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Editorial

A Vertically Integrated Project (VIP) as a learning experience to foster entrepreneurship education

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Abstract

Purpose: we aim is to present a learning approach for students to work on a hands-on project that may be applied to different contexts. This experience relates to an initiative to foster entrepreneurial education embedded in economic sustainability based on the best local practices (highest-ranked municipalities) that we find and analyze to solve complex problems in the business environment. **Design/Methodology/Approach:** our approach is to collaborate with policymakers at the municipal level via a research-based project approach called Vertically Integrated Project (VIP). In our VIP, students work with instructors in a long-term effort to identify challenges and opportunities by working with the community to analyze problems, develop solutions (with different techniques and approaches), and monitor their implementation. **Findings:** new learning approaches can engage the students in real-world problem, adding value to their formation and giving back to society the investment they made in the Brazilian public university. **Originality:** this initiative is in tune with the 4th and the 11th sustainable development goals (SDGs) adopted by the United Nations (UN). **Practical implications:** this study aims to stimulate entrepreneurial education using multidisciplinary and alternative learning approaches. **Social implications:** this approach can deliver SDG-related impact to local communities by linking research-based teaching with community outreach.

Keywords: entrepreneurship. community interaction. sustainable development goals. multidisciplinary reality.

Um Projeto Verticalmente Integrado (VIP) como experiência de aprendizagem para fomentar a educação empreendedora

Resumo

Objetivo: nosso objetivo é apresentar uma abordagem de aprendizagem para que os estudantes trabalhem em um projeto prático. A iniciativa pode ser aplicada em diferentes contextos. Esta experiência relata o fomento à educação empreendedora embutida na sustentabilidade econômica, com base nas melhores práticas locais (municípios mais bem classificados) que encontramos e analisamos para resolver problemas complexos no ambiente empreendedor. **Design/Metodologia/Abordagem**: nossa abordagem é colaborar com os formuladores de políticas em nível municipal por meio de uma abordagem de projeto baseada em pesquisa chamada de Projetos Integrados Verticalmente (VIP). Em nosso VIP, os estudantes trabalham com professores em um esforço de longo prazo para identificar desafios e oportunidades, trabalhando com a comunidade para analisar problemas, desenvolver soluções (com diferentes técnicas e abordagens), e monitorar sua implementação. **Resultados**: novas abordagens de aprendizagem podem envolver os estudantes em problemas do mundo real, agregando valor à sua formação e devolvendo à sociedade o investimento que foi feito na universidade pública brasileira**. Originalidade**: esta iniciativa está em sintonia com as 4ª e 11ª metas de desenvolvimento sustentável (ODS) adotadas pela Organização das Nações Unidas (ONU)**. Implicações práticas**: este estudo visa estimular a educação empreendedora utilizando abordagens multidisciplinares e alternativas de aprendizagem. **Implicações sociais:** esta abordagem pode proporcionar impacto relacionado dos ODS às comunidades locais, ligando o ensino baseado em pesquisa com o alcance da comunidade.

Palavras-chave: empreendedorismo. interação comunitária. metas de desenvolvimento sustentável. multidisciplinaridade.

INTRODUCTION

Working in a research-based project, we engage students in a hands-on project in which real data was analyzed to better deliver benchmarking experiences for policymakers, so an analysis of replicability in different contexts can be made. The initiative is in tune with the United Nations (UN) 2030 Agenda for Sustainable Development (SDGs). The agenda for sustainable development is part of a transformational vision that calls for action to foster development in harmony with nature while considering economic, social, and technological development for human beings. The agenda includes 17 Sustainable Development Goals (SDG), and this project focuses on the 4th and 11th SDGs.

The 4th goal is to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." The 11th goal is to "make cities and human settlements inclusive, safe, resilient and sustainable," with our project aligned with part 11.a which states to "support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning." We focus on the quality of education embedded in sustainable cities and communities through the analysis, identification, and promotion of the best practices regarding entrepreneurial and innovation programs.

Our learning experience brought the students to a multidisciplinary reality considering indicators that can promote a transformational experience within the cities. According to Filho et al. (2021), concrete indicators are required to be able to measure support for and progress of communities. We work according to (Annan-diab & Molinari, 2017), who emphasize problem-solving through the integration of courses and concepts to foster solutions in real-world experiences and a service-learning mindset (Molderez & Fonseca, 2018), overcoming the barriers of unconnected educational content to contribute to a new capacity to achieve the SDGs. We therefore consider education engaged with the community, creating a third mission for the university.

Universities can thus play a unique role in the fulfillment of SDGs (Chapman et al., 2020). SDGs can also be understood as a kind of challenge that encompasses many aspects and can be defined as a "wicked problem," that is, multi-causal, involving multiple stakeholders, connected to other kinds of problems and in which every solution has ramifications across the system. More than a single solution exists for the problem. Solutions are not right or wrong but feasible or not, and the evaluation of solutions can take a long time, since problems are never completely solved and no definitive formula for a solution exists; or a solution cannot be immediately tested.

This paper aims to present a hands-on integrated project as a learning experience. The project can be used in multiple contexts. We applied it to analyze indicators of entrepreneurship to support policymakers. The Vertically Integrated Project (VIP) project analyzed here focus lies on the cities of the state of Sao Paulo, Brazil and identified best practices at the municipal level to suggest their implementation for other cities. The learning approach presented here was developed in a university encompassing (un)graduate students entitled VIP. We used a municipality index, named Sebrae Local Economic Development Index (ISDEL) that was authored by the Brazilian Micro and Small Business Support Service (SEBRAE-MG, 2018), which is an important agent of the Brazilian entrepreneurial ecosystem, and is situated in Minas Gerais State (MG).

There are 645 municipalities in the state of São Paulo, but we focused on the analysis of the 35 best ISDEL ranked cities considering determined aspects. Top-ranked cities can offer more appropriate competitive conditions, as pointed out by the Competitive Cities for Jobs and Growth report (World Bank Group [WBG], 2015) and Musterd and Kovács (2013). The final phase was addressed to analyze the public policies implemented by these top-ranked municipalities, so they become benchmarks for the other municipalities. We understand that indicating the best practices identified to the community contribute to the university´s third mission.

All the work was managed in multiple teams composed by students of different backgrounds and each team had sub-objectives to target.

This paper is presented in the following sections. Section 2 (The VIP program) brings the VIP program. Section 3 (Methodological steps and the target objective of the VIP) focuses on methodological steps. Discussion and results are presented on section 4 (Discussion and results), followed by the last section (Closing remarks).

THE VIP PROGRAM

The VIP program was presented at the XII EGEPE 2022 opening session. The opening session can be seen at: https://www.youtube.com/watch?v=LJ6oMnBEsQM.

The VIP program was developed and implemented by Edward J. Coyle at Purdue University in 1995 as a new pedagogy program. VIP projects are based on long-term projects homed in faculty research, and students can participate in multiple semesters. VIP teams are vertically integrated, with each team enrolling students of different academic background. Thus, it enables long-term, large scale and multidisciplinary teams and the cross-disciplinary projects may help to contribute to motivation and knowledge acquisition and retention. So, VIP project is a model of entrepreneurship education that creates a fruitful environment to overcome the traditional separation between courses and departments, and good to boost interdisciplinarity (Klofsten et al., 2020) and retention.

VIP was popularized at Georgia Tech in Atlanta in the United States, and many institutions have adopted it over the years (https://www.vip.gatech.edu/teams). In 2019, the VIP Consortium was held, hosting 44 educational institutions from 13 countries (https://www.vip-consortium.org/). In Latin America, VIP programs were implemented in different courses at the University of Chile, Universidad Mayor (Chile), Universidad ICESI (Colombia), and the University of Campinas (Sonnenberg-Klein et al., 2022). The VIP program essential elements are the following:

1. VIP program is led by a faculty member who has their own VIP team;
2. VIP projects are embedded in professors' scholarship and exploration;
3. Large-scale projects lasting years/decades;
4. Interdisciplinary teams are possible/encouraged;
5. The program is curricular: all students receive course credit and are graded;
6. Incentives are given for students to participate for two or more academic semesters;
7. Dedicated meeting space is provided for teams (in and outside the classroom);
8. Learning outcomes include disciplinary and professional skills;
9. Team topics are based on faculty interests; students select teams based on personal interest;
10. Working with the Community/outreach activities are possible/encouraged.

In Brazil, the University of Campinas (UNICAMP) is the higher education institution (HEI) participating in the VIP consortium. Unicamp is a public and free-of-charge university in Sao Paulo state, Brazil. Participation in the VIP consortium is free of charge and open to all. A VIP project overcomes the time fragmentation of a particular course and conducts the project over several semesters. When a student enrolls in the VIP course in each semester, he or she assumes a task within the time frame in which the project is being developed.

The VIP program was implemented at the School of Applied Sciences (FCA) at Unicamp in March 2020. The program was designed to occur over two years, or four semesters. In each semester, one undergraduate and one postgraduate course were proposed, so that they would be offered on the same day, time, and location. Thus, it means the creation of 8 courses, 4 of which were processed by the undergraduate committee and 4 by the postgraduate committee. All the syllabuses were constructed in such a way as to support the development of a single project articulated with the theme of municipal indicators aimed at fostering entrepreneurship, associated with public policies linked to the subject. Students from any background could enroll, as these are elective courses. The student's course of origin guided him/her to the specific objective that would be worked on within the project, conducted in teams, respecting each one's abilities. The credit system followed the pattern of the other courses, offered every semester, with the student having the option to continue in the following semester(s). The VIP at Unicamp videos can be seen at: https://www.youtube.com/watch?v=0dyFpmpCyp4&t=1719s and https://www.youtube.com/watch?v=rkEyfdH4JnE. Classes and supporting material can be accessed at: https://sites.google.com/view/vip3-unicamp/in%C3%ADcio. A sample of final videos produced by the projects can be seen at: https://www.youtube.com/watch?v=nxvrcoP02q8 and https://www.youtube.com/watch?v=5O3mu9rB15o.

In four semesters, the project enrolled (under)graduate students from Mathematics, Statistics, Electrical Engineering, Food Engineering, Manufacturing Engineering, Environmental Engineering, Mechanical Engineering, Physical Education, Social Sciences, Architecture and Urbanism, Computer Science, Nursing, Public Administration, and Business Administration; and graduate students in Business Administration, Nutrition, Food Engineering, Physical Education, Scientific and Technological Program, and Production Engineering. The course syllabus was designed to focus on a major objective, from which several secondary objectives can be outlined considering the background of each student enrolled.

The University´s third mission regards the responsibilities and commitment to serve the communities. In this regard, the nature of VIP involves multidisciplinary real-life problems (Lozano, 2006), but the Unicamp VIP project went a step further by actively engaging the community and in tune to the 4th and 11th SDGs. In the development of the courses, the representative of the Secretariat of the Economic and Sustainable Development of the city where the University is based actively engaged in discussions with the students, together with Sebrae, an agency focused on the promotion and support to small business in Brazil. A memorandum of understanding was developed with both.

Traditional teaching mostly considers 1 professor in classroom teaching 1 course; 1 (same) assessment for all class; 1 environment (classroom); 1 semester; and focus on contents. In contrast, at VIP project we implemented an original approach named “one plus” (1+), which considers several (1+) professors engaged in the same project; several (1+) courses; different (1+) assessments for each group of students; in and out of classroom; projects last more than 1 semester; focus on the outcomes.

In this kind of approach, the students must develop flexibility, adaptability, creativity, team-working skills, good communication and listening skills, and the ability to overcome the gap between theory and practice (Abreu et al., 2017). The authors are working on an additional paper outlining those characteristics, based on a survey as a primary source.

From 2020’s first academic semester to 2021’s second semester, 84 students were successfully approved in the 8 VIP courses offered, 60 from undergraduate courses and 24 from graduate programs. They worked in teams to meet the objective – to analyze and propose benchmarks to lower-ranked municipalities. This way, we understand the VIP program fulfils the SDG´s goal for quality education and promotes lifelong learning opportunities for all (4th SDG), making cities more inclusive and sustainable, including at economic level (11th SDG).

VIP programs that focus on the SDG have been implemented in other countries, such as in the University of Strathclyde, in Glasgow, Scotland. The Strathclyde VIP Program, VIP for Sustainable Development (VIP4SD), combines research-based education and sustainable development to expand their research portfolio and leverage innovative teaching (Strachan et al., 2019). In 2020, the Strathclyde’s VIP4SD program received the International Green Gown Award for Student Engagement, which recognizes exceptional sustainability efforts being undertaken by universities and colleges across the world.

METHODOLOGICAL STEPS AND THE TARGET OBJECTIVE OF THE VIP

Brazil has the most complex business environment in the world according to the Global Business Complexity Index 2021 (TMF Group, 2021). The problem is the number of levels of government (municipalities, states, and federal) with different legal and tax requirements. Simplification, facilitation and debureaucratization actions are needed. The environment contributes to instability to attract new investors and businesses. We considered this problem as a target objective for the VIP, but VIP can tackle any multidisciplinary problem.

Some rankings consider certain municipalities as business environments. ISDEL (SEBRAE-MG, 2018) is an additive index produced by SEBRAE from the state of Minas Gerais, Brazil. Created in 2015, ISDEL ranks Brazilian municipalities and was conceived using the concept of sustainability to help the actors involved in local development to analyze their municipalities, strengths, and weaknesses, to promote inclusive economic and sustainable social development. ISDEL was built considering the best approaches and recommendations presented in the report published by the Organization for Economic Co-operation and Development (OECD) and associates entitled Handbook on Constructing Composite Indicators (OECD/European Union/EC-JRC, 2008). The possible new public policies based on scientific evidence provided by ISDEL fill the gap of the absence of these kinds of indicators.

We used a sort of quantitative approach - by applying a multi-decision criterion analysis called Promethee (Behzadian et al., 2010; Brans et al., 1986), that was implemented with Phyton on Google’s Colab platform, K-means clustering method - and a qualitative analysis - mapping out the public policies and regulations in cities that ranked the best -. Finally, QGis software was applied as well to produce choropleth maps.

The Promethee method can be described as a ranking methodology anchored in mathematical properties that enables multi-decision criterion analysis. Clustering or cluster analysis is the unsupervised classification of patterns into groups, as much as possible, with homogeneity within-group and heterogeneity inter-groups (Hair et al., 2014; Jain et al., 1999). The cluster analyses applied the non-hierarchical procedure K-means algorithm and the Euclidean squared distance, ran at Python at Google colab, which is one of the most popular algorithms used in hierarchical methods of clustering (Marutho et al., 2018).

Cluster analysis was used to aggregate municipalities with similar indicators. After the cluster analysis considering ISDEL indicators related to the entrepreneurship theme, the best evaluated cluster was analyzed in a qualitative way, in order to identify best practices that could be replicated for the municipalities of the other clusters.

Then, we generated choropleth maps of the state of São Paulo and their respective municipalities in the QGIS program. QGIS software (http://www.qgis.org) is a free and open-source Geographic Information System (GIS). The file with the geographic information of all the municipalities in the state of São Paulo was downloaded from the Brazilian Institute of Geography and Statistics - IBGE website; the data was then opened by QGIS. Maps are useful tools for visualizing different quality attributes in a spatial way of organizing data.

The details of the use of these softwares can be seen in a book about VIP experience at Unicamp (Azevedo et al., 2022).

There are 645 municipalities in the state of São Paulo, Brazil. We focused on the analysis of the 35 best-ranked municipalities considering spotted indicators, thus they were clusterized and analyzed qualitatively. The final phase was addressed to analyze the public policies implemented in the top-ranked municipalities, so they may serve as benchmarks for the other cities. As we already indicated, top-ranked municipalities can offer more appropriate competitive conditions, as pointed out by the Competitive Cities for Jobs and Growth report (WBG, 2015) and Musterd and Kovács (2013).

DISCUSSION AND RESULTS

The results of each team can be analyzed in depth in the book Vertically Integrated Projects: a methodology for the collective construction of knowledge applied at Unicamp (Azevedo et al., 2022).

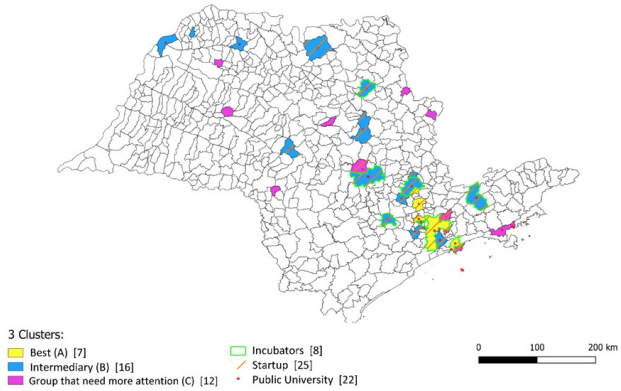
Despite the indicators used, we also considered the presence of incubators, public universities, and startups in Figure 1 which illustrates an example of the choropleth map produced considering indicators related to entrepreneurship.

To conduct the whole process, we use the Theory of Change (ToC). ToC has been used by international organizations throughout the last decades. It is a well-suited method for transformative impact in different contexts. "It focuses on mapping out the area between what a program or change initiative is trying to achieve and the activities of interventions that need to take place to ensure that the desired impact is achieved" (WBG, 2021).

ToC uses a template to better understand and visualize the step by step of the process in practice. Inputs consider a new method to tackle the real community problems inside the classroom. The resources we used in inputs are related to the innovative learning approach. Inputs also consider the objective we want to achieve. Activities are tasks undertaken to generate outputs. And the activities were defined to relate to the improvement of policies and regulations; the analysis of best practices in entrepreneurship and innovation in local public policies; and building capacity expertise.

Figure 1

The 35 selected cities from Sao Paulo state grouped in three clusters

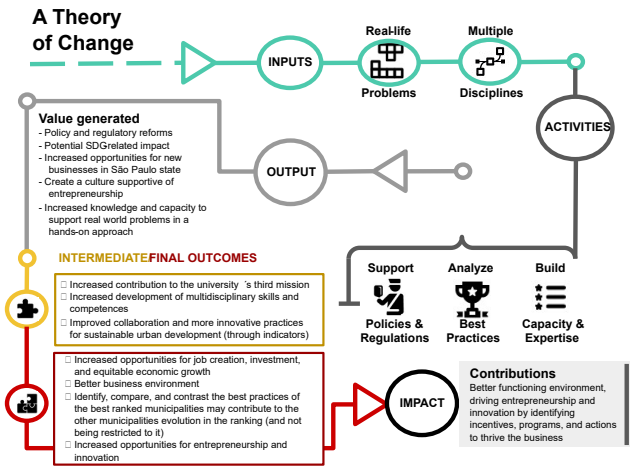


Note: ISDEL (2018). Elaborated the authors.

The outputs consider policy reforms; potential SDG impact; a culture of supporting entrepreneurship; increased knowledge in a hands-on methodology. The path accounts for intermediate outcomes for the university´s third mission; the development of multidisciplinary skills (hard and soft); and improved collaboration for sustainable urban development. Expected outcomes contemplate job opportunities, investment, economic growth; a better business environment; a mirror effect in best practices; increased opportunities for entrepreneurship. We can consider the impact of better functioning of the entrepreneurial environment, to potentialize the business environment. Figure 2 summarizes the path taken.

Figure 2

From inputs to impact – the path taken according to Theory of Change



Note: Elaborated the authors.

Particularly in the VIP project we have implemented at Unicamp, one of the outputs identified was a culture of supportive entrepreneurship. Best ranked municipalities can become "incubators of new ideas".

We also noticed that the presence of technology parks strongly impacts the presence of incubators, just as the presence of leading universities positively influences technological development and entrepreneurship. Additionally, debureaucratization policies were identified as an important aspect, as we can see in the well-ranked city of São Paulo. Tax benefits, innovation centers, support for credit to micro enterprises, training of new entrepreneurs, business incubators and/or technology parks are among the good practices identified.

We must clarify that we worked strictly with science without any political motivation. We applied the knowledge triangle: education-research-innovation (Unger et al., 2020). We did not analyze the lack of replicability due to differences among political groups leading different municipalities. Notwithstanding, we deal with municipalities from Brazil, the method and the path taken can be used in other contexts.

The research is useful for entrepreneurs and managers since this study generated knowledge for practical application.

CLOSING REMARKS

This research project made it possible to identify which characteristics favor cities to have better conditions for the development of a business environment (in a combined initiative considering the 4th and 11th SDGs). This contribution results from an original applied research-based program - VIP - considering university´s third mission. It is relevant for policy makers and students alike, as an innovative way of teaching and learning. Thus, we encourage universities to use innovative approaches to teaching entrepreneurship, with engagement with community problems.

In this experience report, more important than "what" we did (and its results) is "how" we did it, with a focus on the VIP program. And the aim of this editorial is to encourage other innovative initiatives related to the teaching of entrepreneurship. The benefits of an alternative methodology of teaching and learning approach are twofold. First, the student seems more engaged because they are dealing with real problems. Second, the faculty members conduct the learning considering the students´ original background, allocating them to tasks that are suited quite well for their individual contribution working in a team of interdisciplinarity aspects. The VIP program can encompass any kind of problem from different academic backgrounds and perspectives. For a full list of projects at Georgia Tech, please check https://www.vip.gatech.edu/teams.

It is important to notice the barriers regarding the introduction of change in the academic environment. Those barriers relate to faculty members and staff that are immune to change (Kegan and Lahey, 2009) due to the uncertainty it may provoke. Other difficulties are dealing with students from different levels (undergraduate and graduate) in the same project (with different secondary objectives). It requires a lot of organization and leadership from the faculty members working as a living lab (Higgins & Klein, 2011). In the VIP program, we work in a living lab (without immobilizing assets), with the active role of students, interdisciplinary teams, and collaboration. These characteristics encourage critical thinking, attitude, and proactivity. The approach empowers students in their decision-making inside the target and the objective set.

The way of working is like conducting a project in the public or private sector: different skills, different teams, and sub-teams focus the different perspectives to tackle the problem. So, it requires a growth mindset (Dweck, 2006) for new challenges in education.

Important to notice that a new mindset is required not only in faculty members but staff. We used to work in a Euclidian geometry mindset, as we always do. New types of organization of the academic experience require an open mind from the faculty and staff administrations, which may facilitate the practice of implementation and mitigate the barrier to change. Future works may focus on change management in an academic environment.

The chosen SDG embedded with VIP research-based problem act as a wicked problem that first requires understanding it before knowing how to provide a meaningful contribution amid a context of no clear definition (Strachan et al., 2019). Therefore, VIP can contribute to a realistic team experience, analytical thinking and searching for paths not previously taken.

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Conflit of interest statement

The authors declare that there is no conflict of interest.

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Authors' statement of individual contributions

Roles	Contributions			
	Morini C	Azevedo AV	Júnior EI	Coyle EJ
Conceptualization	■			
Methodology		■	■	
Software		■	■	
Validation				■
Formal analysis	■			■
Investigation	■			
Resources	■			
Data Curation		■	■	
Writing - Original Draf	■			
Writing - Review & Editing	■			
Visualization		■	■	
Supervision				■
Project administration	■			
Funding acquisition	■			

REFERENCES

Abreu, S., Caldeira, A., Costa, A. R., Gomes, T., & Roque, L. A. C. (2017). Interdisciplinarity to Integrate Knowledge in Engineering. Advances in Science, *Technology and Engineering Systems Journal*, 2(3), 788–795. https://doi.org/10.25046/aj020399

Annan-Diab, F., & Molinari, C. (2017). Interdisciplinarity: Practical approach to advancing education for sustainability and for the Sustainable Development Goals. *The International Journal of Management Education*, 15(2), 73–83. https://doi.org/10.1016/j.ijme.2017.03.006

Azevedo, A. T, & Morini, C., Inacio Junior, E. (2022). *Vertically Integrated Projects: a methodology for the collective construction of knowledge applied at Unicamp*, Amazon, Columbia, SC, USA. ISBN: 979-83-51922-45-4.

Behzadian, M., Kazemzadeh, R. B., Albadvi, A., & Aghdasi, M. (2010). PROMETHEE: A comprehensive literature review on methodologies and applications. E*uropean Journal of Operational Research*, 200(1), 198-215. https://doi.org/10.1016/j.ejor.2009.01.021

Brans, J. P., Vincke, P., & Mareschal, B. (1986). How to select and how to rank projects: The Promethee method. *European Journal of Operational Research*, 24(2), 228-238. https://doi.org/10.1016/0377-2217(86)90044-5

Chapman, G. R., Cully, A., Kosiol, J., Macht, S. A., Chapman, R. L., Fitzgerald, J. A., & Gertsen, F. (2020). The wicked problem of measuring real-world research impact: Using sustainable development goals (SDGs) and targets in academia. *Journal of Management & Organization*, 26(6), 1030–1047. https://doi.org/DOI: 10.1017/jmo.2020.16

Dweck, C. S. (2006). Mindset: *The new psychology of success*. Random House. ISBN: 978-14-00062-75-1

Filho, W. L., Amaro, N., Avila, L. V., Brandli, L., Damke, L. I., Vasconcelos, C. R. P., Hernandez-Diaz, P. M., Frankenberger, F., Fritzen, B., Velazquez, L., & Salvia, A. (2021). Mapping sustainability initiatives in higher education institutions in Latin America. *Journal of Cleaner Production*, 315, 128093. https://doi.org/10.1016/j.jclepro.2021.128093

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010). *Multivariate Data Analysis*. 7th Edition, Pearson, New York. ISBN: 978-0138132-63-7.

Higgins, A., Klein, S. (2011). *Introduction to the Living Lab approach*. In Y.-H. Tan, N. BjørnAndersen, S. Klein & B. Rukanova (Eds.), Accelerating Global Supply Chains with IT-Innovation. ITAIDE Tools and Methods (pp. 31-36). Berlin: Springer. https://doi.org/10.1007/978-3-642-15669-4_2

Jain, A. K., Murty, M. N., & Flynn, P. J. (1999). Data clustering. *ACM Computing Surveys*, 31(3), 264–323. https://doi.org/10.1145/331499.331504

Kegan, R., & Lahey, L. L. (2009). *Immunity to Change*. How to overcome it and unlock the potential in yourself and your organization, Harvard Business Press. ISBN: 978-1422117-36-1.

Klofsten, M., Jones-evans, D., & Pereira, L. (2020). Teaching science and technology PhD students in entrepreneurship – potential learning opportunities and outcomes. *The Journal of Technology Transfer*, 0123456789. https://doi.org/10.1007/s10961-020-09784-8

Lozano, R. (2006). Incorporation and institutionalization of SD into universities: breaking through barriers to change. *Journal of Cleaner Production*, 14(9–11), 787–796. https://doi.org/10.1016/j.jclepro.2005.12.010

Marutho, D., Hendra Handaka, S., Wijaya, E., & Muljono. (2018). The Determination of Cluster Number at k-Mean Using Elbow Method and Purity Evaluation on Headline News. *2018 International Seminar on Application for Technology of Information and Communication*, 533–538. https://doi.org/10.1109/ISEMANTIC.2018.8549751

Molderez, I., & Fonseca, E. (2018). The efficacy of real-world experiences and service learning for fostering competences for sustainable development in higher education. *Journal of Cleaner Production*, 172, 4397-4410. https://doi.org/10.1016/j.jclepro.2017.04.062

Musterd, S. and Kovács, Z. (2013). Policies and Place-making for Competitive Cities. *In* Place-making and Policies for Competitive Cities (eds S. Musterd and Z. Kovács) https://doi.org/10.1002/9781118554579.ch1

OECD/European Union/EC-JRC (2008), Handbook on Constructing Composite Indicators: Methodology and User Guide, OECD Publishing, Paris. https://doi.org/10.1787/9789264043466-en

SEBRAE/MG. (2018). Índice Sebrae de desenvolvimento econômico local – ISDEL: notas metodológicas 2018. Retrieved from https://www.isdel-sebrae.com/

Sonnenberg-Klein, J., Rosales-Salas, J., Aristizábal-Pinzón, A. A., Muriel, A. F. O., Ruiz, P. S., Azevedo, A. T., . . . Morini, C. (2022, 13-16 March 2022). *Vertically Integrated Project Programs in South America – Profiles of Multidisciplinary Team-Based Project-Based Programs at 4 Institutions*. Paper presented at the 2022 IEEE World Engineering Education Conference (EDUNINE). https:doi.org/10.1109/EDUNINE53672.2022.9782334

Strachan, S. M., Marshall, S., Murray, P., Coyle, E. J., & Sonnenberg-Klein, J. (2019a). Using Vertically Integrated Projects to embed research-based education for sustainable development in undergraduate curricula. *International Journal of Sustainability in Higher Education*, 20(8), 1313–1328. https://doi.org/10.1108/IJSHE-10-2018-0198

Unger, M., Marsan, G. A., Meissner, D., Polt, W., & Cervantes, M. (2020). New challenges for universities in the knowledge triangle. J*ournal of Technology Transfer*, 45(3), 806–819. https://doi.org/10.1007/s10961-018-9699-8

TMF Group (2021). *Global Business 2021*: Bringing clarity to the complexities of doing business across borders. Retrieved from https://www.tmf-group.com/en/news-insights/publications/2021/global-business-complexity-index/

World Bank (2021). *Designing a Theory of Change for a Community of Practice*. Communities Reinvented. Collaboration for Development. Retrieved from https://collaboration.worldbank.org/content/sites/collaboration-for-development/en/groups/communities4Dev/blogs.entry.html/2021/03/22/designing_the_theoryofchangeofacommunityofp-f9pp.html

World Bank Group. (2015). *Competitive Cities for Jobs and Growth: What, Who, and How*. Retrieved from https://openknowledge.worldbank.org/handle/10986/23227

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