Entrepreneurs Competitions (TEC) (Yu & Man, 2007)	Extra-curricular, 3 months, n.a.	TEC is a team-based entrepreneurship competition integrating business planning with actual trade.	entrepreneurship perceptions (i.e., doing a profitable business, creating personal wealth, facilitating a prosperous society, improving creativity, introducing fiercer	TEC participation (without formal courses) led to a higher level of students' perceived feasibility, and entrepreneurship knowledge was enhanced after TEC.

			competition, willingness to bear risks), competency area (i.e., opportunity taking, risk evaluation, goal-setting and goal-direction, planning and organizing, financial management, marketing and promotion, problem-solving, rational decision-making, innovativeness, interpersonal relations, commitment, risk bearing, self-management, self-reflection), entrepreneurial feasibility, entrepreneurial desirability, entrepreneurial knowledge	

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