The Challenges of Interdisciplinarity in Higher Education: the Role of the Course Coordinator in Special Projects and Activities

Desafios da Interdisciplinaridade no Ensino Superior: o Papel do Coordenador de Curso nos "Projetos e Atividades Especiais – PAES"

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ABSTRACT

This is a descriptive exploratory study carried out in a Brazilian Higher Education Institution (HEI) with the participation of the course coordinators for their importance in the joint actions among courses. This work analyzed the relationship among coordinators and how well they know and promote interdisciplinary actions based on the Projects and Special Activities (PSAs) developed at the institution. Furthermore, the coordinators evaluated the principles considered essential for the success of interdisciplinary work. The questionnaire data provided by the coordinators were interpreted through Social Network Analysis (SNA) using UCINET V6 software. It was concluded that interdisciplinary actions are incipient among the coordinators. The "effective communication" principle had the highest score among respondents to consolidate interdisciplinarity. On the other hand, the "individual characteristics" principle scored the lowest. Individual actions are highlighted to promote and disseminate interdisciplinary activities and interdisciplinarity is on the agenda of the HEI, but there is no evidence of institutional action to strengthen the relationship among coordinators. Characteristics of the coordinator and or course make certain courses appear as "islands of knowledge".

Keywords: Interdisciplinarity, interdisciplinary activities, interdisciplinary projects, analysis of social networks, course coordinators.

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RESUMO

Trata-se de estudo exploratório descritivo realizado em uma Instituição de Educação Superior (IES) brasileira com a participação dos coordenadores por sua importância nas ações conjuntas entre cursos. Foram analisados os relacionamentos entre coordenadores e o quanto estes conhecem e promovem ações interdisciplinares tendo por base os Projetos e Atividades Especiais (PAEs) desenvolvidos na instituição. Também foram avaliadas, pelos pesquisados, dimensões consideradas essenciais para o sucesso dos trabalhos de grupos interdisciplinares. Os dados do questionário respondido pelos coordenadores foram interpretados por meio da Análise de Redes Sociais (ARS) com uso do software UciNet V6. Concluiu-se que ações interdisciplinares são incipientes entre os coordenadores. A dimensão "Comunicação eficaz" recebeu a melhor pontuação entre os respondentes para a consolidação da interdisciplinaridade entre os cursos. Já a dimensão "Características individuais" teve a menor pontuação. Notam-se ações individuais para promover e divulgar atividades interdisciplinares e que a interdisciplinaridade está na pauta da IES pesquisada, mas não se evidencia ação institucional para fortalecimento dos relacionamentos entre coordenadores. Características do coordenador e ou do curso fazem com que determinados cursos se mostrem como "ilhas de conhecimento".

Palavras-chave: Interdisciplinaridade, atividades interdisciplinares, projetos interdisciplinares.

Introduction

Education in the 21st century can be characterized by stories of global connections, where opportunities are offered by digital technologies, connectivity through mobile platforms and social media, and a shift in students' expectations and those of their parents pressure universities to rethink global learning and flexible delivery within a more modern context (MONK, 2015). If the 20th century can be identified as an era of academic specialization, the current trend is to add interdisciplinary spaces to traditional research and the organization of training (BURSZTYN; DRUMMOND, 2013).

Within this context, interdisciplinarity does not just mean resorting to two or more disciplines to better understand or approach a certain question or problem, which is multidisciplinarity (AUGSBURG, 2016; REPKO, 2008).

Interdisciplinarity integrates the respective disciplines such that new points of view about a given situation or object appear and exceed the limits of the disciplines

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on their own (AUGSBURG, 2016; REPKO, 2008). This allows us to solve problems or answer questions that cannot be done satisfactorily using single approaches or methods (ASHBY; EXTER, 2019).

Disciplines, as one of the main organizing structures of content, persist in the production and transmission of knowledge; however, teachers are increasingly questioning and changing what and how they teach. Universities are offering disciplines and interdisciplinary programs with greater intensity, as an alternative to the traditional disciplines considered to be islands of knowledge (MILLAR, 2016).

Research on interdisciplinary science is largely focusing on the institutional obstacles that discourage or hinder its work, but these are not the only obstacles. There are specific cognitive barriers, including methodological and conceptual ones that must also be faced when trying to work across disciplines. Scientific practices can be very domain specific, restricting interdisciplinary research (MA-CLEOD, 2018).

Discipline-specific approaches are considered islands of knowledge about given themes and cannot tackle bigger questions and broader contexts, even though these are essential, in some specific fields of study, for the comprehension of particular forms of knowledge (JACOB, 2015).

What can be seen is that universities still fail to understand interdisciplinarity as a transition and treat the issue as a tendency (RHOTEN, 2004). There is, however, an important difference between these two concepts. If interdisciplinarity were a tendency, it would be enough for universities to be predisposed to move in that direction. Yet, as it is a transition, what is expected of them is that they be prepared for a "change of state".

Universities have been shown to be fragile in handling interdisciplinarity, because they treat it in a fragmented and non-encompassing manner that ends up wasting the financial resources earmarked for the theme, as well as the energy of the researchers dedicated to this cause, as they are no longer able to achieve what they could or should have been able to (RHOTEN, 2004).

The point of concern with this fragmentation is the content's lack of integration with the various curricular components, in addition to the actual disconnection between academia and society, where students will enter the market and the holistic vision will be essential in resolving socioeconomic questions (SEVERINO, 2008).

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However, the complex nature of participation in learning over the course of one's life urges scholars to go beyond this fragmentation of disciplines and to advance knowledge in an integrative manner, through the construction of new interdisciplinary theories and the adoption of interdisciplinary research approaches (BOEREN, 2017).

Globalization and the corporate economics standards that arose in the 20th and 21st centuries show that modern, high technology companies no longer use the Taylor-Ford production model as the only strategy to solve their management problems. Organizations comprise a systematic and multidimensional whole in which all aspects are connected and interdependent, with each aspect either influencing the others or being influenced by them (CEZARINO et al, 2016). This is a fact that could be considered by learning institutions.

The daily problems experienced by organizations are difficult to comprehend and impossible to understand through a single point of view or specific knowledge. For this reason, higher education institutions (HEIs) need to use interdisciplinary approaches to tackle these issues in the formation of professional competencies. The integration of efforts by researchers from different origins and areas of specializations confers advantages in solving problems, generating innovation, shaping leaders and advancing in research and development (JACOB, 2015).

Interdisciplinarity in management studies is a social system that requires the development of complex thought. Thus, students should be introduced to a critical and systematic way of thinking, avoiding approaches based on a single discipline. However, there are still some HEIs, and especially their administrators, who seem to be unaware of the changes in the industry or, if they are aware of these, their programs are not up to date with the new techniques and methods required by organizations to operate efficiently (CEZARINO et al, 2016).

Higher education needs to meet the needs of a volatile labor market, where the known disciplines no longer define their own niches in terms of topics or practices for their candidates. In this context, interdisciplinarity is a continuous reconsideration of creation, communication and the application of knowledge, bringing together the perspectives of research, learning and decision making (LARSEN, 2018).

Há um crescente reconhecimento da necessidade de interdisciplinaridade na solução de problemas complexos de pesquisa em muitas áreas da ciência, princi-

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palmente na tecnológica e os conceitos de interdisciplinaridade influenciam o trabalho de tecnólogos educacionais e outros envolvidos na pesquisa de aprendizagem avançada por tecnologia (SCANLON; CONOLE, 2018).

There is a growing acknowledgement of the need for interdisciplinarity in the solving of complex research problems in many areas of science, especially in technology and the concepts of interdisciplinarity influence the work of educational technologists and others involved in the research of advanced learning through technology (SCANLON; CONOLE, 2018).

Another question that is worthy of mention is the degree to which knowledge and investigation methods are needed to understand and tackle ecological and social problems that humans are currently facing. The integration of fragmented knowledge in its organization, classification, production and use across academia, the workplace and society is necessary to tackle the multiple perspectives, epistemologies and fragmentation inherent to such problems (CLARK; WALLACE, 2015).

Although interdisciplinarity is considered a significant innovation in today's higher education, few empirical studies reveal how to face the challenges and create opportunities to expand interdisciplinarity in specific programs. The complex problems faced by society will probably demand the participation of multiple disciplines and individuals from a variety of sectors, leading to the development of new approaches, programs and fields of practice (SHANDAS; BROWN, 2016).

Part of this complexity is perceived in research carried out by a design school in East Asia that compared the holistic experience of a student's learning to the conditions of being taught by a team or an individual, as an influence on the specific learning experiences. The results show that, despite students taught by a single professor having a more positive general opinion about the quality of the course, when compared to those taught by a team, the latter significantly increased students' experience of a balanced contribution of different disciplinary perspectives. Furthermore, the approach of teaching by teams was significantly more effective at giving students greater opportunities to comprehend the relevance of the different disciplines to the course subjects (SELF; BAEK, 2017). In the conclusion by the authors, we note the importance of teaching by teams, even when students lack this perception.

Although the research by Self and Baek (2017) demonstrates that students may not perceive the efficacy of teaching by teams, the empathy generated among

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students based on interdisciplinary projects was captured by Hutchison (2016). These projects allowed students to improve basic written and verbal communication skills, ethical and quantitative reasoning and critical thinking. The students' accounts confirmed the researcher's perception that working collaboratively was advantageous, as they were able to create something totally different and to bring creativity to their projects.

One can see, through the studies presented so far, the importance of interdisciplinarity in the educational context for the formation of very well-prepared and qualified students for the labor market and the social environment as a whole.

In this research, carried out within an HEI located in the greater metropolitan area of São Paulo city and that presents engineering, administration and design in its portfolio of higher education courses, it was fitting to question whether the relationship model between the course coordinators and institutional actions implemented favored an awareness and promotion of interdisciplinary actions.

The overall objective of this research was to analyze the existing relationships among the course coordinators, employing the analysis of social networks, considering how much they know about and promote interdisciplinary actions, based on the PSAs developed between professors and students. Specific objectives were to analyze the structure of the knowledge networks and the promotion of interdisciplinary actions and the principles considered essential for the success of interdisciplinary groups, from the point of view of the course coordinators.

This work is relevant in the measure that one seeks to investigate aspects relating to actors of interdisciplinary groups, as well as corporate or institutional aspects that favor the success of these groups. There is a lack of studies tackling these two spheres of analysis.

Another factor to consider and that makes this research new is the fact that the HEI being studied presents courses connected to exact and human sciences (engineering, design and administration), which makes the study of interdisciplinarity an important contribution, because such an integration of the courses could qualify professionals graduating from the institution in a differentiated manner.

The work is structured thusly: chapter 2 tackles the review of the literature that served as the theoretical framework for the research work, considering interdisciplinarity and the principles of success for interdisciplinary groups and the SNA.

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Chapter 3 describes the boundaries of the research, allowing for other researchers to replicate the work at different HEIs. Chapter 4 presents the results obtained and the discussions, based on the theory underpinning the work and, at the end, the final considerations.

Theoretical reference

The theme of interdisciplinarity has been the agenda for discussions on a variety of instances (in governments, companies and universities) with the objective of finding interactions that ensure knowledge normally found in isolation among specialists can be shared, allowing for joint actions that provoke the mutual enriching of knowledge. Better communication among these professionals and efforts in the sense of greater cooperation among them are necessary (CARVALHO et al, 1999).

This theoretical reference sought to tackle interdisciplinarity from the point of view of different authors.

INTERDISCIPLINARITY AND ITS PRINCIPLES

Interdisciplinarity is more than a lesson that adds new contents from other disciplines. It comprises and incorporates new values and approaches in the definition and resolution of problems. In order for interdisciplinary learning to take place, students and professors need to identify, incorporate and respect different points of view, recreating the actual knowledge, understanding and practices on a given theme based on the learning acquired from each other (BRADBEER, 1999).

Interdisciplinarity can also be understood as a process and a practice that allow for the establishing of a set of intentional arrangements and a sense of community to, in the end, integrate ideas with others and so form a final product (RHOTEN; CONNOR; HACKET, 2009). One experiment carried out by these authors with small, interdisciplinary groups of graduate students tasked with producing an innovative scientific research problem and an integrative research proposal showed that both the disciplinary skills and interdisciplinary willingness were essential to the integration of the creative research proposals.

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However, differences exist between multidisciplinary and interdisciplinary collaboration. In multidisciplinary collaboration, little information is exchanged and the context of the disciplines remains unaltered by the participants. They progress in parallel to the solution of a given problem and, subsequently return to their initial states, without changes. In interdisciplinary collaboration, the participants jointly incorporate knowledge and approaches, changing the contexts of the disciplines that come together for a solution to the problem and generate a new discipline and/or knowledge (RICHTER; PARETTI, 2009).

Interdisciplinarity can exist within a single HEI, just as it can within two or more. Among the tendencies related to interdisciplinarity in higher education, we can see teaching carried out by teams of professors from different areas and education institutions to students of varying departments in the arrangement of these HEIs. There is an increasing need to bring members of the faculty with a range of origins to provide suitable instruction and education to shape tomorrow's professionals. HEIs in Australia, Ireland and the US already offer online interdisciplinary courses to their students. What was once delivered in the actual university, now has an interdisciplinary character (JACOB, 2015).

Working within an interdisciplinary team is essential to solving complex problems, regardless of whether these are academic or corporate. In the field of exact sciences, computer science and engineering are examples of courses that have evolved to, in an interdisciplinary way, influence society's lives and wellbeing in a variety of areas. To give examples, the evaluations of big data are carried out within the scope of media platforms, like Facebook, where robotics combines engineering and computer sciences to improve industrial development processes, while numerical (multiscale) simulations are widely used to forecast the behavior of materials, and so forth (NEUMANN et al, 2017).

Interdisciplinarity as a term can have different characterizations depending on its use. In empirical terms, interdisciplinarity can be considered the reach of new experimental data obtained through teamwork by professionals from different fields in the solution of an interdisciplinary research problem. Methodologically, interdisciplinarity is about methods developed for the solving of complex problems in interdisciplinary research. Meanwhile, interdisciplinarity in theoretical terms brings together

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concepts, models or theories from more than one field to develop a new theory (CARR; LOUCKS; BLÖSCHL, 2018).

The three categories presented reinforce the idea that the use of interdisciplinarity provides the actors of interdisciplinary groups with a refined ability to learn about a new field of knowledge, one distant to those familiar to them. This is important to create a "knowledge bridge" that people can subsequently capitalize on when they apply such knowledge to their respective fields (CARR, LOUCKS e BLÖSCHL, 2018). However, putting together an interdisciplinary team requires effort and dedication, in addition to a period of personal adaptation (JACOB, 2015).

The work by Nancarrow et al. (2013) provided an important contribution in this sense, when they researched professionals in different organizations in the UK that use interdisciplinary teams. The results they obtained included a list of ten key principles for the success of the teams in completing interdisciplinary tasks.

Nancarrow et al. (2013) based themselves on two sources of knowledge to identify the attributes a good interdisciplinary team should have: a systematic review of the literature on work by interdisciplinary teams and the perceptions of 253 professionals, captured through interviewed, who worked in interdisciplinary teams at 11 different organizations in the UK.

These sources of data were brought together using qualitative content analysis to arrive at a table identifying characteristics and proposes ten principles that support effective work by interdisciplinary teams: 1) leadership and management; 2) communication; 3) personal reward, training and development; 4) suitable resources and procedures; 5) a suitable combination of competencies; 6) atmosphere; 7) individual characteristics; 8) clarity of vision; 9) quality and results of the service; and, 10) respect for and understanding of roles (NANCARROW et. al, 2013).

The current paper opted to consider the principles presented by Nancarrow et al (2013) to: 1) analyze the existing relationships between the course coordinators of the HEI in question, considering the degree to which they know about and promote interdisciplinary actions based on their PSAs, and 2) identify, from the point of view of the course coordinators, the principles considered essential for the success of the works in groups. The central idea was to identify which, of the ten principles presented and within the scope of this study, contributed or not to increase the chances of success of the teams who carry out interdisciplinary work.

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SOCIAL NETWORK ANALYSIS

The Social Network Analysis (SNA) seeks to understand the relationships among the actors belonging to a studied network; that is, among the categories of roles that they occupy within this network, given that the relationships among the different actors can influence the behavior of an actor, significantly altering their personal characteristics (SILVA; AVELAR; FARINA, 2015).

The SNA shows the types of relationships that people can have, given that social networks generally characterize themselves by "who knows who, or who communicates with who within a community, organization or any other social group" (SILVA; AVELAR; FARINA, 2015, p.74 – translated from the original in Portuguese).

Among the existing metrics for the SNA, five measures of centrality were used for the study of interdisciplinarity of the HEI the object of this research:

- **Degree –** measures the actors' degree of centrality. Those with more connections are more predisposed to have power and more prestige in the network, because they can directly affect other actors (HANNEMAN; RIDDLE, 2005).
- **Betweenness** – indicates the location of an actor in the network. The more people who depend on a given actor to establish connections with others, the more power this actor will have within the network (HANNEMAN; RIDDLE, 2005).
- **Closeness** – measures the shortest distance to an actor in relation to the others in the network in order to have access to information. The closer an actor is, the sooner he will have access to the information (HANNEMAN; RIDDLE, 2005).
- **Density** – measures the proportion between the ties present and all the possible ties of a given network. It provides information about the speed with which information propagates between the connections and if the actors have high or low levels of social capital (HANNEMAN; RIDDLE, 2005).
- **Bonacich measure –** determines the centrality of an actor in relation to the centrality of the others connected to him. There are two interpretations of power, with the first using the positive beta parameter that empowers an actor when he is connected to actors with greater centrality.

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The second uses the alternative negative of the beta parameter that empowers an actor when he is connected with those who have less centrality (HANNEMAN; RIDDLE, 2005).

The use of the SNA contributed to the analysis of the practices and forms of communication among the existing relationships of the different courses in the HEI in question, as regards the promotion of PSAs.

The communication interactions and promotion of interdisciplinary actions by the coordinators of a course of an HEI were studied with the objective of analyzing two social networks relating to PSAs. The first network regards the knowledge of the course coordinators on interdisciplinary actions carried out by their colleagues involving the PSAs. The second deals specifically with actions of interdisciplinarity promoted by the course coordinators.

Methodology

This research was of an exploratory and descriptive nature, with the objective of obtaining greater knowledge about interdisciplinarity in higher education. The bibliographic survey on the theme allowed for a theoretical foundation that served as the basis for the development of the work.

The next step was the elaboration of a questionnaire that met the specific objectives of this work: a) to identify the course coordinators' knowledge of the interdisciplinary actions carried out involving the PSAs; b) to identify the course coordinators' promotion of interdisciplinary actions carried out involving the PSAs; and, c) to identify the success factors for the consolidation of interdisciplinarity.

Based on the questionnaire, 11 coordinators of the various courses that students can graduate in at the HEI the object of this work, with nine engineering – Nutritional (NT), Civil (CV), Computational (CM), Control and Automation (CA), Electrical (EL), Electronic (ET), Mechanical (MC), Production (PD), and Chemical (CM) –, in addition to Administration (AD) and Design (DE). The data was collected in a structured manner by the researchers themselves, through individual conversations with the course coordinators.

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The proposal of this research, the questionnaire and the free and informed consent form were approved by the Ethics Committee for research.

For data collection, the first two questions posed to the course coordinators tackled the previously stated objectives, a) and b), with the expectation that binary answers would be given, in the yes/no format, regarding their knowledge and promotion of interdisciplinary actions. Each course coordinator was asked, for example, if he knew of interdisciplinary actions for each of the other courses. Thus, each coordinator answered the same question for the other ten courses being studied, in addition to their own. These questions allowed for two tables to be drawn up, each 11 by 11, that served as the starting point for the UCINET (one table per question). In these tables, "yes" answers were coded as "1", demonstrating relationships, while "no" answers were considered as "0"; that is, no relationship between the coordinators. The questions were:

As regards the PSAs, do you know interdisciplinary actions by the course ...?
Still thinking about PSAs, do you promote interdisciplinary actions with course ...?

Following on, each course coordinator was asked to individually assess, using a Likert-type scale, where 0 = no importance at all and 10 = very important, the 10 principles from Nancarrow et al (2013) that favor the development of work by interdisciplinary teams. The proposal was to obtain the perception of the research subjects about which factors/ principles would be of more importance to the team, considering their place of work, culture and working context. As higher education professors, with master's degrees or doctorates, it was understood that a scale of 0-10 would not be a concern, but rather, help refine the research and lend greater accuracy to the answers.

At the end, in order to assess the general conditions for the carrying out of interdisciplinary activities at the HEI in question, the course coordinators were asked to attribute an overall score as an average for the 10 principles presented by Nancarrow et al (2013).

Seeking to enrich the study as regards the data collection, the following attributes were gathered for each coordinator: how long they have worked at the HEI, how long they have coordinated their course, the number of students in their course, their gender. Questions relating to time and gender can reflect in the

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suitability of professionals to act in interdisciplinary networks and groups (SILVA; AVELAR; FARINA, 2015).

This being the case and with the coordinators providing their scores, the following statistical considerations were made: the average score for each principles, the average overall score for the principles as a whole, an assessment of the highest and lowest scores given and an assessment of the average scores, by course, considering engineering, design and administration.

The data was collected in the month of October, in 2017, and the data was analyzed the following month using UCINET software to get the results regarding the answers to the first two questions, and basic descriptive statistics to think about the importance of the principles proposed by Nancarrow et al (2013).

As regards the UCINET output, the centrality measurements considered were degree, betweenness, closeness, density and Bonacich measure to measure the specific objectives a) and b), in addition to statistical calculations to measure specific objective c).

Indegree was used to indicate how much each coordinator is recognized by his fellow coordinators for his interdisciplinary actions. Meanwhile, outdegree measured how much each coordinator know of the interdisciplinary actions by the other courses.

Incloseness measured how close the coordinator was to the others and how well his interdisciplinarity actions are known by them. Outcloseness, in turn, indicates how close the coordinator is to the other coordinators and how well he knows the interdisciplinarity actions they have developed.

As regards the Bonacich measure, for the effects of this study the beta negative parameter of -0.5 was considered, as the objective was to evaluate the power of the course coordinators and not just the force of one coordinator, based on the quantity of relationships connected to the knowledge and promotion of interdisciplinarity actions regarding PSAs (HANNEMAN; RIDDLE, 2005).

Results

The data collected from the first two questions in the questionnaire were analyzed independently, using UCINET 6 for Windows software. Once the square ta-

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bles (using values 0 and 1 for the answers) were input into the software, the results obtained were statistics that indicate the relationships among the participants of each table; represented using a chart of the social network of the coordinators and through centrality measurements for each of these networks. Analyzing the chart analysis and the centrality measurements degree, betweenness, closeness, density and Bonacich measure, it was possible to identify the following situations:

- The relationships among course coordinators as regards their knowledge about interdisciplinary actions promoted by the other courses regarding PSAs.
- The relationships among course coordinators as regards the promotion of interdisciplinary actions they carry out to the other courses as regards the PSAs.

The data collected in the evaluation of the ten principles of success for work carried out by interdisciplinary groups allowed the consideration, according to the perceptions of the course coordinators, which the main principles were as regards the effect of the actions. This analysis was undertaken using basic descriptive statistics, with the principles being those presented in the Theoretical Reference, as proposed by Nancarrow et al (2013).

a. Regarding the knowledge of course coordinators about interdisciplinary actions car-ried out by other courses in relation to PSAs

Charting the answers given by the course coordinators regarding their knowledge of interdisciplinary actions carried out by the other courses in relation to PSAs, resulted in the network chart presented in Figure 1. The arrows in the chart show the existence and direction of the respective relationship. For example, we can see a one-way arrow in the chart from the chemical engineering course coordinator (CC) to the civil engineering course coordinator (CV). This shows that CC knows the interdisciplinary actions regarding PSAs carried out by CV, but it is not reciprocal, with CV unaware of CC's actions. Meanwhile, there is reciprocal awareness of the respective actions carried out by CC and NL.

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Charting the answers given by the course coordinators regarding their knowledge of interdisciplinary actions carried out by the other courses in relation to PSAs, resulted in the network chart presented in Figure 1. The arrows in the chart show the existence and direction of the respective relationship. For example, we can see a one-way arrow in the chart from the chemical engineering course coordinator (CC) to the civil engineering course coordinator (CV). This shows that CC knows the interdisciplinary actions regarding PSAs carried out by CV, but it is not reciprocal, with CV unaware of CC's actions. Meanwhile, there is reciprocal awareness of the respective actions carried out by CC and NL.

Examining Figure 1, we can see that it is not dense. In fact, the average density measurement for this network was 40.9%, meaning that only 45 of the 110 possible relationships about the awareness of interdisciplinary actions relating to PSAs were observed. If all the coordinators had been reciprocally aware of the interdisciplinary actions, there would have been 110 relationships shown; that is, 55 two-way arrows in the chart, representing a density of 100%.

It is worth mentioning that the data processed resulted in a reciprocity rate of 36.36%, which, for an institution looking to stimulate and develop interdisciplinary actions could be seen as a result with room for improvement, given that this represents only 20 reciprocal pairs out of a possible total of 55, which is a low, somewhat fragile figure. It could be that coordinators treat interdisciplinarity as an expectation and not a process of transition, as pointed out by Rhoten (2004).

The coordinator of the mechanical engineering course (MC), was shown to be the most aware of other courses' interdisciplinary actions, with an outdegree equal to 7 out of a possible total of 10, followed by the coordinators of the design (DE) and production engineering (PD) courses, who both had outdegree scores of 6. Figure 1 also shows that MC has seven arrows leading to other colleagues; this demonstrates that MC is aware of these colleagues' actions.

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Figure 1 Relationship network of course coordinators regarding their awareness of interdisciplinary actions carried out in relation to PSAs.
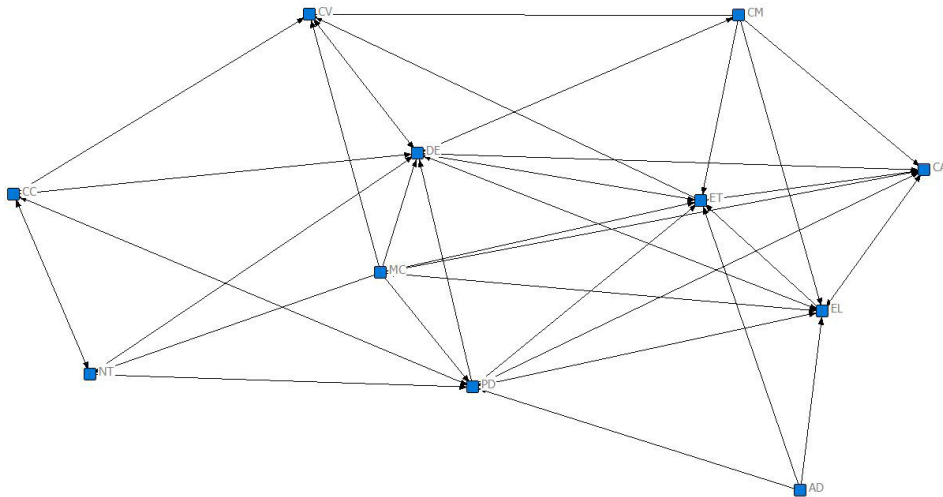
Source: Developed by the authors.

On the other hand, the civil engineering course coordinator (CV) was the least aware of interdisciplinary actions by the other courses, with an outdegree of 1 (there is only one arrow leading away from this coordinator, in the direction of his colleague, DE), followed by ET, with an outdegree score of 2. This result could be the consequence of singularities present in these courses or it could denote the need for bring these coordinators closer to those of the other courses. Both figures are low, considering that the HEI in question has directed efforts at promoting interdisciplinary activities, with PSAs being important agents in that process.

The other courses obtained the following outdegree results: CM = 5, CA = 4, EL = 4, CC = 4, AD = 3 and NT = 3.

As regards the indegree metric, which indicates the degree to which each coordinator is known by the other coordinators for their interdisciplinary actions, the data indicates that DE, the design course coordinator, is the most well-known with an indegree score of 8, followed ET with a score of 7.

The courses with the lowest indegree scores were AD, with 0, and CM with 1, showing that the coordinators of the other courses are not aware of their interdisciplinarity actions.

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The other course coordinators received the following indegree scores: EL = 6, PD = 5, CA = 5, CV = 5, NL = 4, MC = 2 and CC = 2.

In this analysis, of special note are the electronic engineering course coordinator's indegree and outdegree results. Despite seven other coordinators being aware of the interdisciplinary actions carried out by ET, this course coordinator answered that he maintains interdisciplinarity relationships with only two other coordinators. So, even though the interdisciplinarity actions carried out by ET are known by others, the course coordinator of the actual course does not have that same perception. There is a perception of a disconnection among the course coordinators. Severino (2008) and Carvalho et al (1999) mention that this disconnection is due to the distance present in the academic and social environments. The coordinators concern themselves with their disciplines and contents, but do not consider the social questions that involve the actors who take part in interdisciplinary activities. The relationships may only be based on specific technical knowledge.

The next centrality metric analyzed was betweenness, which measures the power held by an actor, in this case, course coordinators, within a network based on the number of dependent actors for the establishing of connections with other actors. First place went to DE, the design course coordinator, who obtained 24.417 points, followed by PD, with a score of 11.000. The coordinators who were unable to score were CM and AD, showing that the coordinators of the computational and administration courses, respectively, do not act as intermediaries in terms of awareness of interdisciplinary actions by the courses and little interaction as propagators of interdisciplinary actions.

The other coordinators received the following scores: MC = 7.833, ET = 6.167, EL = 5.500, NT = 5.000, CA = 3.250, CV = 1.000 and CC = 0.833.

It should, however, be noted that the percentage of intermediation in the awareness of interdisciplinarity actions was low, at 22/62%, demonstrating that there is no significant intermediation among the course coordinators or influence over each other.

The other centrality metric used in this analysis was closeness, which measures the shortest distance between actors needed to have access to information. This metric allowed for two items of information to be gleaned about the course coordinators: the first, incloseness, revealed the proximity of the coordinator to the

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others and the proximity of his interdisciplinary actions in terms of their awareness. The second, outcloseness, is a measure of how close the coordinator is to the other ones and his awareness of the interdisciplinarity actions they have developed.

First place for incloseness went to the coordinator whose interdisciplinary actions are most known by his colleagues, in this case, the design course coordinator (DE), with 0.833 points, while ET came second with 0.769 points, closely followed by EL, with 0.714 points. The coordinator with the lowest score was AD, with 0.250 points. The others scored as follows: CV = 0.,667, CA = 0.667, NT = 0.625, PD = 0.625, CM = 0.476, MC = 0.476 and CC = 0.455.

As regards the metric of outcloseness, the results were similar: MC = 0.667, DE and PD both got 0.625 points, AD, CM and CA scored 0.556, EL and CC got 0.526 points, NT = 0.500, ET = 0.455 and CV = 0.417, showing that all the coordinators were aware of interdisciplinarity actions by other courses to a reasonably balanced degree, with no one coordinator being much more aware in this sense than the others.

The last analysis carried out was on the Bonacich measure, considering the β negative parameter, seeing as the objective was to assess the power of the course coordinators and not just the force of a coordinator based on the quantity of relationships he has.

All the course coordinators had negative Bonacich measures; that is, the bonds among the course coordinators are primarily with other actors who have a high degree of relationships, making them "weak". By having powerful neighbors who relate to each other and, in some way, know the interdisciplinarity actions of their colleagues, there is no single coordinator who is found to have greater power over the others.

b. Regarding the promotion of interdisciplinary actions carried out by course coordina-tors with the other courses, in relation to the PSAs.

Charting the answers from the course coordinators regarding the interdisciplinary actions they have carried out with the other courses, in relation to the PSAs, resulted in the network presented in Figure 2.

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Figure 2 Network of relationships among course coordinators regarding the inter-disciplinary actions they have carried out aimed with the other courses, in relation to the PSAs.
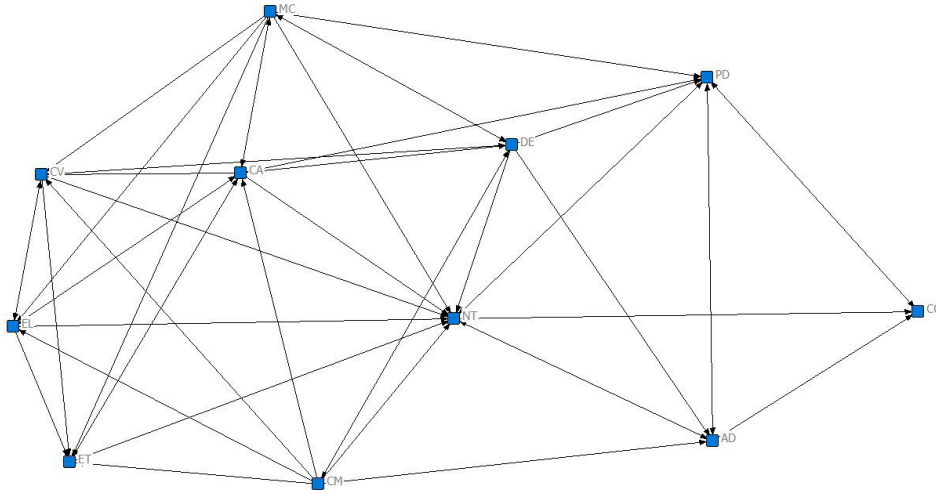
Source: Developed by the authors .

Examining Figure 2, one can see that it also lacks density, with a result only slightly superior to the previous one. The measure of average density of this net-work was 0.445, meaning that only 49 of the possible 110 relationships regarding running interdisciplinary actions with the other courses, in relation to the PSAs, were observed.

It is worth noting that the processed data presents a reciprocity rate of 36.1%; that is, a result with room for improvement. Due to the square table, a total of 55 relationships among the coordinators was possible, which means that if every co-ordinator were reciprocal with each of the others, we would have 55 reciprocal rela-tionships, but only 20 actually exist. There are 35 reciprocal relationships that should be taking place but are not.

The coordinators who stand out for promoting the greater number of interdis-ciplinary actions with the other courses are computational engineering (CM), control and automation engineering (CA) and mechanical engineering (MA), all with an out-degree equal to 7 out of a possible 10, followed by the design course coordinator (DE), who scored a 6.

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On the other hand, the electronics (ET) and chemical (CC) engineering course coordinators are those who least promoted interdisciplinary actions with the other courses, with an outdegree score of 2.

The other course coordinators achieved the following outdegree scores: AD = 3, NT = 3, CV = 4, EL = 4 and PD = 4.

For the indegree metric, which indicates how much each coordinator is sought out by other coordinators for the promotion of interdisciplinary actions with other courses, nutritional engineering (NT) was shown to obtain the highest score, a perfect 10; that is, each of the other coordinators mentioned he had promoted interdisciplinarity with other courses.

The course coordinator with the lowest indegree score was computational (CM), with a 1, meaning that this coordinator is not sought out by the other coordinators for his promotion of interdisciplinarity among the courses.

The other course coordinators obtained the following indegree results: PD = 6, CA = 5, ET = 5, AD = 4, DE = 4, CV = 4, EL = 4, MC = 3 and CC = 3.

In this analysis, there are two results that stand out when looking at the indegree and outdegree metrics. The nutritional engineering course coordinator (NT) is sought out by all the other coordinators to promote interdisciplinary actions among the courses. However, he declared to only interact with 3 coordinators who run this interdisciplinarity. Meanwhile, the control and automation engineering course coordinator (CA), declared to know 7 coordinators with whom he promotes interdisciplinarity among the courses. However, he was only mentioned by one coordinator who recognized him as a promoter of interdisciplinary activities among the courses.

The next metric of centrality analyzed was betweenness, which measures the power of an actor within a network based on the number of actors who depend on him to establish connections with other actors, in the promotion of interdisciplinarity among the courses.

First place was taken by the mechanical engineering course coordinator (MC), who achieved 25.000 points, followed by the production engineering course coordinator (PD), with 23.500 points. On the flip side, the electronics (ET) and electrical (EL) engineering course coordinators obtained only 0.333 points each, while the chemical engineering course coordinator (CC) did not even receive a score, showing that these coordinators do not act as intermediaries in terms of awareness of actions

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that promote interdisciplinarity among the courses, interacting little as propagators of interdisciplinary actions.

The other coordinators scored as follows: DE = 12.750, NT = 10.250, CA = 9.750, AD = 1.083, CV = 1.000 and CM = 1.000.

It should be noted that the percentage of intermediation in the awareness of actions promoting interdisciplinarity among the courses was low, at 21.11%, demonstrating that there are no significant intermediations or influences of certain course coordinators over the others.

The other centrality metric used for this analysis was closeness, which measures the shortest distance between one actor and the others in the network to have access to information, as previously stated in item a) of this paper.

The first place in terms of incloseness was the nutritional engineering course coordinator (NT) with a score of 1.000. This means that the other coordinators want to be close to this course for the promotion of interdisciplinary actions. The computational engineering course coordinator (CM) achieved the lowest score: 0.357. The others were distributed thusly: PD = 0.714, AD = 0.625, MC = 0.588, CC = 0.588, CA = 0.556, ET = 0.556, DE = 0.526, CV = 0.526 and EL = 0.526.

As regards the outcloseness metric, the results were close. CM, CA and MC scored 0.769, DE = 0.714, CV = 0.625, EL and PD scored 0.588, ET = 0.526 and AD and NT scored 0.417, while CC got last place, with a score of 0.400. These results show that all the coordinators were interested in interacting in order to promote interdisciplinary actions.

The final analysis carried out was the Bonacich measure, considering the β negative parameter.

The control and automation (CA) and electronic (ET) engineering course coordinators stood out in their Bonacich measure, with the most negative values, because their relationships were those made with actors with a high degree of relationships in the group, making them "weak" for having powerful neighbors who promote interdisciplinarity actions with the other course coordinators.

The chemical (CC) and production (PD) engineering course coordinators presented the largest positive values as they had the most ties with neighbors with few relationships, making them "strong" and powerful in relation to the promotion of interdisciplinarity actions.

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Non-conventional behavior can be noted in the course coordinators regarding the awareness and promotion of interdisciplinary actions in the PSAs. Knowledge and promotion of interdisciplinarity should walk hand in hand; that is, the greater the knowledge about actions of other courses, the greater the interest in promotion joint actions. However, the results showed that, despite there being interest on the part of the course coordinators in promoting interdisciplinary actions with the other courses, they are not aware of the interdisciplinarity actions that the pairs present.

Again, these aspects demonstrate a lack of connection among the course coordinators, something that Severino (2008) and Carvalho et al (1999) pointed out in their studies and remark that such disconnection can be minimized by bringing the academic and social environments closer; that is, social events can strengthen relationships and improve handlings in the academic environment.

It can be inferred that the desire to promote interdisciplinarity actions for the PSAs exists, but that there are no relationship opportunities that allow for the knowledge of what is undertaken and presented by the different courses.

c. Regarding the success factors for the consolidation of interdisciplinarity.

Using the ten principles suggested by Nancarrow et al (2013) in the questionnaire given to the course coordinators and, after charting and statistically analyzing the answers obtained, it was observed that, of the listed principles, the one considered most important for success in consolidating interdisciplinarity was "effective communication", with an average of 9.6 out of 10. This points attribution corroborates the discrepancy of the metrics between knowing and promoting.

There is the perception on the part of the coordinators that communication is very important and they point out the need to bring them closer together in order to strengthen communication among them, contributing to the construction of a cohesive team dedicated to interdisciplinarity as emphasized by Jacob (2015).

On the other hand, the principle with the lowest score was "individual characteristics", with 6.7. Principles such as "leadership and management", "positive and conducive atmosphere", "transparency of a shared vision" and "respect and

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understand roles" also scored highly, with averages of more than 9.0. Individual characteristics are the least important to interdisciplinarity actions.

There is a consensus that the participants incorporate knowledge and approaches that strengthen interdisciplinarity, and that the group's adaptability is greater than individual issues, as previously identified by Richter and Paretti (2009).

The course coordinators were also asked to give an overall score for the HEI in question., considering the 10 principles identified by Nancarrow et al (2013). The coordinators' opinions varied substantially, with the highest score – an 8.0 – given by the administration course coordinator (AD), followed by a 7.5 from the design course administrator (DE), while the lowest score, a 3.0, was given by the mechanical engineering course administrator (MC).

The average among the coordinators was 6.8, demonstrating that there is room for improvement in the successful consolidation of interdisciplinarity.

It should be noted that the mechanical engineering course coordinator (MC), at the time of the interviews, had only held the position for a year, which might have influenced the low score he gave. His perception of the interdisciplinary actions among the course coordinators may not, yet, have matured at that stage.

However, it does draw attention that the lowest scores were given by the coordinators of the engineering courses. This demonstrates that, for these coordinators, the interdisciplinary actions promoted by the HEI in the study still need to be optimized.

And, although it was not the objective of this work to evaluate the opinions of male and female coordinators separately, it was observed that the average score given by female coordinators was 7.2, while for their male counterparts it was 6.6. This difference could suggest that male course coordinators are more critical of the principles of success for the consolidation of interdisciplinarity, or that their perception of the interdisciplinary actions taken by the HEI in this study are less satisfactory.

Two coordinators spontaneously mentioned, when aiming to justify their assessment, the "lack of more time for the group of coordinators to discuss interdisciplinarity actions and actions that to take place are the result of individual efforts and are not strategically planned". The coordinators further stated that ordinary meetings take place among them, but themes linked to interdisciplinarity are not normally

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on the agenda and, when they are tackled, are not emphasized, even though the HEI has requested that interdisciplinary actions are undertaken. The suggestion given was that specific meetings be held on the theme.

A concern on the part of the course coordinators was perceived over the quality of the communication among them, and such a concern could be extrapolated to the HEI being studied, seeing as it is the driver of initiatives for the promotion and consolidation of interdisciplinarity.

Furthermore, the coordinators demonstrated the desire that this study be evaluated by the institution in order for measures to be taken that could enhance the relationships among them, allowing for interdisciplinary actions that are jointly planned, leading to greater interaction and the generation of new knowledge, as stipulated by Jacob (2015) and Richter and Paretti (2009).

Final considerations

Knowledge of interdisciplinary actions that are being developed in other courses offered by an HEI serves as an incentive for similar actions occurring in all the courses. The probability of a coordinator practicing interdisciplinarity in his course will be higher the more he knows about interdisciplinary actions in the other courses.

The Projects and Special Activities (PSAs) developed by the professors of the HEI in question have an interdisciplinary nature and the actions that have been taken by the institution in the sense of encouraging the PSAs are a counterpoint to the fragmented vision of educational practice. The PSAs allow for new approaches to the solving of problems under different perspectives. Coordinators, professors and students learn from each other.

By participating in the PSAs, it is hoped that teachers and students can capture the alignment among the courses offered by the HEI in the consolidation of interdisciplinarity and the role of course coordinators should favor this alignment. For interdisciplinarity actions, respect for the other participants, a creative environment, leadership shown on the part of the facilitating teachers and an organizational atmosphere are all essential.

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Knowledge and the promotion of interdisciplinarity actions are still incipient aspects at the HEI in question and demand corrective actions to undergo improvement. It was observed that the interdisciplinarity actions promoted in the Projects and Special Activities are poorly divulged and, consequently, little known by the course coordinators.

Those with less time in their role present a greater difficulty with their relationships with the other courses and, therefore, know about and promote fewer interdisciplinarity actions when compared to coordinators who have held their positions for longer.

The findings of this study contributed in the sense of alerting the managers of the HEI who seek interdisciplinarity about the need for greater integration among course coordinators. Spaces reserved for the discussion of interdisciplinary actions are important, because they improve the communication, emphasize leadership and provide network arrangements that facilitate the interdisciplinary process.

The research provided information about the network of relationships in which the coordinators find themselves, allowing for each coordinator to, at a later time and based on the answers given to the questions tackled in the questionnaire, to conduct a critical analysis of how their actions to consolidate interdisciplinarity in the PSAs and the HEI itself, have actually been.

Based on this critical analysis, the coordinators could seek to improve communication with the other coordinators, strengthening the constant interdisciplinarity actions of the teaching plans of the various courses of the HEI in question.

It is imperative that HEIs have institutional actions that favor work by interdisciplinary groups, facilitating communication among actors of interdisciplinary projects and that such institutions provide environments sited to interdisciplinary learning, bringing in professionals from other institutions, mixing together competencies in a positive climate that generates innovation.

For future studies, the authors suggest this research be applied to course coordinators of other HEIs that work with similar projects. Another possibility is to apply the questionnaire adapted to the perception of students who carry out PSAs and comparing them to the results of the coordinators. As this study was developed at a single HEI, the results of this research cannot be generalized.

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References

ASHBY, I.; EXTER, M. Designing for interdisciplinarity in higher education: considerations for instructional designers. *TechTrends*, v. 63, n. 2, p. 202-208, 2019. DOI: 10.1007/s11528-018-0352-z.

AUGSBURG, T. *Becoming interdisciplinary:* An introduction to interdisciplinary studies. Dubuque, IA: Kendall/Hunt, 3 ed., 254 p., 2016.

BOEREN, E. Researching lifelong learning participation through and interdisciplinary lens. *International Journal of Research & Method in Education*, v. 40, n. 3, p. 299-310, 2017. DOI: 10.1080/1743727X.2017.1287893.

BRADBEER, J. Barriers to interdisciplinarity: Disciplinary discourses and student learning. *Journal of Geography in Higher Education*, v. 23, n. 3, p. 381-396, 1999. DOI: 10.1080/03098269985326.

BURSZTYN, M.; DRUMMOND, J. Sustainability science and the university: pitfalls and bridges to inter-disciplinarity. *Environmental Education Research*, 2013. DOI: 10.1080/13504622.2013.780587.

CARR, G.; LOUCKS, D. P.; BLÖSCHL, G. Gaining insight into interdisciplinary research and education programmes: A framework for evaluation. *Research Policy*, v. 47, n. 1, p. 35-48, 2018. DOI: 10.1016/j.respol.2017.09.010.

CARVALHO, F. C. A. et al. A Interdisciplinaridade no Ensino da Engenharia: a Internet como Ferramenta. In: XXVII Congresso Brasileiro de Ensino de Engenharia – COBENGE. *Anais em CD-ROM*, Natal, 1999.

CEZARINO, L. O. et al. Soft systems methodology and interdisciplinarity in management education. *Systems Research and Behavioral Science*, 33, p. 278-288, 2016. DOI: 10.1002/sres.2383.

CLARK, S.; WALLACE, R. Integration and interdisciplinarity: concepts, frameworks, and education. *Policy Sciences*, v. 48, n. 2, p. 233-255, 2015. DOI: 10.1007/s11077-015-9210-4.

GARDNER, S. K et al. Socialization to interdisciplinarity: faculty and student perspectives. *Higher Education,* v. 67, n. 3, p. 255-271, 2014. DOI: 10.1007/s10734-013-9648-2.

HANNEMAN, R. A.; RIDDLE, M. *Introduction to social network methods*. Riberside, CA: University of California, Riverside. 2005.

HUTCHISON, M. The empathy project: using a project-based learning assignment to increase first-year college students' comfort with interdisciplinarity. *Interdisciplinary Journal of Problem-based Learning,* v. 10, n. 1, 2016. DOI: 10.7771/1541-5015.1580.

JACOB, J. W. Interdisciplinary trends in higher education. *Palgrave Communications*, v. 1, n. 1, p. 1-5, 2015. DOI: 10.1057/palcomms.2015.1.

LARSEN, S. E. Interdisciplinarity, history and cultural encounters. *European Review*, v. 26, n. 2, p. 354-367, 2018. DOI: 10.1017/S1062798717000734.

MACLEOD, M. What makes interdisciplinary difficult? Some consequence of domain specificity in inter-disciplinary practice. *Synthese*, v. 195, n. 2, p. 697-720, 2018. DOI: 10.1007/s11229-016-1236-4.

MILLAR, V. Interdisciplinary curriculum reform in the changing university. *Teaching in Higher Education,* v. 21, n. 4, p. 471-483, 2016. DOI: 10.1080/13562517.2016.1155549.

MONK, N. Portal pedagogy: from interdisciplinarity and internationalization to transdisciplinarity and transnationalization. *London Review of Education*, v. 13, n. 3, p. 62-78, 2015.

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NANCARROW, S. A. et al. Ten principles of good interdisciplinary team work. *Human resources for Health*, v. 11, n. 19, p. 1-11, 2013. DOI: 10.1186/1478-4491-11-19.

NEUMANN, P. et al. Interdisciplinary teamwork in HPC education: Challenges, concepts, and outcomes. *Journal of Parallel and Distributed Computing*, v. 105, p. 83-91, 2017. DOI: 10.1016/j.jpdc.2016.12.025.

REPKO, A. *Interdisciplinary research*: Process and theory. Thousand Oaks, CA: Sage, 2008.

RHOTEN, D. Interdisciplinary research: Trend or transition. *Items and Issues*, v. 5, n. 1-2, p. 6-11, 2004.

RHOTEN, D.; CONNOR, E.; HACKETT, E. The act of collaborative creation and the art of integrative creativity: Originality, disciplinarity and interdisciplinarity. *Thesis Eleven*, v. 96, n. 1, p. 83-108, 2009. DOI: 10.1177/0725513608099121.

RICHTER, D. M.; PARETTI, M. C. Identifying barriers to and outcomes of interdisciplinarity in the engineering classroom. *European Journal of Engineering Education*, v. 34, n. 1, p. 29-45, 2009. DOI: 10.1080/03043790802710185.

SCANLON, E.; CONOLE, G. Interdisciplinarity in technology enhanced learning: an interview study. *Journal of Interactive Media in Education*, v. 1, p. 11, 2018. DOI: 10.5334/jime.476.

SELF, J.; BAEK, J. S. Interdisciplinarity in design education: understanding the undergraduate student experience. *International Journal of Technology and design education*, v. 27, n. 3, p. 459-480, 2017. DOI: 10.1007/s10798-016-9355-2.

SEVERINO, A. J. O conhecimento pedagógico e a interdisciplinaridade: o saber como intencionalização da prática. In: Fazenda, Ivani C. Arantes (org.). *Didática e interdisciplinaridade.* Campinas: Papirus, 2008.

SHANDAS, V.; BROWN, S. E. An empirical assessment of interdisciplinarity: perspectives from graduate students and program administrators. *Innovative Higher Education*, v. 41, n. 5, p. 411-423, 2016. DOI: 10.1007/s10755-016-9362-y.

SILVA, A. S.; AVELAR, A. B. A.; FARINA, M. C. Pesquisa exploratória sobre a transferência de responsabilidade pelo paciente. *Revista da FAE*, v. 18, n. 1, p. 70-85, 2015. DOI: 10.5585/rgss.v2i2.79.