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Assessment of Young People's Attitudes Towards Sustainable Entrepreneurship with Machine Learning Techniques Use

Abstract

RESEARCH OBJECTIVE: The main purpose of the research is to assess whether the young generation in Poland has the potential to build sustainable companies by evaluating the attitudes of university students towards sustainable entrepreneurship..

THE RESEARCH PROBLEM AND METHODS: The readiness to create a sustainable enterprise was assessed on the basis of self-assessment of pro-social attitudes, business intentions and knowledge of social and environmental aspects in business with the use of multidimensional analysis based on machine learning methods.

THE PROCESS OF ARGUMENTATION: A significant challenge for policymakers, scientists and entrepreneurs is solving important social and environmental problems through the development of sustainable entrepreneurship. The implementation of this concept requires efforts to educate and shape pro-social attitudes, especially among the young generation. Therefore, the research focuses on identifying and assessing the attitudes and awareness level of pro-social

aspects in business and recognition of entrepreneurial intentions among representatives of this generation.

RESEARCH RESULTS: The research results show that young people have an intuitive sense of what sustainable business is all about, but the formal knowledge in this area is low. Financial aspects, i.e. the possibility of obtaining significant income from own business, as well as independence and the possibility of being a manager, turned out to be much more motivating for entrepreneurship than the possibility of changing the world for the better, helping local communities or protecting the environment.

CONCLUSIONS, INNOVATIONS AND RECOMMENDATIONS: The innovative approach to multidimensional data analysis highlighted the lack of knowledge and insufficient level of pro-social attitudes among the young generation, which is a particularly worrying phenomenon in the context of formulated challenges and social and environmental needs.

Keywords:
machine learning; social entrepreneurship, sustainable entrepreneurship

INTRODUCTION

The need to educate entrepreneurship and its impact on undertaking entrepreneurial challenges is of interest to practitioners as well as many researchers (Dickson *et al.* 2008; Martin *et al.* 2013; Nabi *et al.* 2017; Pasierbek & Pera 2018; Suska 2018; Thompson *et al.* 2010). Taking into account the complexity of conditions of modern enterprises, scientists and practitioners more and more often focus on issues related to the ideas of sustainable entrepreneurship and social entrepreneurship as concepts directing business towards social and environmental issues. Technological progress contributes to permanent changes in social functions, human psyche, and finally the image of the Earth as a planet. Will these changes ensure a good quality of life also for future generations? This question is often raised by researchers in many fields, and by practitioners and policy makers.

For this reason, the need to conduct research in the field of education and shaping awareness and attitudes towards sustainable entrepreneurship seems to be very important, which is reflected in the research presented in this article.

Companies focused on sustainable development are often managed in an unconventional manner, going beyond standard management activities, and therefore they can play a particularly important role in reviving local economies and overcoming crises, including those caused by the COVID-19 pandemic. Currently and after the pandemic, sustainable entrepreneurship will face new challenges and problems. That is why it is so important to support and diversify sustainable entrepreneurship, which is playing an increasingly important role in shaping the reality today and in the future. To achieve this it is necessary to educate the young generation and shape attitudes that encourage them to take up the challenges of the modern world and solve serious social and environmental problems, e.g. by creating mission-oriented, profit-oriented ventures (Kickul *et al.* 2018).

The aim of the study is to assess whether the young generation in Poland has the potential to build sustainable companies by evaluating the attitudes of university students towards sustainable entrepreneurship. To achieve this goal, research was carried out among students of two universities in Poland: Pedagogical University of Krakow (PUC) and Rzeszów University of Technology (RUT), examining the state of their knowledge, awareness and attitudes towards sustainable entrepreneurship, and diagnosing their business intentions.

Machine learning method – rule induction was used to analyze the data collected in the surveys. This made it possible to identify relationships between respondents' characteristics in terms of their awareness and knowledge of specific aspects of sustainable entrepreneurship and business intentions.

As the research issues are interdisciplinary in nature, the results constitute the basis for further research that would provide a way to formulate recommendations for building curricula aimed at filling the gaps in the education of entrepreneurship, sustainable entrepreneurship, economics, management, as well as sociology, psychology and ecology.

The article is structured as follows; the first part is a literature review of the research subject, the second is a presentation of the research methodology, and the third is a discussion of the obtained results. It ends with a summary, conclusions and an outline of future research directions.

REVIEW OF THE LITERATURE

Sustainable and pro-social entrepreneurship is perceived as a multifaceted phenomenon combining the social, environmental and economic dimensions between entrepreneurial processes, market changes, and large-scale social changes (Johnson and Schaltegger, 2019). The development of entrepreneurship as such is shaped by a wide range of socio-economic aspects (Khan *et al.*, 2005). The complexity, the multiplicity of factors determining business success, but also the transformation of business priorities, prompts a rethinking of the entrepreneurship education model by placing greater emphasis on social entrepreneurship and moving from the model of "learning about entrepreneurship" to the model of "learning for social entrepreneurship" (Pache and Chowdhury, 2012). Taking into account the multidimensionality of sustainable entrepreneurship, it is worth appreciating the importance of competences as one of the most important factors shaping sustainable entrepreneurship. The existing competency framework for sustainable entrepreneurship has been verified in surveys conducted among potential entrepreneurs by Ploum *et al.* (2017).

An interesting approach to sustainable entrepreneurship was presented by Shepherd and Patzelt (2011), who define this concept as paying attention to nature conservation, supporting life and communities in search of perceived opportunities to create future products, processes and services for profit, where profit is broadly understood as including benefits economic and non-economic for individuals, economy and society. Murzyn *et al.* (2020) pointed to the need to educate young people in the field of social entrepreneurship, presenting several practical recommendations resulting from research conducted in Poland, North Macedonia, Italy and Jordan. They defined a social enterprise as a business, market-oriented and usually associated with the local community, dealing with important and neglected social problems and / or having a clear social impact through an innovative approach. In the specificity of social entrepreneurship, the local context is emphasized, pointing to the need for education and involvement in solving local problems (M. Starnawska, 2018).

In Poland, the framework for social entrepreneurship was established in the National Program for Social Economy (www.ekonomia-spoleczna.gov.pl).

Therefore, it seemed reasonable to verify the results of the adopted framework and action plans by conducting research assessing the level of knowledge of social aspects in business of representatives of the young generation and their attitudes towards sustainable entrepreneurship.

METODOLOGY. RULE INDUCTION

The research was carried out in Poland among groups of students at RUT and PUC. The questionnaire was completed by 335 respondents. They were asked about their intentions and entrepreneurial motives which might encourage them to start their own business, as well as obstacles preventing them from taking up this challenge, and whether they assess themselves as entrepreneurial persons, or as responsible for the community in their environment, responsibly using natural resources. They also assessed the impact of local companies on the natural environment and neighboring communities. The study likewise assessed young people's knowledge of corporate social responsibility (CSR) law and the importance of individual areas of CSR. They also made suggestions on the possibility of increasing the involvement of enterprises in social activities. The questionnaire was built on the basis of many years of experience of the authors in the field of practice, education, and research on sustainable entrepreneurship. In turn, an innovative, authors' research approach based on artificial intelligence methods, in particular, a machine learning method – rule induction, was used for multidimensional data analysis.

Rule induction enables to infer new knowledge based on regularities hidden in data. Data from which the rules were induced, were expressed in the form of a decision table (Table 1). Rows of the decision table represent cases (respondents' answers), while columns represent variables creating a set of entrepreneurial competencies (attributes). The following were adopted as dependent variables (i.e. decision in Table 1): university, gender, year of studies, professional situation and material status. This enabled to identify of pro-social competences and behaviors or the lack of them due to the aforementioned demographic and social characteristics.

Table 1. Example of a decision table

Cases	Attributes			Decision
	Sustainable entrepreneurship in school curricula	Sensitivity to human needs	Support in setting up a sustainable business	Attitudes towards sustainable entrepreneurship
1	yes	high	medium	positive
2	yes	low	low	negative
3	yes	low	high	positive
4	no	low	low	negative
5	no	high	medium	positive
6	no	low	high	negative

Source, own elaboration.

The importance of the rules was evaluated by two parameters: 1) supportSize – the sum of all cases correctly classified by a rule during training; and 2) the Laplace estimate of the rule's confidence (Cestnik 1990). Only the most important rules were identified.

Usually, the rules are expressions of the following form: (attribute_1, value_1) & ... & (attribute_n, value_n) → (decision, value). If the conditions of the rule are satisfied, then, the cases belong to the decision value given in the conclusion. The rule induction method based on rough sets was chosen because it has excellent accuracy, in particular, the LEM2 algorithm (Grzymala-Busse 2010; Narsale and Agarwal 2019; Wang et al. 2016; Zhang et al. 2016; Kopczyński et al. 2016).

Generally, the procedure of the LEM2 is as follows:
1. selection of a decision's value (decision-value), creating a set D of all cases for the selected decision-value,
2. indicating of all attribute-value pairs and creating sets [(attribute-value)] of all cases for each attribute-value pair,
3. selection of an attribute-value pair with |[(attribute-value)] ∩ D| is maximum; if there are more such pairs, selection of the pair with the smallest cardinality; if there are more such pairs, select first pair,
4. if selected [(attribute-value)] ⊆ D the rule can be created, if [(attribute-value)] ⊄ D step 3 should be repeated to select another (attribute-value) pair(s) until [(attribute-value)] ∩…∩ [(attribute-value)] ⊆ D,

5. if [(attribute-value)] ∩…∩ [(attribute-value)] is minimal complex the rule can be created,

6. the procedure should be repeated until all cases decision-value will be covered.

An example of a decision table is shown in Table 1.

In Table 1 Sustainable entrepreneurship in school curricula, Sensitivity to human needs, Support in setting up a sustainable business are the attributes. The Propensity towards one's own business is the decision. In Table 1 there are two decision values: *positive* and *negative*: (Attitudes towards sustainable entrepreneurship-*positive*) = {1, 3, 5} and (Attitudes towards sustainable entrepreneurship-*negative*) = {2, 4, 6}.

To induce a rule for a positive decision value in the first step the set D ={1, 3, 5} is created. In the second step of the algorithm LEM2 all attribute-value pairs are computed:

[(Sustainable entrepreneurship in curricula-*yes*)] = {1, 2, 3}
[(Sustainable entrepreneurship in curricula-*no*)] = {4, 5, 6}
[(Sensitivity to human needs-*high*)] = {1, 5}
[(Sensitivity to human needs-*low*)] = {2, 3, 4, 6}
[(Support in setting up a sustainable business-*high*)] = {3, 6}
[(Support in setting up a sustainable business-*medium*)] = {1, 5}
[(Support in setting up a sustainable business-*low*)] = {2, 4}

In the third step the attribute-value pairs with the largest |[(attribute-value)]∩D| are identified. Three attribute-value pairs – (Sustainable entrepreneurship in curricula-*yes*), (Sensitivity to human needs-*high*) and (Support in setting up a sustainable business-*medium*) – have maximal intersection at equal two but only the last two have smallest cardinality also equal two. If all criteria are equal, the first pair (Social sensitivity-*high*) is selected. [(Sensitivity to human needs-*high*)] = {1, 5} ⊆ D. The first rule is created:

(Sensitivity to human needs-*high*) → (Propensity towards own business-*positive*)

The rule cover cases {1, 5}. The case {3} for positive decision value is not covered. From the rest of attribute-value pairs the (Support in setting up a sustainable business-*high*) have maximum intersection and smallest cardinality. However, [(Support in setting up a sustainable business-*high*)] = {3, 6} ⊄ D so the third step should be repeated. Two attribute-value pairs: (Sustainable entrepreneurship in curricula-*yes*)

and (Sensitivity to human needs-*low*) have maximum intersection with set {3}. The cardinality of the (Sustainable entrepreneurship in curricula-*yes*) pair is smaller than (Sensitivity to human needs-*low*), so this pair is selected. And [(Support in setting up a sustainable business-*high*)] ∩ [(Sustainable entrepreneurship in curricula-*yes*)] = {3, 6} ∩ {1, 2, 3} = {3} ⊆ D so the candidate for the minimal complex is the set [(Support in setting up a sustainable business-*high*)] ∩ [(Sustainable entrepreneurship in curricula-*yes*)]. In the fifth step, for both attribute-value pairs of the candidate for the minimal complex it is checked whether deleting any of them causes that reduced candidate ⊆ D. As a result, the minimal complex is identified: [(Support in setting up a sustainable business-*high*)] ∩ [(Sustainable entrepreneurship in curricula-*yes*)]. The second rule can be created:

(Support in setting up a sustainable business-*high*) & (Sustainable entrepreneurship in curricula-*yes*) → (Attitudes towards sustainable entrepreneurship-*positive*).

All cases for the positive decision value (Attitudes towards sustainable entrepreneurship-*positive*) = {1, 3, 5} are covered by the first and second rules.

The procedure should be repeated for negative value of the decision (Attitudes towards sustainable entrepreneurship-*negative*). In result the rules induced are as follows:

(Support in setting up a sustainable business-*low*) → (Attitudes towards sustainable entrepreneurship, *negative*)

(Sustainable entrepreneurship in curricula-*no*) & (Support in setting up a sustainable business-*high*) → (Attitudes towards sustainable entrepreneurship-*negative*).

It should be noted that the attribute Sensitivity to human needs was not used in rules. Only attributes with the highest priority are selected. This is because the LEM2 algorithm induces a minimal set of rules, which covers all cases from the dataset and classifies them correctly.

RESEARCH RESULTS

The questionnaire was completed by 335 respondents, including 65% of students at RUT and 35% of PUC. The largest group – 64% – were studying finance and accounting, 30% administration, 5% social

economy and 1% management. Half of the respondents represented first-cycle studies, the other half – second-cycle studies; 33% the first year of studies, 36% second and 27% – fourth year of studies. The vast majority – 78% studied in full-time studies, the rest – in part-time studies. 88% of the respondents were women. 62% lived in rural areas, 19% in cities with more than 100,000 inhabitants, 9% in cities up to 20,000 inhabitants, 10% in cities between 21 and 100,000 inhabitants. 60% of the respondents lived in Podkarpackie, 31% – in Małopolskie, 9% in other regions. 53% of the respondents did not work, 29% had a part-time job, 13% worked in private companies, 5% in public administration, 1% ran their own businesses already. 88% assessed their material status as good or average, 7% as very good. Only 5% rated it as unsatisfactory or very bad. 43% of respondents declared being in a relationship with another person, and 57% were single.

Rules analysis

The analysis of the rule's induction was conducted for gender, year of studies, university, professional situation and material status separately in regard to 10 closed questions of the questionnaire. The number of rules for the abovementioned metric questions is presented in Table 2.

Table 2. The number of rules induced

Metrics	No. of rules
university	61
year of studies	81
gender	47
professional situation	72
material status	31

Source: own study based on the conducted research.

Regarding limitation of the paper only the most important rules have been selected with the supportSize value of no less than 20 cases supporting individual rules.

61 rules in regard with *the university* were generated describing the diversity of respondents. The example of a rule structure is as follows:

IF *Knowledge of term: cross – sectoral cooperation* **IS** *Yes*

& *Thinks he/she is entrepreneurial person (resourceful, organized and thrifty)* **IS** *Rather yes*

& *Knowledge of term: corporate governance* **IS** *No*

& *Lack of capital as a discouraging factor from own business* **IS** *Hard to say*

THEN *the name of the university* **IS** *RUT*

(supportSize=26; laplace=0.931).

It can be interpreted that there is a rule according to which students from RUT lack knowledge about corporate governance, however they understand the term of cross-sectoral cooperation and perceive themselves as rather enterprising people, and the lack of capital is a factor that moderately prevents them from starting their own business.

Below only the interpretation of the strongest rules are presented.

When analyzing the issues related to knowledge in the field of pro-social and pro-environmental involvement of business, it is worth verifying whether the respondents' knowledge grows with the subsequent years of educating young people. For the ***year of study*** criterion, 82 rules were generated, the most important of which were identified for the first- and the second-year students:

- first-year students more frequently postpone decisions regarding their own business for a further, indefinite future (supportSize = 30; laplace = 0.8611) and they do not know the concepts of Cause Related Marketing nor CSR (supportSize = 20; laplace = 0.8077) but the possibility of obtaining significant income as well as independence are very important factors stimulating them to start their own business,
- second-year students plan their own businesses, and the relationship between entrepreneurs and employees in terms of working conditions, social sphere, occupational health and safety, etc. are definitely an important area of CSR. An opportunity to obtain significant income and independence are important factors motivating to set up own business (supportSize = 18; laplace = 0.7917).

Among the answers of students of subsequent years such strong rules cannot be identified.

Gender differentiation is an interesting criterion differentiating entrepreneurial attitudes that is frequently analyzed. In this respect, 48 rules characterizing the respondents according to gender, were identified.

The most important rules that describe women are as follows:

- they do not know the concept of social reporting and consider themselves as rather responsible persons for the community living in their environment and an important factor motivating them to their own business is the desire to achieve success as an entrepreneur (supportSize = 32; laplace = 0.9429),
- in turn, for those who know the concept of corporate governance and perceive it as rather important areas of CSR, a factor that discourages them from running their own business is the lack of business contacts (supportSize = 33; laplace = 0.9444),
- women are also characterized by the rule showing that they do not know any regulations regarding social involvement of business or are able to indicate the examples. Moreover, they are familiar with the concept of sustainable development and cross-sectoral cooperation, and perceive respecting human rights as a very important aspect of CSR (supportSize = 41; laplace = 0.9545).

As men were underrepresented in the study, thus the indicator laplace was considered in this part of the analysis. For men, 13 rules were generated, which show that they consider it rather important to disseminate good practices in the field of CSR, and intersectoral cooperation as important. When it comes to plans for their own business, they postpone it for future. They are most motivated to set up their own business by getting independence and becoming their own boss, as well as a possibility to obtain subsidies for their start-up and development of the company. They admit to a lack of knowledge of CSR (laplace=0.7143).

The other subgroup of men can be described by the rule indicating that they plan their own business and they know what CSR is. They are driven to business by the possibility of pursuing their passions, the possibility of creating jobs and the possibility of obtaining grants for the start and development of their company.

Analyzing the *professional status*, 73 rules were generated. The strongest rules reveal that:

- working people know the concept of cross-sectoral cooperation and would be significantly encouraged to start their own business by getting independence and the opportunity of obtaining significant income (supportSize = 24; laplace = 0.8621),
- among the employees there is also a subgroup that does not know the terms of Cause Related Marketing or social reporting but declare knowledge of the concept of sustainable development, and at the same time their independence, as well as the possibility of obtaining a significant income, would encourage them to start their own business. Among the areas of CSR, this group considers the relations of entrepreneurs with employees as particularly important regarding working conditions, social sphere, health, and safety, employee training development (supportSize = 25; laplace = 0.8667),
- non-working people do not know the concept of social reporting, and a very important motivator for them to start their own business is the possibility of obtaining significant income and gaining independence. They believe that an important area of CSR is caring for the ethical behavior of competitors and contractors in economic cooperation and competition (supportSize = 21; laplace = 0.8462).

Analyzing the diversity of respondents in terms of *material status*, as many as 20 rules for people declaring a good financial situation turned out to be significant. The vast majority of respondents assessed their material status as good and the most evident characteristics of this subgroup show that:

- respecting human rights and corporate governance are important aspects of CSR in small businesses. They are also people who know what CSR is (supportSize = 85; laplace = 0.9773),
- they know the concepts of cross-sector cooperation and eco/social labeling (supportSize = 107; laplace = 0.9818).

Summing up, the analysis of the rules shows that students, however, when thinking about their own business, are primarily guided by personal motivations, such as the possibility of obtaining significant income and gaining independence. Social factors and concern for the environment turned out to be much less important, although they

are noticed by young people who, despite their economic studies, do not have knowledge in the field of sustainable entrepreneurship.

CONCLUSIONS

Research has shown that the young generation in Poland is insufficiently prepared to implement the concept of sustainable entrepreneurship. An important conclusion that emerges from the analysis of the research carried out, and in particular from the analysis of the induced rules, is that the young people seem to have an intuitive sense of what sustainable business is all about, but formal knowledge in this area is low. Financial aspects, i.e. the possibility of obtaining significant income from own business, as well as independence and the possibility of being a manager, turned out to be much more motivating for entrepreneurship than the possibility of changing the world for the better, helping local communities or protecting the environment. Young people hardly perceive their own business as a tool that could help them change the world for the better, help local communities or protect the environment. Similarly to the results of the research by M. Starnawska (2018), this research shows that in education of social entrepreneurship, attention should be paid to emphasizing the local context, teaching the young generation to diagnose needs and adapting social entrepreneurship education programs flexibly to local conditions. There is a need to increase the emphasis on knowledge development in this area, taking into account that care for sustainable development is relatively the least important factor when starting your own business.

The rule induction method as an innovative approach in multidimensional data analysis allowed the identification of common features characterizing individual subgroups and enabled a relatively fuller look at a range of pro-social aspects in the business. Appplication of the machine learning method made it possible to identify relationships between respondents' characteristics in terms of their awareness and knowledge of specific aspects of sustainable entrepreneurship and business intentions. Answering the question about the existence of the potential for building sustainable enterprises in Poland, it can be stated that this potential (at least in the analyzed

two regions) is still small, and the young generation is insufficiently prepared.

Due to the limitations of the article, it is not possible to present detailed analyzes of all induced rules for individual subgroups, but the practical dimension of this analysis allows for detailed design of changes in education programs at individual stages of education, for various fields of study and groups of students.

The results constitute the basis for further research that would provide a way to formulate recommendations for building curricula aimed at filling the gaps in the education of entrepreneurship, sustainable entrepreneurship, economics, management, as well as sociology, psychology and ecology.Further research directions will concern the competences, attitudes and entrepreneurial intentions of young people from different European countries, with an emphasis on the concept of sustainable entrepreneurship. New methods of data analysis in the area of artificial intelligence will be used, which will allow for in-depth recognition of the directions and needs of activities in the field of education and shaping attitudes towards sustainable entrepreneurship.

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