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Assessing engineering students' attitudes towards corporate social responsibility principles

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ABSTRACT

Ethical and sustainable thinking is an important competence in the engineering education to support students' abilities to act and perform in a responsible manner in corporate contexts, and consequently contribute to a sustainable future. This paper investigates engineering students' attitudes towards ethical and sustainable thinking focusing on the corporate social responsibility (CSR) principles in the context of entrepreneurship courses as a part of larger research project. Engineering students from a Finnish and an Estonian university ($N = 342$) responded to a self-assessment survey. The students' attitudes towards CSR principles were assessed both on the enterprise level and the individual level as expectations of potential future employees. The findings indicate that engineering students acknowledge the need to take into account responsible thinking and that it is important for enterprises to be both socially and environmentally responsible in their activities. The self-assessment tool of ethical and sustainable thinking associated with the entrepreneurship competence model and CSR principles can be helpful in practice when university teachers wish to support and assess their students' attitudes towards CSR principles among other entrepreneurship competencies when creating new course content.

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Corporate social responsibility principles; Engineering education; Responsible management education; Self-assessment tool; Sustainable entrepreneurship

Introduction

Higher education should support the development of students and enable them to make sustainable and responsible decisions in their careers and work life (e.g. Birdman, Wiek, and Lang 2022). Responsible higher education is increasingly focusing on Environmental, Social and Governance (ESG) objectives and the United Nations (UN) Sustainable Development Goals (SDGs). In the light of the EU Green Deal and recent EU taxonomy and other directives, such as the Corporate Sustainability Reporting Directive, Regulatory Technical Standards, and Sustainable Finance Disclosure Regulation, there is significant demand for more responsible and sustainability-oriented entrepreneurs, managers, and engineers. Moreover, with regards to students finding new responsible business opportunities and engineering solutions currently challenges occur due to the change of

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values and expectations of the new generation workforce (Ditlev-Simonsen and Midttun 2011; Grow and Yang 2018; Maxwell and Broadbridge 2017).

The underlining attitudes of the basic corporate social responsibility (CSR) principles have not been previously measured among students without a connection to a specific course. Instead, the focus in the literature has been on measuring the outcome of sustainability and business ethics courses students have taken (e.g. Jarchow et al. 2018) or in tracking sustainability competencies during a sustainability course (e.g. Birdman, Wiek, and Lang 2022; Remington-Doucette and Musgrove 2015). CSR can be linked to business ethics on a general level, as both are based on moral values and responsibilities of the business actors (Okechukwu Ugwuozor and Otu 2020). These also apply in the engineering context, as the objective in engineering is to improve the quality of life on the societal (macro) level, thus contribute to sustainability in various industrial sectors; however, currently many industrial production and consumption practices are unsustainable and are causing environmental pollution and human health problems (Heikkurinen, Young, and Morgan 2019). Future engineers need to learn a more holistic system thinking approach that promotes sustainability and learn to apply CSR principles when developing solutions and operating with a wider perspective on the macro level and not focus only on the continuous development of companies', that is micro-level production and services (Luis et al. 2009).

When comparing the research on students and sustainability in higher education institutions, the literature on the general attitudes of engineering students towards CSR principles is particularly scarce (Smith, McClelland, and Smith 2017), as the research scope often covers general engineering ethics on micro level but less on macro level (Burgess et al. 2013; Herkert 2005; Howland, Kim, and Jesiek 2022; Lim et al. 2021; Valentine et al. 2020). A recent study carried out in Finland 2014 and 2016 by Taajamaa et al. (2018) found out that young engineers, freshly entered the workforce (born 1981–1983) rated the importance of ethics in the workplace significantly lower than their older counterparts. This finding sheds light to the necessity to pay more attention to the ethical issues during education. We see a research gap in exploring engineering ethics education at the macro level, particularly in business contexts. A recent study made by Howland, Kim, and Jesiek (2022) suggests that in engineering education there is a need to pay more attention to the moral understanding of other professionals and encourage mutual accountability. This explains the importance of researching students' attitudes towards CSR principles with regards to ethical and sustainable thinking.

With the increasing sustainability issues and problems related to climate change and social responsibility, the understanding of CSR principles is a key competence for today's students, the future decision makers who will need to take into account CSR aspects when working to find solutions that will have a positive economical, societal, and environmental impact (Canney and Bielefeldt 2015). Today, even engineers' professional associations consider environmental sustainability a key responsibility of the educated engineer, and there is a call for more knowledge on students' current level of thinking when designing educational curricula on CSR and sustainability topics (Dyehouse et al. 2017). There has also been a recent call for academic educators in the field of engineering to develop more educational activities that will help to prepare more socially responsible engineers for future businesses (Howland, Kim, and Jesiek 2022; Smith, McClelland, and Smith 2017; Zandvoort 2008), especially in economically unstable times (Anholon et al. 2020). The responsibility of universities is to ensure that as many graduates as possible are equipped to respond to the environmental, social, and ethical dilemmas that confront business and society now and, in the future (Dabija et al. 2017; Didier and Huet 2008; Navarro 2008; Stubbs and Schapper 2011; Waddock 2007).

Our motivation for studying students' ethical and sustainable thinking and attitudes based on CSR principles is linked to the ongoing entrepreneurship education development initiatives in both universities involved in this research. Ethical and sustainable thinking is seen as one of the sub-competencies included in the entrepreneurship competence model and it contributes to the development of enterprising engineers and to increase their employability on the labour market (Venesaar et al. 2022). In the current article the starting point for the development of

the framework for our survey is based on the CSR concept of Carroll (2016) that states that a manager and/or entrepreneur must take into consideration that CSR-driven firms should, in addition to striving to make profit, also obey the law, engage in ethical practices at the workplace, and act as good corporate citizens. The attitudes of students as future employees or employers may thus be understood as value judgments held with either respect or disrespect to something (Rodrigo and Arenas 2008). We use the sociological definition of attitude that considers a mental expression as an intention to act (Chaiklin 2011). In our study, the focus is on the cognitive components of attitude, including the students' opinions and beliefs. In this article sustainability is considered as a capability to serve the needs of society today and future generations and using resources in a way that does not deplete them for future generations and maintaining a balance between economic, social, and environmental aspects (Brundtland 1987; The Estonian Association for Environmental Management n.d.).

The aim of our research is to identify engineering students' attitudes towards CSR principles by asking about their ethical and sustainable thinking, with a focus on the social and environmental responsibility perspectives in the business context. Ethical and sustainable thinking skills focusing on CSR principles are the basis for systematic and far-sighted thinking when making decisions that support the responsible and balanced functioning of individuals and organisations in realising economic, social, and environmental goals (Ettevõtlusõppe Programm 2018). The overarching research question we investigate is the following: *What are engineering students' attitudes towards the CSR principles with regards to ethical and sustainable thinking?*

We designed a self-assessment tool that was sent out to students to investigate their attitudes and aspects of ethical and sustainable thinking with the focus on CSR principles. The ability to self-reflect on one's own thinking and personal competencies has been highlighted as one way to support students in their learning process, so they derive critical insights and meaning from the subjects they study at the university; this also applies in the context of sustainability in management education (Muff 2013; Muff et al. 2013; Rimanoczy 2017). Students' self-assessments of their level of ethical and sustainable thinking at the beginning of courses may help teachers to be aware about what issues need support and improve pedagogical content that supports the development of sustainable and responsible thinking throughout their higher education studies. This could help in selecting relevant business and engineering case examples that include practical assignments on business ethics with discussions on morally right and wrong decisions, and the possible risks of unethical behaviour as well as the advantages of ethical behaviour (De George 2011; Dziubaniuk and Nyholm 2021). Our research gives information to teachers and allows to pay more attention in the study programmes to the CSR principles that get a lower score from students. The self-assessment and teaching of sustainability should be a continuous process because students' attitudes and motivations can decline after their courses end (Zhang et al. 2021). The comparison of students' attitudes with a self-assessment tool in the two universities diversifies the understanding of the effectiveness of ethical and sustainable thinking and CSR topics in teaching and learning, which is also beneficial when considering international teaching.

The theoretical frameworks applied are from the CSR, entrepreneurship, and engineering education literature. The major contributions are to the engineering education literature and our results indicate to university educators the benefits of assessing the incoming students' level of understanding of the CSR principles. When the attitudes of the first-year bachelor students are assessed, it is easier for the teachers to plan course programmes to match the current understanding of the CSR principles and future learning needs of the students.

The first section below summarises the literature on CSR and sustainability education for engineering and business students regarding our overarching research question. The methodology and results are described in the next section. After that, the findings and discussion, including the study's practical implications and limitations as well as suggestions for future research, are presented.

Literature review

Sustainable entrepreneurship in business studies has been the focus of sustainable business research in recent years (Anand and Singh 2021; Buil et al. 2016; Christensen et al. 2007; De Clercq and Dakhli 2009; Kuckertz and Wagner 2010; Lans, Blok, and Wesselink 2014; Ploum et al. 2018; Stonkutė, Vveinhardt, and Sroka 2018). According to an in-depth literature analysis based on 33 international journal articles related to engineering education (Mesa, Esparragoza, and Ramirez 2017), there has been an increase since 2005 in developing curricula and courses for sustainable engineering. The authors demonstrated that eight cases out of 33 linked to the development of curricula and courses in engineering education for sustainability are not connected with economic aspects, and almost every third case (9 out of 33 cases) does not take into consideration the social dimensions, indicating a research gap that we focus on in the current research. Future engineers need to work with and share the same commitment to society and the environment as their business partners. Moreover, they should understand and share their business partners' values on sustainable development for the benefit of humankind and work in accordance with those values that are aligned with the CSR principles and the circular economy.

Smith and her colleagues (2017) have carried out several studies in engineering education and stated that educators should pay more attention to developing an understanding of socially responsible engineering. For example, they found that students are still struggling in a deficit thinking and lack understanding of engineers' role in social and community perspectives. Therefore, fostering engineering students' interdisciplinary understanding of the sociotechnical dimensions of professional practice and strengthening the quality and quantity of students' engagement with social issues in a holistic business context are challenges for educators. Future managers and engineers need to actively seek new opportunities in the markets and solve unsatisfied customer needs and environmental problems to meet the changing demands of society (Schaper 2016). For example, the transition to the more sustainable circular economy business practices poses new kinds of requirements for corporations that cannot be solved with traditional CSR practices. Reorganising customer-centered business models towards more sustainable and circular economy-based models requires special knowledge, skills, and attitudes also from engineers when implementing the transformation from linear production and consumption patterns towards a circular economy (e.g. De Lima, Seuring, and Sauer 2022). These are critical for carrying out practical project tasks, solving problems, and operating ethically in new emerging markets, considering the moral responsibility of engineers that require micro and macro level thinking (Herkert 2005; Mulder, Weigel, and Collins 2007).

The CSR literature presents different perspectives for viewing CSR and sustainability practices in the actual working environment. In this research, we focus on the social, environmental, and ethical dimensions in addition to the economic dimension (Carroll 2016; Elkington 2004; Garriga and Melè 2004; Matten and Moon 2004; Melè 2012). While Garriga and Melè (2004) see CSR as a theoretical model that can be used to implement CSR initiatives, providing the basis for creating organizational- and employee-level processes to develop CSR activities, including environmental assessments, stakeholder management frameworks, management of social impacts, and social programmes, Carroll defined CSR as consisting of four dimensions on which society has set the expectations for organisations. Those four levels are: economic, legal, ethical, and philanthropic (Carroll 1979; 1991; 2016). These dimensions can be formulated with specific responsibilities for businesses. The focus in Carroll's pyramid of CSR is on the societal responsibilities, those that are *required* by society (economic responsibility of being profitable and legal responsibility of obeying the law), those *expected* by society (ethical responsibility of doing what is fair and avoiding harm), and those *desired* by society (philanthropic responsibility of being a good corporate citizen) (Carroll 2016, 5). The importance of the social dimension in the CSR concept was highlighted already in the 1980s, when, for example, Wartick and Cochran (1985) proposed that social responsibility is at the core of the CSR principles.

Although Carroll (1979; 1991; 2016) does not explicitly mention the environmental-related activities as a separate CSR dimension, he (2016) defined a corporation's ethical responsibility as the dimension that includes policies and practices that go beyond the minimum legal responsibilities. In addition, Carroll (2016) lists philanthropic responsibilities that include voluntary activities through which a corporation contributes to society as good corporate citizens, for example, in community development and collaboration with stakeholder groups. Elkington (2004) included the environmental dimension in the triple bottom line (TBL) approach, in addition to the social and economic dimensions. This dimension includes undertaking additional activities beyond those required by the minimum environmental standards, which is seen as a prerequisite for driving responsible entrepreneurship to create more sustainable businesses (Elkington 2004). The environmental dimension is also linked to a broader concept of sustainable development derived from the Brundtland Report published in 1987 by the United Nations (Brundtland 1987; Garriga and Melè 2004). Currently, environmental issues are handled and incorporated in corporations in a sustainability related and TBL approach (Matten and Moon 2004). Initially, sustainability-related activities focused on the natural environment; however, nowadays, it includes the three dimensions of the TBL approach: economic, social, and environmental (Melè 2012).

When referring to the CSR concept in the context of engineering ethics, we rely on the approaches of distinguished scholars of engineering ethics such as McLean (1993) and Herkert (2005). Engineering ethics is considered on the micro and macro levels and through three frames of reference – individual, professional, and social. On the micro level one can consider morality, ethical thinking and decision making of an individual. This also includes responsibility of safe products, avoiding bribes and frauds, obeying the law and personal moral responsibilities. A macro-ethics perspective refers to the profession's collective social responsibility and to societal decisions about technology. Macro ethics includes the social responsibilities of engineers and the engineering profession concerning such issues as sustainable development and product liability. Herkert (2005) emphasises in the education process the need to pay more attention to the roles of professional societies and corporate social responsibility programmes. Interdisciplinarity support is also required to acquire deeper understanding of the broader social context in the engineering profession. Since we rely on the engineering students' attitudes in the context of entrepreneurship, our research differs from the approach of Canney and Bielefeldt (2015), who have focused on professional social responsibility of engineers inside the engineering context. They also suggested examining further how students develop in each realm, relating that development of educational or professional experience necessitates an understanding of the impacts of engineering decisions on society.

The individual-level possibilities to develop sustainability skill sets are becoming more important for students in their attitudes towards CSR principles as they consider their options after graduation, either as entrepreneurs, engineers, or employees in some enterprise, as is increasingly indicated by recent research (e.g. Emblen-Perry 2019; Fodor, Szabó, and Ternai 2021). University education prepares graduates to shift from their educational environment into their real working life (Matlay and Westhead 2005), and thus universities have the responsibility to respond to work-life requirements as well as students' own needs and expectations (Bootsma et al. 2014; Galloway et al. 2005; Sobczak, Debuquet, and Havard 2006). For future managers to be able to create added value and employment opportunities, they need to adapt to changing environmental and social requirements through ethical and sustainable thinking (Buil et al. 2016). Moreover, Christensen and her colleagues (2007) believe that the trend towards the integration of ethics, sustainability, and CSR may serve the most stakeholders in the most efficient manner.

Ethical and sustainable thinking is one of the sub-competencies in the entrepreneurship competence model created by a group of scientists in Estonia (Venesaar et al. 2018). Generic working life skills, including ethical, responsible, and sustainable thinking, are increasingly viewed as important learning goals in higher education because of their significant role when students enter the job market (Grosemans, Coertjens, and Kyndt 2017). Ramirez-Pasillas and Evansluong (2017) have looked at the community of practice aspect in entrepreneurship education and how it can be

used to change students' perceptions about sustainable entrepreneurship. In this case, the focus is on encouraging students' active participation in the community, along with an awareness of their motivations and skill sets, which helps them develop further skills for evaluating and creating sustainable business ideas. Rimanoczy (2017) has researched the sustainability initiatives of business leaders to understand the specific aspects that contribute to the development of a sustainability mindset in managers. She refers to the sustainability mindset as a method of sustainability thinking and acting that results from a wider understanding and knowledge about entire ecosystems, as well as from a more internal perspective in which the personal values and self-perception of individuals are critical drivers and motivations for initiating actions towards the greater good. The contribution of an enterprise to society and to earning stakeholders' trust is crucial in many ways.

Study design

The ethical and sustainable thinking considering the CSR principles survey designed for this research is based on the earlier research work on sustainability and ethical commitment by Buil et al. (2016), De Clercq and Dakhli (2009), and Kuckertz and Wagner (2010), which was adapted to the context of entrepreneurship and engineering education in higher education institutions.

The starting point for the development of a framework for our survey is the CSR concept put forward by Carroll (2016), which holds that a manager and/or entrepreneur must take into consideration that CSR-driven firms should, in addition to striving to make a profit, obey the law, engage in ethical practices in the workplace, and act as good corporate citizens. The attitudes of students as future employees or entrepreneurs may thus be understood as value judgments held with either respect or disrespect to something (Rodrigo and Arenas 2008). We use the sociological definition of attitude that considers a mental expression as an intention to act (Chaiklin 2011). According to Chaiklin (2011, 48), 'attitudes have some utility in predicting behavior when it is not a problem to the person and there is social acceptance of its expression in action'. Based on the main CSR principles: the economic, social, environmental, and ethical dimensions, we included in our model empirical constructs that are relevant in the context of teaching the CSR principles at universities. Based on the literature of Buil et al. (2016), De Clercq and Dakhli (2009), Kuckertz and Wagner (2010), and Carroll (2016) we have compiled a set of CSR principles that we analyse more closely in this research (Table 1).

Table 1. The corporate social responsibility (CSR) principles with references to relevant sources.

Construct & level	Measurement Items	References of measurements items
Working conditions <i>micro level</i>	Supportive and friendly working environment (WC1)	Buil et al. (2016); Galloway et al. (2005); Sobczak et al. (2006)
Social contribution <i>macro level</i>	Equal wages for similar tasks (WC2)	Buil et al. (2016); Carroll (2016)
	Enterprise's contribution to community/ society (SC1)	Buil et al. (2016); Kuckertz and Wagner (2010)
Economic contribution <i>micro level</i>	Enterprise regularly assesses their environmental impact (SC2)	Buil et al. (2016); Kuckertz and Wagner (2010); Venesaar et al. (2018)
	Importance of success of the enterprise (Reverse-coded) (EC1)	Buil et al. (2016); Kuckertz and Wagner (2010)
Ethical values in enterprise <i>micro level</i>	Importance of earning profit (EC2)	Carroll (2016)
	Not allowed to lie (EVE1)	Buil et al. (2016); Carroll (2016); De Clercq and Dakhli (2009)
Responsibility on enterprise <i>macro level responsibility</i>	Not allowed to break the law (EVE2)	De Clercq and Dakhli (2009); Buil et al. (2016)
	It is important for an enterprise to always be responsible for its actions (REnt)	Buil et al. (2016)
Responsibility on employees <i>micro level responsibility</i>	The employees should be trained and encouraged to initiate and undertake environmentally friendly actions (REmp)	Buil et al. (2016)

When referring to ethical values in enterprises we rely on Carroll (2016) approach. In the Carrolls CSR pyramid, obeying the law is one out of four main principles. Therefore, we found that the question about law obedience is directly related to responsibility on employee and enterprise level. Telling the truth reflects to the moral norms and ethical values. Following ethical values and obeying the law are supporting sustainable development of enterprises. While working conditions, ethical values in enterprise and employees' responsibility are reflecting ethics on the micro level, social contribution and enterprise responsibility indicate to the ethics on macro level. We interpreted economic contribution as macro level responsibility because profitability is a key component of sustainability (Carroll 2016; Elkington 2004; Melè 2012).

The social responsibility towards employees is reflected in the *working conditions* of an enterprise. This construct is based on the social commitment scale of Buil et al. (2016), in which the main attention is given to the belief in job preservation and the positive effects on the work environment. In addition, equal pay for equal work is an indicator of social equality. The *social contribution* refers to the community and societal contributions as well as environmental responsibility (Buil et al. 2016; Kuckertz and Wagner 2010). The *economic contribution* is measured according to the level of importance given to financial success and earning a profit (Buil et al. 2016; Carroll 2016; Kuckertz and Wagner 2010). The *ethical values in the enterprise* construct is based on the work of De Clercq and Dakhli (2009) and includes statements on the necessity to not lie and to abide by the law. Ethical responsibility is understood by doing what is right and good and thus avoiding any harmful activities, and this often goes beyond any actual legislation. Future decision makers should know how to implement and incorporate specific CSR-related initiatives into their core company strategy and to ensure that this approach creates mutual benefits for multiple stakeholders, including society as a whole (Edward Freeman and Evan 1990; Jones 1995; Porter and Kramer 2006). Many scholars have argued that value-based management and ethical decision making in business are the basis for sustainable and responsible entrepreneurship (e.g. Lashley 2016; Melè 2012). However, in daily business, there are many conditions (e.g. pressure for profitability, speed of satisfying consumers' needs, and the goal of personal materialistic success) which could affect a person's willingness to behave ethically. According to the strain theory (Agnew 1992; De Clercq and Dakhli 2009; Su et al. 2019), unethical behaviour can occur when personal strains and frustration lead to deviant means, such as telling lies or violating the law in one's own or an enterprise's interest, with an aim to achieve desired ends. People working in challenging business and technology management positions require a mature moral identity that will not allow them to deviate from their ethical principles even in ambivalent business contexts (cf. PRME 2022).

To fulfil the aim of our study, we focus on students' attitudes from the ethical, social, and environmental responsibility perspectives. By social dimension, we consider that future managers and engineers should understand the social impact of their decisions, the importance of meaningful work, and the necessity of equality and safety in their working environment. The economic responsibility to earn a profit as one driver in business is considered a prerequisite for a well-paying job, as well as for creating value and innovations. The environmental dimension is seen as managers' responsibility to take into consideration the ecological impact of their actions with the ultimate goal of decreasing the harmful impacts of businesses and industrial activity on the natural ecosystems.

The construct of *responsibility on enterprise level* has been derived from the work of Buil et al. (2016), who define it as a business commitment beyond the generation of profits, for example as a recognition of the increasing significance of corporate social responsibility in the actions of the enterprise. The construct *responsibility towards employees' engagement in environmentally friendly actions* has also been derived from the work of Buil et al. (2016). In this case, it is considered that employees' activities that have positive effects on the environment and not only business-wise are to be supported, and employees should be allowed to act as change agents. Responsible entrepreneurs should balance the economic health of their stakeholders (including earning a profit for them) with the economic welfare of and contribution to the society in which they operate and

strive to develop environmental resilience through their entrepreneurial behaviour and decisions. The survey questions are listed in Appendix 1.

In the study design we have applied the general guidelines for developing psychometric measurement scales recommended by Hinkin (1995), Nunnally (1978), and Churchill (1979) for the development and compilation of the scale. First, a literature review was conducted to select the appropriate constructs. Then the selected constructs were combined in the survey instrument. The survey had a 5-point Likert-type scale as response options. Exploratory factor analysis (EFA) was conducted to assess the reliability and validity of the study constructs.

Some sources of biases in surveys include the question design, questionnaire design, and administration of questionnaire (Choi and Pak 2005). To avoid the biases in the question design, we ensured the understandability and concise wording of the items. In the questionnaire design, the formatting of the questionnaire on the web page was managed by a survey tool (Limesurvey) that ensured that the layout of the questions and responses were clear and aligned consistently on the webpage. The main approach to mitigate the social desirability bias was to clearly state in the invitation to participate in the survey an assurance of anonymity and confidentiality of the responses. In addition, the set of questions in this survey was a part of a larger survey focusing on entrepreneurship, thus the research purpose was partly disguised which is one approach in minimising social desirability bias (Ried, Eckerd, and Kaufmann 2022).

To reach the objectives of the study, and to investigate engineering students' attitudes towards the CSR principles with regards to ethical and sustainable thinking, we formulated two supporting sub-questions in addition to the main overarching research question RQ1: *What are the engineering students attitudes towards the CSR principles regarding ethical and sustainable thinking?* The two sub-questions are the following: RQ2: *How engineering students' attitudes towards CSR principles relate to attitudes toward enterprise responsibility in macro and micro level?* RQ3: *Are there differences between Finnish and Estonian engineering students in terms of their attitudes of the CSR principles (related to RQ1), and how attitudes towards CSR principles relate to attitudes toward enterprise responsibility in macro and micro level (related to RQ2)?* Additionally, we formulated a research question to examine gender differences: RQ4: *Are there gender differences in terms of how engineering students' attitudes towards CSR principles relate to attitudes towards enterprise responsibility in macro and micro level?*

Methods

Participants

The original sample ($N = 342$) included 24 respondents who had one or multiple missing values (7%). These respondents were removed from the dataset. In addition, analysis of multivariate skewness and kurtosis of CSR factors revealed 10 unique outliers (over ± 3 SDs of variable), which were also removed, resulting in the final sample used in the analyses ($N = 310$). This final sample included 176 students from Finland and 134 students from Estonia, representing different major subjects in various engineering fields. The respondents in Finland were mainly from mechanical, civil, electrical, software engineering and industrial management study programmes (number of students in parentheses)¹ while in Estonia respondents represented IT engineering, product development, robotics, and logistics study programmes. The share of men among the respondents is 64%, and 36% of the respondents are women. From the respondents, 71% are in the age group 18–20, 22% are 21–23, and the remaining 7% are over 23 years old ($M = 20.42$, $SD = 2.38$).

Data collection

The data were collected in the autumn semester of 2017 via an online survey sent out to all first-year engineering students in two universities, one in Estonia and one in Finland. The response rate was approx. 23% for both universities. The students were sent two reminders of the open survey to

ensure that the response rate was high enough for a quantitative analysis. The participants of the survey were informed in written format in the invitation to participate that the results would be handled anonymously and used for research purposes only, and that by responding to the survey, they were allowing the results to be used for this purpose. In Estonia, the survey was launched both in English and Estonian; most students replied to the Estonian version, and the international students responded to the English version. In Finland, the survey was sent out in English only. The level of English is high in the Finnish educational system, and in Finnish universities of technology, students typically have a command of approximately three to four foreign languages on average and all of them understand and can speak English (Schrey-Niemenmaa and Hellman 1995).

Survey

The students' attitudes towards CSR principles were measured using the self-assessment tool based on previous research, which was supplemented and adopted to the context of entrepreneurship and engineering education in universities. The use of the three most important CSR components, working conditions, ethical values, and social responsibility, to characterise students' attitudes towards CSR principles allows us to obtain a more holistic overview of the students' attitudes compared with the previous research. The CSR principles survey described in our research is an assessment tool that has been elaborated as part of a larger research project focusing on the development of an entrepreneurship competence and its sub-competencies (Ettevõtlusõppe Programm 2018). Theoretical background of the survey is presented in the 'Study design' section.

The survey contained five factors that were measured with 10 items: WC ([Working conditions], 2 items); SC ([Social contribution], 2 items); EC ([Economic contribution], 2 items); EVE ([Ethical values in enterprise], 2 items), REnt ([Responsibility on enterprise level], 1 item), and REmp ([Employees' individual environmental responsibility], 1 item). Survey items are presented in Appendix 1. The response options for the questions followed a 5-point Likert-type scale (totally disagree (1), rather disagree (2), neutral (3), rather agree (4), totally agree (5)).

Statistical analyses

First, we conducted exploratory factor analysis (EFA) to assess the reliability and validity of the study constructs. Confirmatory factor analyses (CFA) were used to compare factor solutions. Model fit was evaluated with the chi square difference test and the following fit indices (Hu and Bentler 1999): Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Akaike Information Criteria (AIC), and Bayesian Information Criteria (BIC). Composite reliability (ω ; McDonald 1999) was assessed using the 'sem-Tools' package (Jorgensen et al. 2022). In addition, we analysed measurement invariance (MI; Byrne, Shavelson, and Muthén 1989) between the two countries' samples in order to ascertain that we can use the full sample in investigating the first two research questions. We assessed three kinds of MI: configural, metric, and scalar (Putnick and Bornstein 2016). MI was tested with the chi square difference test and the inspection of the differences of the scaled Comparative Fit Index (Δ CFI) and scaled Root Mean Square Error of Approximation (Δ RMSEA) estimates (Chen 2007; Cheung and Rensvold 2002). Configural invariance was investigated by the model fit indices (CFI should be $> .90$ and RMSEA should be $< .08$; Hu and Bentler 1999).

To answer RQ1, we calculated descriptive statistics and correlations. To answer RQ2, we used multiple regression to investigate how the CSR factors influence corporate and employee responsibility. To answer RQ3, Welch's unequal variances *t*-test was used to compare universities in terms of their students' perceived importance of CSR principles (related to RQ1) and analysis of variance (ANOVA) was used to investigate the differences between universities and genders (RQ4) in terms of how students' attitudes towards CSR principles relate to attitudes toward enterprise responsibility (related to RQ2). Multiple comparisons were addressed by controlling the false discovery rate (Benjamini and

Hochberg 1995), which retains more statistical power when comparisons are more exploratory compared to controlling family-wise error rate (e.g. Holm 1979). All statistical analyses were conducted with RStudio (R Core Team 2021). Descriptive statistics were calculated using the 'psych' package (Revelle 2023). Multivariate normality, EFA, CFA, and MI analyses were conducted using the 'lavaan' package (Rosseel 2012).

Results

We first examined the factorial structure of the full sample through exploratory factor analysis (EFA) using the minimal residual extraction method in combination with an oblimin rotation. Table 2 presents the results from EFA (overall KMO = .69; Bartlett's test of sphericity $\chi^2(28) = 423.02, p < .001$). EFA supported a three-factor solution accounting for 44.39% of the variance. The solution showed a good fit (RMSEA = .02; TLI = .99; $\chi^2 = 8.35, df = 7, p = .302$). The three-factor solution merged the concepts related to 'working conditions' (WC1, WC2) and 'social contribution' (SC1, SC2) into the first factor (labelled here as '[general merged label for WC + SC]'). The second factor was labelled as 'economic contribution' (EC1, EC2), and the third factor was 'ethical values in enterprise' (EVE1, EVE2).

Since the theory proposes a four-factor structure for our measurements, we conducted two CFA analyses to compare the EFA-supported three-factor solution (Model 1) and the theory-driven four-factor solution (Model 2) with full sample ($n = 310$) and with both university samples separately. Table 3 shows the fit indices of the solutions and model fit comparisons between models (cut-off values indicating good fit: CFI $\geq .95$, TLI $\geq .95$, RMSEA $\leq .06$, SRMR $\leq .08$; Hu and Bentler 1999). Both Model 1 and Model 2 had a better fit compared to the one-factor solutions. Regarding full sample, Model 1 had lower values for the Akaike information criteria (AIC) and Bayesian information criteria (BIC), but a higher χ^2 -value (non-significant difference) compared to Model 2. Estonian sample ($n = 134$) had better fit using Model 2, whereas Finnish sample had no significant differences of fit between the models. For the full sample Model 1 was selected over Model 2 as it is less complex and is suggested by the EFA. Figure 1 presents the CFA results for the three-factor solution. Composite reliability of the three-factor model was low for the merged WC + SC factor ($\omega = .57$) but better for EC ($\omega = .69$) and EVE ($\omega = .73$) factors. Measurement invariance was assessed next to justify use of full sample in the analysis.

We assessed three kinds of measurement invariance (MI): configural, metric, and scalar (Putnic and Bornstein 2016). In the model, all eight manifested variables (survey items) were indicators for the three/four latent variables (CSR factors). MI was tested with the chi square difference test and the inspection of differences of the scaled CFI and scaled RMSEA estimates. The results are presented in Table 4. The CFI estimates for configural MI were over .90, and the RMSEA estimates were under .06. There were no significant differences between the scaled estimates ($\Delta CFI < -.01$; $\Delta RMSEA < .015$) indicating MI. Thus, the MI results permit the analyses using the full sample for RQ1 and RQ2.

Table 2. Exploratory factor analysis (EFA) results.

Items	Factor loadings		
	1	2	3
WC1	.48		
WC2	.35		
SC1	.50		
SC2	.68		
EC1		.68	
EC2		.72	
EVE1			0.48
EVE2			1.00

Note: Minimum residual extraction method was used in combination with an oblimin rotation; Only loadings larger than .30 are shown. WC = Working conditions, SC = Social contribution, EC = Economic contribution, EVE = Ethical values in enterprise.

Table 3. Model comparisons for the full, Estonian, and Finnish samples.

	RMSEA	SRMR	CFI	TLI	AIC	BIC	χ^2 (df)	χ^2 diff
<i>Full sample (N = 310)</i>								
Model 1 (Three-factor)	.049	.038	.969	.948	5842	5913	29.573 (17)	
One-factor model					5917	5979	110.678 (20)	81.106***
Model 2 (Four-factor)	.052	.033	.971	.942	5844	5926	25.576 (14)	
One-factor model					5969	6029	162.459 (20)	136.883***
Model 2 (Four-factor)	.052	.033	.971	.942	5844	5926	25.576 (14)	
Model 1 (Three-factor)	.049	.038	.969	.948	5842	5913	29.573 (17)	3.997
<i>Estonian sample (n = 134)</i>								
Model 2 (Four-factor)	.067	.045	.960	.920	2655	2718	22.348 (14)	
Model 1 (Three-factor)	.078	.062	.932	.889	2657	2712	31.014 (17)	8.667*
<i>Finnish sample (n = 177)</i>								
Model 2 (Four-factor)	.034	.037	.985	.971	3219	3289	16.784 (14)	
Model 1 (Three-factor)	.024	.040	.991	.985	3215	3275	18.672 (17)	1.889

Note: RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; CFI = Comparative Fit Index; TLI = Tucker Lewis index; AIC = Akaike Information Criteria; BIC = Bayesian Information Criteria; χ^2 = chi-square value; df = degrees of freedom; *** $p < .001$.

To respond to RQ1 (*What are the engineering students attitudes towards the CSR principles regarding ethical and sustainable thinking?*), we analysed the descriptive statistics and correlations of study factors (See Table 5). Participants reported relatively high values in importance of working conditions (WC), social contribution (SC), ethical values (EVE), and in both dependent variables of enterprise responsibility (REnt, REmp). Distributions of these items were negatively skewed thus indicating that students' perceived the importance of these factors were relatively high. Economic contribution (EC) items, on the other hand, were symmetrical distributed (skewness values close to 0) around the middle of the scale indicating a more neutral perception of importance of economic contribution. As

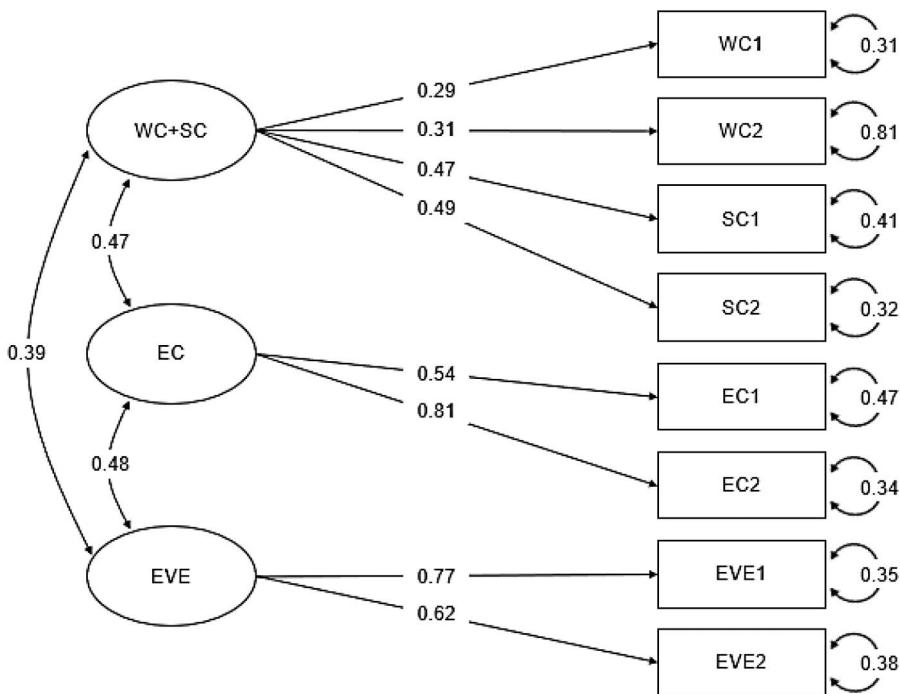


Figure 1. Confirmatory factor analysis of the 3-factor model.

Note: Standardised estimates are based on the variances of latent variables only.

Table 4. Results of the measurement invariance testing (three-factor model).

MI	χ^2 (df)	CFI	RMSEA
Configural	22.868 (34)	.982	.030
Metric	28.228 (39)	.990	.021
Scalar	31.141 (44)	.991	.018
Metric – Configural	5.360 (5)	.008	–.009
Scalar – Metric	2.913 (5)	.002	–.003

Note: χ^2 = chi-square value; *df* = degrees of freedom; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation.

expected by the literature review, all bi-variate correlations were positive and mostly statistically significant.

To respond to RQ2 (*How engineering students' attitudes towards CSR principles relate to attitudes toward enterprise responsibility in macro and micro level?*), we analysed the results from the regression analysis of CSR factors of responsibility on enterprise level (REnt) (See Table 6). False discovery rate criterion (*q*) was set to 0.05. The first working condition dimension (WC1: supportive and friendly working environment), the second social contribution dimension (SC2: Enterprise regularly assesses their environmental impact), and the second ethical values in enterprise dimension (EVE2: Not allowed to break the law) predicted REnt. The amounts of variance explained in REnt were small, ranging from 4% to 12%. Regarding responsibility towards employees' engagement in environmentally friendly actions (REmp), both supportive and friendly working environment (WC1) and equal wages for similar tasks (WC2), enterprise regularly assesses their environmental impact (SC2), both economic contribution dimensions (EC1: Importance of success of the enterprise, EC2: Importance of earning profit), and the first ethical values in enterprise dimension (EVE1: Not allowed to lie) predicted REmp (Table 7), of which social contribution had the largest R^2 -value, explaining nearly 30% of the variance.

To respond to RQ3 (*Are there differences between Finnish and Estonian engineering students in terms of their attitudes of the CSR principles (related to RQ1), or how attitudes towards CSR principles relate to attitudes toward enterprise responsibility in macro and micro level (related to RQ2)?*) we first analysed whether there were differences between Finnish and Estonian students' attitudes towards the importance of CSR principles (Table 8). The results show that there were differences between universities only in ethical values in enterprise (EVE): 'Not allowed to lie' (EVE1), $t(269) = 3.62, p < .01$, and 'Not allowed to break the law' (EVE2), $t(261) = 3.81, p < .01$, with Finnish students having higher values compared to Estonian students in both.

Next, we investigated whether the universities differed in terms of CSR factors regressed on responsibility on enterprise level (REnt) and responsibility of employees' engagement in environmentally friendly actions (REmp). False discovery rate criterion (*q*) for model comparisons

Table 5. Descriptive statistics and bivariate correlations of study variables.

	<i>M</i>	<i>SD</i>	<i>Skew</i>	1	2	3	4	5	6	7	8	9
1. WC1	4.50	0.63	–0.87	–								
2. WC2	4.01	0.95	–0.76	.170	–							
3. SC1	3.72	0.79	–0.28	.242	.171	–						
4. SC2	4.13	0.75	–0.54	.324	.221	.385	–					
5. EC1 ^a	2.97	0.88	–0.09	.094	.031	.213	.188	–				
6. EC2 ^a	2.95	1.00	–0.13	.114	.147	.310	.213	.502	–			
7. EVE1 ^a	3.84	0.97	–0.62	.136	.044	.169	.198	.273	.309	–		
8. EVE2 ^a	4.31	0.88	–1.09	.273	.101	.138	.185	.166	.270	.563	–	
9. REnt	4.62	0.63	–0.66	.334	.115	.084	.201	.118	.026	.269	.322	–
10. REmp	4.18	0.78	–1.83	.290	.195	.257	.542	.237	.234	.227	.214	.321

Note: ^a = reverse coded. Statistically significant correlation coefficients ($p < .05$) are bolded.

Skew = skewness, WC = Working conditions, SC = Social contribution, EC = Economic contribution,

EVE = Ethical values in enterprise, REnt = responsibility on enterprise level, REmp = Responsibility towards employees' engagement in environmentally friendly actions.

Table 6. Multiple regression analysis results for CSR factors predicting corporate responsibility of enterprise (REnt) in full sample.

Predictor	β	SE	95% CI		t	F (2, 307)	R ²
			LL	UL			
Working conditions						19.970***	.115
(Intercept)	3.012	0.264	2.493	3.530	11.435***		
WC1	0.323	0.054	0.216	0.430	5.949***		
WC2	0.039	0.036	-0.031	0.109	1.091		
Social contribution						6.492**	.041
(Intercept)	3.916	0.219	3.485	4.347	17.875***		
SC1	0.006	0.048	-0.089	0.100	0.120		
SC2	0.166	0.051	0.066	0.266	3.277*		
Economical contribution						2.398	.015
(Intercept)	4.408	0.135	4.141	4.674	32.571***		
EC1	0.100	0.047	0.008	0.192	2.142		
EC2	-0.028	0.041	-0.109	0.053	-0.681		
Ethical values in enterprise						19.910***	.115
(Intercept)	3.539	0.175	3.195	3.883	20.217***		
EVE1	0.083	0.042	0.001	0.166	1.989		
EVE2	0.177	0.046	0.086	0.268	3.832***		

Note: N = 310; SE = standard error; CI = confidence interval; LL = lower limit; UL = upper limit; Bonferroni-Holm corrected *** $p < .001$, ** $p < .01$, * $p < .05$.

(ANOVA) was set to 0.05. University was not a significant predictor and had no interaction effects on the regressions.

Lastly, to respond to RQ4 we examined whether there were differences between genders in the regressions. False discovery rate criterion (q) for model comparisons (ANOVA) was again set to 0.05. Gender was a significant predictor in all the regressions models of CSR principles on REmp: working conditions (WC), $\beta = -0.20$, $t = -2.30$, $p < .05$; social contribution (SC), $\beta = -0.20$, $t = -2.62$, $p < .05$; economic contribution (EC), $\beta = -0.21$, $t = -2.28$, $p < .05$; ethical values in enterprise (EVE), $\beta = -0.25$, $t = -2.80$, $p < .05$. Apart from EVE, gender was a significant predictor only when false discovery rate was controlled. Gender was not a significant predictor in any regressions of CSR principles on REnt. Thus, identifying as a man was negatively associated with REmp in all regression models regarding CSR principles influence in perception of enterprises responsibility of employees' engagement in environmentally friendly actions. Gender had no interaction effects on the regressions.

Table 7. Multiple regression analysis results for CSR factors predicting responsibility towards employees' engagement in environmentally friendly actions (REmp) in full sample.

Predictor	β	SE	95% CI		t	F (2, 306)	R ²
			LL	UL			
Working conditions						18.090***	.106
(Intercept)	2.221	0.329	1.573	2.868	6.750***		
WC1	0.326	0.068	0.193	0.460	4.814***		
WC2	0.122	0.045	0.034	0.209	2.731!		
Social contribution						64.320***	.296
(Intercept)	1.750	0.233	1.292	2.208	7.514***		
SC1	0.056	0.051	-0.045	0.156	1.089		
SC2	0.538	0.054	0.432	0.644	9.999***		
Economical contribution						12.200***	.074
(Intercept)	3.406	0.163	3.086	3.727	20.920***		
EC1	0.141	0.056	0.030	0.252	2.506!		
EC2	0.120	0.049	0.022	0.217	2.420!		
Ethical values in enterprise						10.18***	.062
(Intercept)	3.221	0.223	2.781	3.661	14.413***		
EVE1	0.124	0.053	0.019	0.230	2.331!		
EVE2	0.111	0.059	-0.005	0.227	1.881		

Note: N = 310; SE = standard error; CI = confidence interval; LL = lower limit; UL = upper limit; Bonferroni-Holm corrected *** $p < .001$, ** $p < .01$, * $p < .05$; ! statistically significant only when controlling False Discovery Rate ($q = .05$).

Table 8. Results of *t*-tests comparing Finnish and Estonian students.

	FIN		EST		<i>df</i>	<i>t</i>	<i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Working conditions							
WC1	4.458	0.647	4.557	0.597	292	-1.394	.163
WC2	3.967	0.911	4.069	1.009	263	-0.918	.113
Social contribution							
SC1	3.743	0.712	3.679	0.888	242	0.676	.087
SC2	4.117	0.705	4.145	0.805	258	-0.315	.039
Economical contribution							
EC1	3.039	0.830	2.885	0.933	260	1.499	.186
EC2	3.061	0.990	2.794	0.990	280	2.351	.281
Ethical values in enterprise							
EVE1	4.011	0.924	3.611	0.989	269	3.621**	.442
EVE2	4.475	0.816	4.092	0.915	261	3.810**	.472
Macro level							
Rent	4.145	0.735	4.223	0.828	258	-0.854	.075
Micro level							
REmp	4.603	0.666	4.649	0.567	301	-0.648	.106

Note: *N* = 310, *df* = degrees of freedom, *t* = value of the Welch's *t*-test, *d* = effect size (Cohen's *d*); Bonferroni-Holm corrected ***p* < .01.

Discussion

This study investigated engineering students' attitudes towards the CSR principles with regards to ethical and sustainable thinking as a part of larger research project. Regarding our first research question about engineering students' attitudes toward CSR principles, we found that, based on the mean and distribution of the survey items, the students reported relatively high values of perceived importance of working conditions, social contribution, ethical values, and both enterprise responsibility in enterprise and employee levels, while most perceived the importance of economic contribution as more neutral. This attitude related to economic contribution as such may harm the sustainability of enterprise as economic contribution is one of the basic CSR principles which cannot be denied in any practice (Carrols 2016; Elkington 2004; Mele 2012). The respondents showed on the individual level high moral standards through attitudes towards obeying the law and telling the truth. The importance of good working environment was highly evaluated as well. Based on these results, students' attitudes towards CSR principles on the micro ethics level seemed to be advanced. Looking into macro level ethics, the importance of enterprise earning profit (which matters in terms of sustainability) was relatively low.

With respect to our second research question about engineering students' attitudes towards CSR principles in relation to attitudes toward enterprise responsibility in macro and micro level, we observed that students' assessments of certain CSR activities of enterprises (such as working conditions, social contribution, and ethical values) were linked to responsibilities at both the enterprise-wide (macro) and employee-specific (micro) levels. At the macro level, this included factors like maintaining a supportive and welcoming work environment, regular environmental impact assessments, and adherence to legal regulations. On the micro level, it encompassed aspects like providing equal pay for similar tasks, valuing the success and profitability of the enterprise, and prohibiting dishonesty. The view that enterprises are not allowed to break the law was the most impactful CSR aspect associated with enterprises responsibility on enterprise level, while enterprise regularly assessing their environmental impact was the most impactful CSR action associated with enterprise responsibility on employee level. The findings indicate that engineering students already acknowledge the need to consider ethical and sustainable thinking and that it is important for enterprises to be both socially and environmentally responsible in their activities.

Regarding our third research question about differences between Finnish and Estonian engineering students' attitudes toward the CSR principles, and toward enterprise responsibility in macro and micro levels, we found that there were similarities but also some differences between the Finnish

and Estonian universities. There were no differences between universities on students' attitudes on working conditions, social contribution, economic contribution principles. This may be similarly interpreted as individual-level actions and corporate culture guiding the enterprise-level impact positively. This seems to indicate that students understand the importance of the instrumental perspective to CSR that highlights the importance of businesses incorporating specific social and environmental initiatives driven by ethical values as their core strategy, in order to benefit a wider range of stakeholders and society as a whole (Edward Freeman and Evan 1990; Jones 1995; Porter and Kramer 2006).

The universities differed in their students' perceived importance of ethical values in enterprise, as Finnish students rated these factors higher than Estonian students. This somewhat surprising finding indicates that in Finland, students may perceive the company-level steering systems as important to responsible actions, while in Estonia, the students view employee-level actions as more important than enterprise-level systems in inducing responsible behaviour. Thus, in management and engineering education, these aspects should be taken into account, with a special focus depending on the students' views. The differences in this case could stem from the different social and political histories of the nations, or it could be related more to the specific student cohort included in the study rather than directly dependent on the country (Baumane-Vitoliņa et al. 2017). According to the research of Sobczak, Debucquet, and Havard (2006), the reasons could also lie in the content of the programmes or the different cultures of the higher education institutions. Earlier research indicates that the cultural context can have an influence on the way students consider, for example, social responsibility (Wong, Long, and Elankumaran 2010). Hence, it would be important for educators to measure and investigate the expectations of students at the beginning of a course focusing on CSR. Comparing two universities from different but geographically close countries gives teachers a deeper understanding of how to increase efficient knowledge creation in terms of internationalisation. It may also influence the later communication and understanding in the world of practice regarding two countries. Our findings suggest the need to improve the teaching in entrepreneurship, engineering and/or other subject-specific courses by encouraging more discussion and argumentation about the understanding of ethical and sustainable thinking considering the main concepts and attitudes related to CSR. As suggested in the literature, universities should integrate CSR in their culture, as the culture seems to have an impact on the understanding/trust in companies' business practices and CSR (Sobczak, Debucquet, and Haverd 2006), which is as important as the content of the education. The country or university was, however, not a significant predictor when examining the associations between attitudes on CSR principles and attitudes toward enterprise responsibility in macro and micro level.

Finally, regarding gender differences in engineering students' attitudes towards the CSR principles (RQ4), women perceived employees' individual environmental responsibility higher than men when the influences of social contribution and ethical values in enterprise were examined. Previous literature and research on environmental concern and responsibility also indicates clear gender differences both in the perception of (McCright 2010) and attitudes toward (Zelezny, Chua, and Aldrich 2000) environmental problems. Recent research on the pro-environmental attitudes of female representatives in the European Parliament even shows that female MEPs are more likely to advance environmental protection (Ramstetter and Habersack 2019).

This study contributes to the empirical research gap on university students', especially engineering students', attitudes towards CSR principles and the need to develop methodologies that are derived from standard sustainability indicators in higher education (Mesa, Esparragoza, and Ramirez 2017). The first key contribution of our study is that there seems to be generalisable attitudes towards CSR principles among the students, regardless of their societal background, such that the social contribution of enterprises is perceived to be an important commitment to employees. This may be interpreted so that students view CSR activities and individual-level capabilities and their development to be intimately linked in a positive cycle to the sustainability efforts and societal contributions of enterprises.

Practical implications for teaching CSR principles in higher education institutions

Ethical values and CSR principles as a part of entrepreneurship competence can be readily included in the curriculum, as students in technical universities already recognise their value and meaning in sustainability-driven activities in companies. The use of student-centered activities and incorporating instructional procedures alongside learning assignments related to working life (i.e. active learning methods) are believed to promote the development of these skills. However, a recent review in engineering higher education (Hartikainen et al. 2019) showed that these pedagogical innovations and interventions are more focused on promoting cognitive learning outcomes (i.e. students' subject-specific learning) than in developing skills that are not bound to any specific profession.

The incorporation of ethical and sustainable thinking in all applicable university courses instead of dealing with them as separate courses could be a solution for linking the attitudes towards CSR principles more tightly to the subject matter. It is thus critical to reinforce the existing values and attitudes towards the CSR principles of engineering students in universities throughout their studies by offering them content that helps them solve the wicked sustainability problems that society and the planet are currently facing. In addition, it should be noted that it is not only about content but also how this content is delivered to the students and how it is ensured that it is also learnt by the students.

The objectives of responsible management education link the UN Sustainable Development Goals (SDGs) and ESG approach, and they are the guidelines used in many universities already. Especially in technical universities and engineering faculties, the practical implications of our findings are that these issues could be more readily included in study programmes and in the culture of higher education institutions. Our study results are also aligned with the suggestion of Herkert (2005) that more courses or course sequences that cover approaches grounded in practical ethics are still needed. In addition, when using a self-assessment tool in selected courses focusing on sustainability, students can obtain immediate feedback and thus consciously develop their knowledge, skills, and attitudes on sustainability issues.

The findings of our research can be used to promote the development of CSR principles driven thinking and acting among students in engineering education, business management, and entrepreneurship in universities. The competency of sustainable and responsible thinking is one of mandatory components in the entrepreneurship competence model elaborated in Estonia, consisting of the knowledge, skills, values, and motivation required for the creation of cultural, social, economic, and environmental values in society (Ettevõtlusõppe Programm 2018). This set of skills is crucial for everyone, not only for entrepreneurs, and they can be applied in many technical fields. Higher education institutions should thus contribute to the integration of CSR-related thinking in the training of future decision makers and management professionals.

Limitations and future research

Our findings and model have some limitations that provide ample interesting research avenues for future research. The study was conducted in only two countries, and the model needs to be tested in other countries and cultures to verify the generalizability of the findings. In addition, as the respondents were students from two technical universities, it would be important to also test the model with students from other disciplines outside the engineering and business schools. Another limitation of the study is that the sample comprised of first-year engineering students and the survey was launched at the beginning of the academic year. As a consequence, students' attitudes toward CSR likely reflect their upbringing and prior schooling, rather than the values of their engineering programmes. Future research could focus on investigating how engineering students' attitudes may change as a result of the academic education.

One should also take into consideration that very often entrepreneurs have not studied business or entrepreneurship according to a university curriculum (Buil et al. 2016). In the current research, the

authors concentrated on students' sustainable orientations at the university level, where it is more likely that CSR awareness is on the individual level, but it would also be interesting to continue the research with longitudinal studies and to investigate students as employees in real decision making and judgment situations in which they are required to apply the CSR principles.

A self-assessment tool may not always be the best way to assess competences or mindsets, but in teaching and learning situations self-assessments have been found for learning purposes to help students. The results from a self-assessment can provide quick feedback to the students so that they can discuss the results, and better understand where their views may have differed from the other students' views which in turn can then help them to further develop their thinking and competencies.

Future research could further investigate whether the findings that were common in both countries hold for other societal and national contexts, and similarly, of course, the applicability of the differences in the findings. Our exploration to find engineering students' attitudes towards CSR principles may be used to further investigate how attitudes towards CSR principles are built and constructed in students' activities and intentions as well as how their attitudes towards CSR principles influence their career choices. In addition, future research could further test the survey items in this paper as well as develop additional novel items based on Carroll's pyramid of CSR (what's required, expected, and desired) to, for example, evaluate if 'what's required' is rated higher than 'what's desired' (Carroll 2016). Increasing the number of items could improve the survey's performance and allow the use more complex analyses of CSR factors.

Despite the limitations of this research, to the best of our knowledge, this is the first study that has explored engineering students' attitudes towards CSR principles in the frame of a larger research on entrepreneurship competence among engineering students. Thus, this study contributes to the way higher education institutions could start to measure more consistently the effectiveness of incorporating more sustainability- and social responsibility-related courses in their curricula on students' attitudes towards CSR principles.

Note

1. Architecture (5), Automation Engineering (17), Biotechnology (12), Mechanical Engineering (28), Materials Science (11), Civil Engineering (20), Electrical Energy Engineering (16), Technology and Natural Sciences (15), Information Management (12), Software Engineering (14), Industrial Management (16), Environmental and Energy Technology (10). The respondents in Estonia were from the following study programmes: Mechatronics (6), Product development and robotics (23), Logistics (20), Business info technology (61), Informatics (3), Product development and production technique (8), Applied chemistry and biotechnology (4), Food technology (4), Thermal engineering (1), Electrical Power engineering (3), Geotechnology (1).

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Appendix 1. Survey questions

The following statements are connected to taking into account the sustainability of environment and society. Please indicate your level of agreement with the following statements.

1. Supportive and friendly working environment is important for me.
2. Enterprises should be equal wage to persons responsible for similar tasks.
3. The success of the enterprise is more important than contributing to the society.
4. Enterprises should contribute to community/ society.
5. The employees should be trained and encouraged to initiate and undertake environmentally-friendly actions.
6. Enterprises should regularly assess their environmental impact (costs and savings).
7. Earning profit is more important for the enterprise than contributing to the development of the society.
8. It is allowed to lie in the interests of an enterprise.
9. When it is in the interests of the enterprise, it is allowed to break the law sometimes.
10. It is important for an enterprise to always be responsible for its actions.