

A T-shaped model for rethinking higher education programs

Marialuisa Saviano

Department of Pharmacy, University of Salerno
Salerno, Italy
email: msaviano@unisa.it

Francesco Polese

Department of Management & Innovation Systems
University of Salerno - Salerno, Italy
email: fpolese@unisa.it

Francesco Caputo (corresponding author)

Department of Computer Systems and Communications, Faculty of Informatics, Masaryk
University – Brno, Czech Republic
email: fcaputo@mail.muni.cz

Leonard Walletzký

Department of Computer Systems and Communications, Faculty of Informatics, Masaryk
University – Brno, Czech Republic
email: qwalletz@fi.muni.cz

Abstract

The vibrant scenario emerging, given recent social and economic trends, is launching new challenges to organizations, highlighting the need to increase their competitiveness by improving human resources capabilities and competences.

Increasing complexity requires that managers and policy makers be endowed with new competences and capabilities to more effectively manage variety. In particular, the need to combine traditional hyper-specialized knowledge with more dynamic and cross-sectional capabilities is growing and requires new management approaches.

In an attempt to address this need, a promising research stream is attracting interest among scholars from various disciplinary domains, affirming the “T-shaped professional” as a possible reference model in which vertical expertise is combined with horizontal and cross-sectional knowledge. Building on the advancements of this research stream, the paper aims to investigate the opportunities and key factors of rethinking traditional education models and programs by exploring the contribution of service research in the field of education through the interpretative lens of systems thinking. Basic arguments for the proposal developed in the paper find support from evidence emerging from the analysis of the Master Degree program in Service Science, Management and Engineering (SSME) of the Masaryk University in Brno (Czech Republic), considered an example of application of the T-shaped model.

Keywords

T-Shaped Professional; Education models; Multi- and trans-disciplinary pathways; Service research; Systems thinking.

1. Introduction

Nowadays, the increasing complexity of social and economic dynamics is pushing both researchers and decision makers to search for new models, approaches, and instruments to better understand and face new challenges (Holling, 2001). The old approaches and perspectives are proving useless in supporting organizations in defining efficient, effective, and suitable managerial pathways and strategies (Boyatzis, 2006).

Building on these reflections, various authors have tried to identify requirements to enrich the set of knowledge, competences, and capabilities of organizations with new more performant instruments (Allee, 1997; Yang, 2010). Several authors have focalised attention on the relationship between providers and users (Ravald & Grönroos, 1996), others have pointed to the role of organizational models in ensuring a more efficient and effective use of available resources (Pfeffer & Salancik, 2003), and to the contribution that Information and Communication Technologies can offer in terms of better acquisition, documentation, and application of the knowledge required to manage social and economic dynamics (Malecki, 1997).

Despite the advancements in knowledge offered by all these contributions, they appear to pivot mainly on the individual dimensions of company pathways and behaviours (relationships with the market, use of resources, knowledge management etc.). In addition, a holistic approach to support organizational behaviours in facing the emerging social and economic dynamics is still missing (Burnes, 2004).

Growing social and economic complexity can be interpreted as the consequence of the increasing interconnection between different dimensions, perspectives, and aims (Savory & Butterfield, 1998). This reveals the inadequacy of traditional hyper-specialized knowledge in supporting the effective understanding of dynamics as a whole (McMillan, 2008) and underlines the need to improve the capability of organizations' and people to link different social and economic dimensions in a common interpretative path (Del Giudice et al., 2016). Accordingly, a wider perspective inclusive of different hyper-specialized contributions and approaches is required to understand the multiple dimensions engaged in the construct of complexity (Barile et al., 2015c).

In order to bridge this gap, the paper aims to enrich previous contributions in the management of emerging social and economic challenges focusing attention on the role of human resources in understanding and managing the multi-faceted nature of complexity (Jackson & Schuler, 1995). More specifically, the work aims to investigate the following research questions: *1] How can Human resources support organizations in understanding and managing social and economic complexity? 2] What competencies, capabilities, and knowledge human resources are required to face the emerging social and economic challenges? 3] Is it possible to define a common shared approach to train human resources in managing growing variety?*

The structure of the paper is as follows: after this introduction, in section 2, a description of the theoretical and conceptual background underpinning our reflections is set out briefly. In section 3, a conceptual model to support the emergence of multi- and trans- disciplinary education programs is proposed. In section 4, potential contribution of a change in perspective in higher education programs is discussed with reference to the case of the Master Degree program in Service Science, Management and Engineering (SSME) of the Masaryk University in Brno (Czech Republic). Finally, in section 5 some concluding remarks and future lines of research are outlined.

2. Theoretical and conceptual background

2.1. *The need for a multi- and trans-disciplinary approach in education*

During the last twenty years the increasing pressures imposed by social and economic changes such as globalization, the evolution in consumer lifestyle, and the increasing peer to peer information sharing have profoundly affected companies' strategies and behaviours (DeLanda, 2006). Many companies have perceived such emerging dynamics as a risk for their market shares and have tried to defend their position focusing attention on very specific activities and processes (Doyle & Saunders, 1985).

In such a vein, specialized human resources endowed with specific knowledge in delimited domains (Miles & Snow, 1984) were required. Following market demand, public and private 'educators' have started to build more specialized learning pathways addressed to improving people's capabilities to analyse, understand, and manage all the specific dimensions of particular processes and activities (Ulrich, 1997). According to Baird and Meshoulam (1988), the tangible evidence of this trend has been the emergence of the hyper-specialized, knowledge-based society in which we all live.

The opportunities and advantages offered by specialized learning pathways and human resources have been analysed from various research communities and in accordance with multiple viewpoints (Lepak & Snell, 1999). According to Torraco and Swanson (1995), specialized knowledge offers to human resources the opportunities to solve companies' problems faster. In the same direction, Porter (1990) outlines that the in-depth knowledge of the dimensions of social and economic phenomena is the most efficient way to support organizational strategies and plans. Alchian and Demsetz (1972) furthermore, show that there is a strong correlation between the hyper-specialized knowledge of human resources and companies' economic performance. Finally, Kakabadse et al. (2003) underline via a systematic literature review the growing attention of researchers and decision makers in identifying suitable pathways to improve the specialized knowledge of human resources.

Despite the evidence and advancements in knowledge offered by these contributions, emerging dynamics are showing the incapacity of traditional hyper-specialized models to offer suitable solutions in facing many social and economic challenges (Kline, 1995) that are still in search for solutions. According to Shiva (1987), the models and approaches based on such knowledge are not able to support organizational processes and strategies in facing the emerging challenges for two main reasons: 1] the overlapping of dimensions, pathways, and resources hinders the identification of individual variables to which to apply specialized knowledge, and 2] the rapidity in change of social and economic dynamics renders futile and untenable the approaches based on studies of individual dimensions and their connection.

Reflecting on these considerations, some researchers have started to underline the need to recover a more holistic view of social and economic phenomena to understand them (Gummesson, 1991; Giddings et al., 2002). Building on the interpretative contribution offered by eminent thinkers such as Kuhn (1962), Lane (1968), von Bertalanffy (1971), Lovelock (1972), Bohm (1980), and Capra (1996), other researchers have started to highlight the need for wider interpretative approaches (Tichy & Devanna, 1986).

Over the last few years, an increasing number of contributions, ideas, and perspective have attempted to shift the attention from a reductionist to a holistic view (Mele et al., 2010; Golinelli et al., 2012; Saviano & Caputo, 2013). Furthermore, various research streams have underlined the need to frame multi- and trans-disciplinary approaches to face the emerging challenges (Wagner et al., 2011), and some organizations have changed their approaches and structures to build wider cross-cultural pathways (Van Der Vegt & Bunderson, 2005).

In this emerging pathway addressed to supporting 'holistic organizations', human resources are key drivers on which 'act' to build new perspectives for the management of

future organizations (Gupta & Singhal, 1993). More specifically, the ways in which human resources are educated and trained represent a potentially suitable pathway to improve the efficiency, effectiveness, and sustainability of future generations of companies (Schuler, 1992).

2.2. Directions from system thinking in defining a multi- and trans-disciplinary education approach

The topics of human knowledge and learning processes are some of the most debated from different viewpoints in managerial, psychological and sociological studies (Stacey, 2001). Among the contributions offered in such domains, an interesting advancement in knowledge was made by Bloom et al. (1956), with reference to the possible classification of cognitive levels in learning processes.

According to the Authors, every learning process can be divided in the following levels classified from the more simple to the more complex: 1) Knowledge, 2) Comprehension, 3) Application, 3) Analysis, 4) Synthesis and 4) Evaluation (see Table 1).

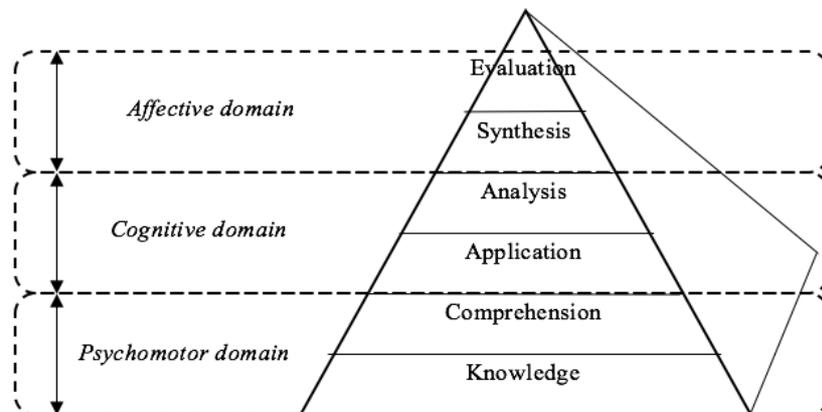
Table 1. The levels of Bloom’s taxonomy

Bloom’s taxonomy	Description
Knowledge	Refers to the acquisition of information related to experiences lived and/or actions carried out.
Comprehension	Refers to the ability to understand the meaning of information acquired from the context.
Application	Is related to the ability to use acquired information in different contexts or situations.
Analysis	Concerns the ability to split up the available information into their essential parts.
Synthesis	Refers to the capabilities to combine available information in new conceptual framework and mental models.
Evaluation	Is related to the capabilities to evaluate the usefulness of specific information and knowledge in solving different problems or in understanding different scenarios.

Source: Adapted from Bloom et al. (1956)

Bloom et al., moreover, identified three domains involved in each learning process: 1) Psychomotor, 2) Cognitive, and 3) Affective. By combining these contributions, it is possible to define a conceptual framework useful to investigate each kind of learning process albeit adopting a holistic perspective (see Figure 1).

Figure 1. A representation of learning processes in the light of Bloom’ levels and domains



Source: Adapted from Bloom et al. (1956)

Reflecting upon the proposal of Bloom et al. (1956), it is possible to note that the education approaches based on the development of hyper-specialized knowledge primarily impact on the Psychomotor domain, while they offer few contributions with reference to the management and implementation of the other two domains in higher complexity contexts. In this respect, Banathy (1991) outlines that there are five main reasons that confirm the inadequacy of hyper-specialized education models in supporting the management of complexity: 1) the incremental approach, 2) the poor integration of solutions and ideas, 3) the prevalence of a discipline based approach, 4) the reductionist view, and 5) the inability to see beyond the existing system.

In order to bridge these gaps, a potential path to define how education programs should evolve to support the improvement of human resources' cognitive and affective domains is offered by the systems thinking approach (Beer, 1985; Espejo, 1994; Checkland, 1999; Golinelli, 2010; Barile & Saviano, 2011; Barile et al., 2012). As highlighted by Senge et al. (1994), the systems thinking approach has overcome the boundaries of the reductionist view enabling a different way of perceiving and interpreting the world. In the same direction, Kim (1995) underlines that systems thinking highlights the relevance of the connection between the parts in understanding the whole. Recognizing the potential contributions that the system thinking could offer in the domain of educational programs, a useful interpretative support is that of the Viable Systems Approach (vSA). More specifically, according to vSA directions, every system (organization, company, people, etc.) can be analysed as an Information Variety (Barile, 2009), which is a combination of information units, interpretation schemes, and categorical values (Barile & Saviano, 2010) (See Table 2).

Table 2. The vSA levels

vSA levels	Description
Information Units	“The information units represent the ‘structural’ composition of knowledge that is the amount of data owned by the viable system including all that it can perceive or can further determine by processing and transforming into information significant to the knowledge process”.
Interpretation Schemes	The interpretative schemes represent the knowledge patterns and refer to how information is organized within the viable system’s whole variety. Without such logical interpretation schemes, every piece of information would appear to the systems as new every time we perceive it and, consequently, the system would need to create a new interpretative model to explain and understand it every time”.
Categorical Values	“The categorical values represent the most relevant dimension of the information variety and qualify the viable system’s values and strong beliefs, defining the system’s identity. The categorical values are responsible for accepting/refusing rational elaborations and for determining the functioning of the interpretative schemes. They act by subjectively filtering incoming information in the interaction process”

Source: Barile & Saviano (2013): 46-47

This representation appears aligned with the domains of learning processes (Psychomotor, Cognitive, and Affective) identified by Bloom et al. (1956), it also outlines potential directions for building holist educational programs, and for supporting the identification of a potential knowledge taxonomy (see Table 3).

Notwithstanding the possible advancement pathways in knowledge suggested by our considerations, other questions are still open with reference to how a more holistic education approach could support people in facing the challenges imposed by emerging complexity. In this respect, it should be underlined that individual knowledge, competences, and capabilities are not enough to manage the various dimensions involved in social and economic dynamics (Barile & Polese, 2010; Barile et al., 2012). Following this line, we should investigate how it

is possible to combine different knowledge, competencies, and capabilities to face social and economic challenges (Barile et al. 2013; Saviano et al., 2016). In this respect, recent advancements of service research seem to offer a potential contribution. Accordingly, the following subsection investigates the potential contribution of service research to the emergence of a multi- and trans-disciplinary education approach.

Table 3. Directions from vSA to manage Bloom's domains

Bloom's domains	vSA levels	Directions from vSA	vSA's knowledge taxonomy
Psychomotor	Information Units	The improvement of the psychomotor domain requires the acquisition of knowledge and information about the phenomenon and the actions to manage. It requires support of information sharing and knowledge acquisition.	<i>Intellectual knowledge</i> Refers to the information set on which decisions and strategies are based (Machlup & Leeson, 1979).
Cognitive	Interpretation Schemes	The improvement of the cognitive domain requires the building of mental model and conceptual frameworks able to support the links between various available knowledge. It acts on the organization of information through knowledge documentation and the building of mental maps.	<i>Epistemological knowledge</i> Acts in the case in which it is necessary to combine different information in order to build new pathways to face unknown problems (Perkins, 1993).
Affective	Categorical Values	The affective domain involves in-depth social and psychological dimensions. It identifies strong beliefs on which act to build individual identity and to identify aligned profiles whereby to interact.	<i>Sensorial knowledge</i> Influences the ways in which individuals make sense of the external world as a consequence of their perceptions (Parr, 2010).

Source: Authors' elaboration

2.3. The contribution of service research to the emergence of a multi- and trans-disciplinary education approach

The education domain is one of the most discussed service field both in managerial and marketing studies (Metcalf, 2005). Over the last few years, a growing number of researchers have analysed it from different viewpoints as a consequence of the increasing relevance of the service perspective (Schneider & Bowen, 1993; Hill, 1995; Sallis, 2014).

As pointed out by Ng and Forbes (2009) the education field is an atypical service domain given that the perceived value of education is hard to define and there is no direct link between the cost of the service and its benefits.

Despite this, the research streams based on service logic can offer interesting contributions in the definition of education programs able to better capture and face the challenges imposed by emerging social and economic complexity (Foropon et al., 2013). In this direction, Lusch and Vargo (2014) outline that society can be analysed in terms of entities interconnected to share knowledge, competences, and capabilities to build more efficiency, effectiveness, and sustainable solutions to market needs. Accordingly, one of the most relevant challenge in the building of efficient, effective, and sustainable solutions is the definition of pathways able to support the sharing of knowledge, competences, and capabilities (Akaka et al., 2012; Di Nauta et al., 2015; Caputo et al., 2016; Lusch et al., 2016).

To achieve this aim, as underlined by Lawson (2004), a shared language able to support the relationships between human resources endowed with different knowledge, competences,

and capabilities requires defining. Moreover, the building of a shared language also requires the identification of shared norms (Lawson & Briar-Lawson, 1997; Calabrese et al., 2013; Saviano et al., 2014) and conceptual frameworks (Lawrence, 2015; Evangelista et al., 2016).

Considering the above, the traditional hyper-specialized education programs show all their uselessness as they pivot on the building of sectorial knowledge and languages (Hefley & Murphy, 2008). At the same time, the few studies on the implementation of multi- and trans-disciplinary education programs show their relevant benefits in terms of learners' capabilities to better understand problems related to different topics (Wicklein & Schell, 1995), to communicate more easily and to share information with colleagues to find better solutions (Glushko, 2008), and more rapid problem solving techniques able to cover the multiple dimensions of a specific problem (Coyle et al., 2006). In addition to the relevant advantages, these studies also show some obstacles in building multi- and trans-disciplinary education programs related to: 1] the definition of shared learning processes (Brown, 1991), 2] the professional identity of students with knowledge based on different topics (Eylon & Linn, 1988), and 3] the opportunities to apply multi- and trans-disciplinary knowledge in a society strictly related to the reductionist view (Ng et al., 2011).

In the light of such considerations and adopting the interpretative lens offered by service logic, a relevant issue requires to be investigated given the emerging need for multi- and trans-disciplinary approaches: *value co-creation*. According to Vargo et al. (2008), value co-creation emerges as a consequence of the interaction between the different entities that share reciprocal knowledge, competences, and capabilities and define common solutions to their reciprocal satisfaction. The application of this proposition to the domain of multi- and trans-disciplinary education programs requires to investigate a relevant question: *how is it possible to support interactions between people endowed with different specialized knowledge, languages and perspectives?*

To offer a potential answer to this question, which can also contribute to understanding how a person can effectively integrate knowledge deriving from different domains, the next section investigates the conceptual framework of the 'T-shaped' model in the light of systems thinking and service logic as a potential contribution to rethinking education programs.

3. A potential model for rethinking education programs

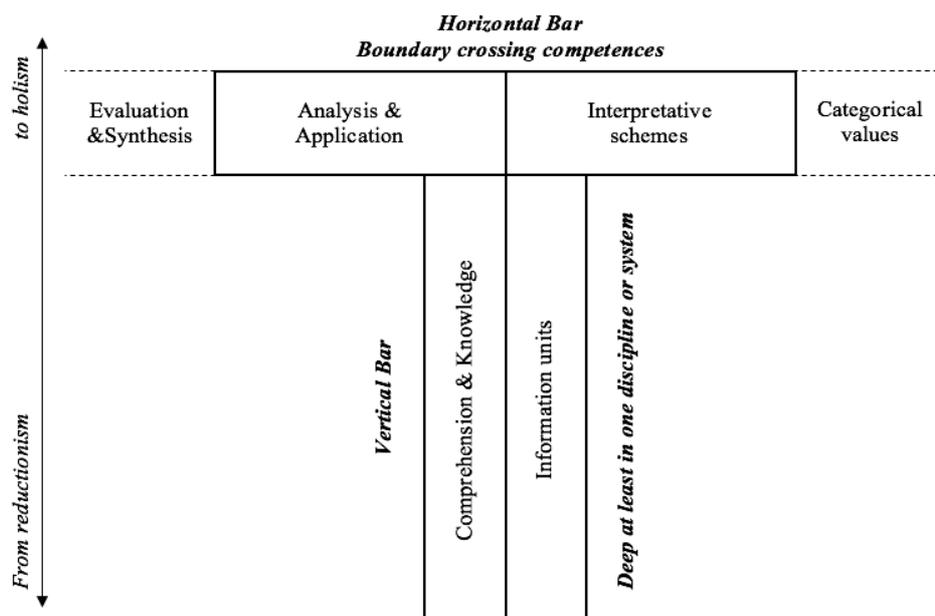
Among the various theoretical and empirical contributions offered in order to build education programs better able to face the challenges imposed by emerging complex dynamics, the promising research stream on the "T-shaped" model is attracting interest among scholars from several disciplinary domains (Hansen & Von Oetinger, 2001; Enders and de Weert, 2009; Spohrer et al., 2010).

The concept of "T-shaped people" was introduced by David Guest (1991) to describe a professional profile "equally comfortable with information systems, modern management techniques and the 12-tone scale" (p. 12). Building on this first contribution, an increasing number of researches have started to investigate the opportunities related to "T-shaped people" or "T-shaped professionals" as human resources able to combine in-depth vertical knowledge in specific fields, disciplines or systems with the horizontal capabilities to shift among them (Spohrer & Maglio, 2010). Various contributions have investigated the differences between the "I-shaped" profiles built by actual education programs and the "T-shaped" profiles required to face emerging social and economic complexity (Donofrio et al. 2010). The advantages related to the opportunity for the emergence of "T-shaped" people have been analyzed from diverse viewpoints both for organizations (Coates, 2012) as well as for society (Rust et al., 2010). Some contributions have also been offered with reference to the

potential measure of “T-shaped” people and professionals working on their experiences and knowledge (Glushko, 2008). Finally, updates were proposed in terms of π -shaped knowledge generated by the interaction among different t-shaped profiles (Barile et al., 2012). However, despite all such advancements in knowledge, a shared approach to its implementation and application is still missing (Fisk & Grove, 2010).

In order to bridge this gap, the paper proposes to act on the education programs as a way to support the emergence and the building of T-shaped profiles. Adopting the interpretative lens offered by system thinking and service logic, it is possible to highlight that the emersion of T-shaped profiles requires a change in the kind of knowledge on which education programs should be based. In terms of the proposed Information variety model, what is missing is the capability of performing effective integration of variety when dealing with very different, variable and unpredictable problems. This approach implies the shifting of attention from the level of information to the levels of interpretation schemes and categorical values where knowledge is structured in deep cognitive models significantly impacting upon interaction in any co-creation context (Barile et al., 2015a; Saviano, 2015). In this respect, as outlined by Nooteboom (2006), interaction among dissimilar cognitive frameworks supports the contamination of different knowledge offering the opportunity for hybridization and for its application in different contexts of problem solving. In such a vein, as essentially also outlined by Elmquist and Johansson (2011), the real contribution offered by the T-shaped model is related to the shift in focus from the definition, sharing, and utilization of information useful to support a problem solving approach to the decoding of interpretation schemes and categorical values useful to support the emergence of a decision making perspective. More specifically, the ability of t-shaped profiles to apply specialized knowledge in different fields and disciplines is related to their endowment of interpretation schemes and categorical values (Barile et al., 2015b) that acting in terms of Cognitive and Affective domains resolves both conditions of problem solving (vertical bar) as well as dynamics of decision making (horizontal bar) building opportunities to shift from a reductionist to a holistic view (see Figure 2).

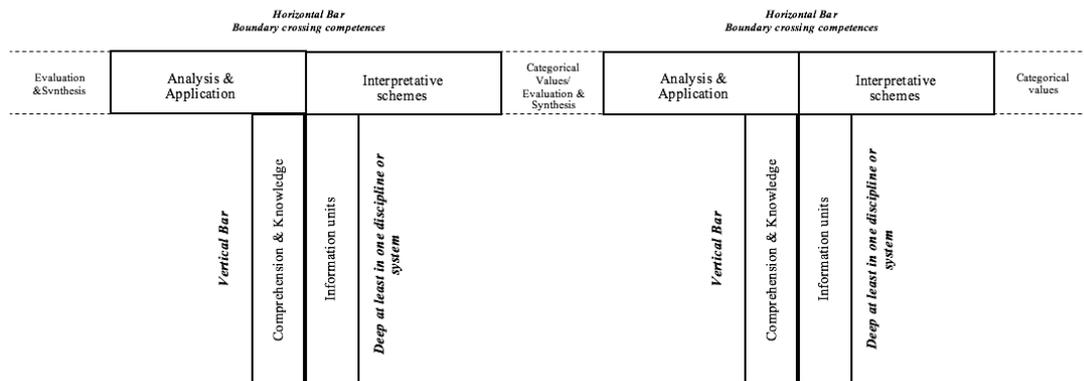
Figure 2. A conceptual representation of the T-shaped profile



Source: Elaboration on Barile, Saviano Simone, 2014

Essentially, the t-shaped profile represents a new challenge in the field of education programs because it combines specialized knowledge with horizontal competences opening to the possibility for a recursive multi- and trans- disciplinary approach to knowledge creation (Karjalainen & Salimäki, 2008). In this respect, each t-shaped profile becomes a piece of a complex puzzle that acquires a different structure with reference to the ways in which different profiles are dynamically composed (see Figure 3).

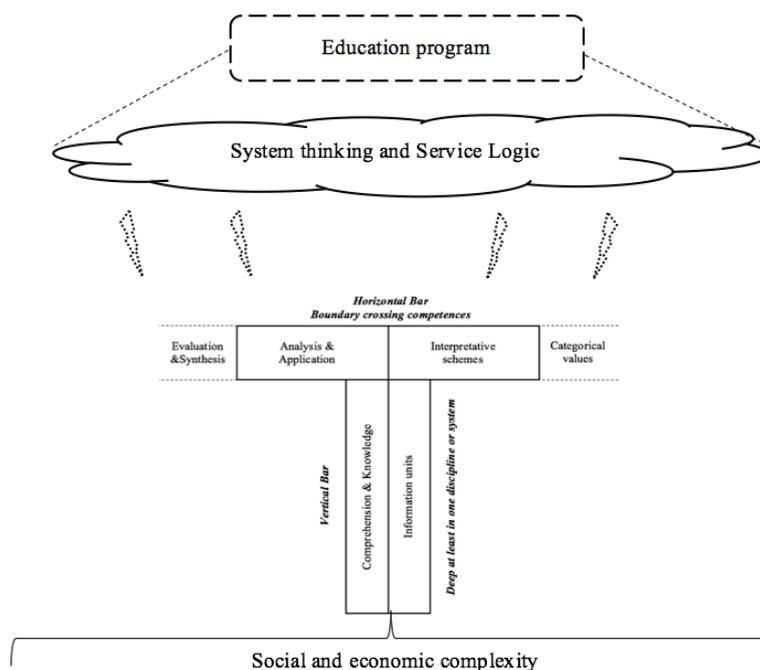
Figure 3. A conceptual representation of interactions between T-shaped profiles



Source: Elaboration from Barile and Saviano, 2013: 53.

In summary, acting on the build of t-shaped profiles, it is possible to overcome the limits of an apparent reductionist approach in many education programs (Spohrer et al., 2010). In accordance with this, the t-shaped model enables the opportunity for rethinking the approach in education programs because it represents a concrete application of principles, directions, and guidelines of systems thinking and service logic in the education domain. It also supports the disclosure of the competences and knowledge required by future professional profiles to understand and manage social and economic complexity (see Figure 4).

Figure 4. A T-shaped model for rethinking higher education programs



Source: Authors' elaboration.

With respect to the study on the contributions of T-shaped professional profiles, in the following section a brief discussion of the Master Degree program in SSME of the Masaryk University as an example of T-shaped based education program is presented to outline advantages and opportunities of a change in perspective in education approaches.

4. Insights from the Master Degree program in SSME of the Masaryk University in Brno

The SSME (Service Science, Management and Engineering) study program was delivered for the first time at the Faculty of Computer Science of Masaryk University in 2008. It was a two-year Master Study program, designed for the graduates of IT oriented study programs.

The demand for the new profile of the graduates from the Faculty of Computer Science came also from the employers of firms in the ICT industry. They were asking not only for developers and programmers, but also for experts, able to lead complex projects or drive portfolios of the project, able to communicate with customers from non-IT domains and understand the complexity of multi and transdisciplinary problems.

Many of the new courses were developed ex novo. The design of the courses was different – they were practically oriented, based on real business case studies and taught by external experts – to show the students a more practical application and implementation of theoretical frameworks. They also contributed to the attractiveness of the study program for the applicants as well as for the companies, cooperating on the internships.

As inspired by Spohrer (2006), the study program was designed on a multidisciplinary basis. The core of the first version of curricula was focused to project management, applied management and marketing with emphasis to communication skills. It was supported by the hypothesis that necessary or important IT knowledge students had already been learned during their previous graduate studies and they needed to focus on other disciplines, related with their multidisciplinary orientation.

The other difference from most other study programs in the Faculty of Computer Science, was the lengthy internship. It was set at 5 months where students worked 4 days for the company and the 5th day reserved for academic activities.

The Study program was started in 2008 and it became very popular among under graduates. The number of students grew from 12 in 2008 to 128 in 2010.

The T-shaped education program pivoted on the assumption of strong knowledge of information and communication technology, stemming from graduate studies. This hypothesis was unconfirmed for three reasons:

- IT itself is a dynamic domain and students need to study new technology and knowledge continuously.
- Students forgot many of their IT skills – they became layered over by others, taught during their SSME studies
- Because of the absence of Entry Tests it was possible for any graduate student to join the program with graduate students of psychology or sociology finishing the SSME study program without any IT technology or skills!

Interestingly, the issues were corrected on the premise that the whole SSME study program was envisaged as a service from the start.

As Wallezky (2014) showed, this situation was a dual service system, where the university produces students for the companies in the first service system, but also companies provide the internships positions for the university students – where the client is the university, because internship is a mandatory part of the study program.

Over time, thanks to the feedback reports of students and companies the following issues were identified:

- The profile of the students' knowledge did not fit the general profile of the graduate of the Faculty of Computer Science. Many of the students lacked a basic knowledge of programming, databases or IT security.
- On the other hand, students lacked practical economic knowledge. They did not understand basic financial or taxation problems, they knew nothing about public services and their differences.

A revision of the profile took place in 2012, summed up in the following points (Wallezky, 2013):

- The entrance test was introduced in 2012
- The structure of T-shape was changed to ensure the IT knowledge remains the core discipline. More IT courses became mandatory.
- The knowledge of top of the T was split into three pillars (Management and Marketing; Economics fundamentals; Soft and other skills).

Moreover, to every group of horizontal bar courses the new courses were added. They were designed especially in relation with knowledge, presented in the vertical bar.

After applying the changes, the structure was reported as satisfactory for all participating parties and has remained unchanged to date (2016).

5. Final remarks and future lines of research

The emerging variety in social and economic dynamics requires the identification of new managerial pathways able to combine different specialized knowledge to face the challenges of a vibrant, dynamic scenario.

Among the potential pathways devised to face emerging social and economic challenges, the paper focalises attention on the advantages offered by a change in perspective in higher education programs. The above considerations underline the implications and advantages related to the definition of education programs inspired by the T-shaped model in terms of competencies and capabilities of human resources to understand and manage emerging variety. More specifically, the paper underlines how, by combining specialized knowledge and trans-disciplinary competences, it is possible to train human resources to overcome the limitations of traditional interpretative frameworks based on the reductionist approach.

Building on this reflection, the paper represents a call to focalise the attention on the opportunities offered by the definition of multi- and trans- disciplinary approaches in the education field. In this direction lie potential future lines of research relative to the development of innovative approaches in education and management of human resources. Moreover, interesting implications derive with reference to the opportunities to better formalize the T-shaped model in education programs, defining instruments able to measure vertical competences and horizontal capabilities in students in order to ensure a better alignment between companies and human resources.

References

- Akaka, M.A., Vargo, S.L., Lusch, R.F. (2012). "An exploration of networks in value cocreation: A service-ecosystems view". *Review of Marketing Research*, 9(Special Issue), 13-50.

- Alchian, A.A., Demsetz, H. (1972). "Production, information costs, and economic organization". *The American economic review*, 62(5), 777-795.
- Allee, V. (1997). *The knowledge evolution: Expanding organizational intelligence*. London: Routledge.
- Baird, L., Meshoulam, I. (1988). "Managing two fits of strategic human resource management". *Academy of Management review*, 13(1), 116-128.
- Banathy, B.H. (1991). "Systems Design of Education: A Journey to Create the Future". Englewood Cliffs, N.J.: Educational Technology Publications.
- Barile, S. (2009, July). "The dynamic of informative varieties in the processes of decision making". In *The 3rd International Conference on Knowledge Generation, Communication and Management, Orlando, Florida*.
- Barile, S., Carrubbo, L., Iandolo, F., Caputo, F. (2013). "From 'EGO' to 'ECO' in B2B relationships". *Journal of Business Market Management*, 6(4), 228-253.
- Barile, S., Franco, G., Nota, G., Saviano, M. (2012). "Structure and dynamics of a "T-Shaped" knowledge: From individuals to cooperating communities of practice". *Service Science*, 4(2), 161-180.
- Barile, S., Pels, J., Polese, F., Saviano, M. (2012). "An introduction to the viable systems approach and its contribution to marketing". *Journal of Business Market Management*, 5(2), 54-78.
- Barile, S., Polese, F. (2010). "Smart service systems and viable service systems: applying systems theory to service science". *Service Science*, 2(1-2), 21-40.
- Barile, S., & Saviano, M. (2010). "A new perspective of systems complexity in service science". *Impresa, Ambiente, Management*, 4(3), 375-414.
- Barile, S., Saviano, M. (2011). "Foundations of systems thinking: the structure-system paradigm". In Various Authors, *Contributions to Theoretical and Practical Advances in Management. A Viable Systems Approach (vSA)*. Avellino: International Printing, (pp. 1-24).
- Barile, S., Saviano, M. (2013). "Dynamic Capabilities and T-Shaped Knowledge: A Viable Systems Approach". In Barile S. (Ed.), *Contributions to Theoretical and Practical Advances in Management. A Viable Systems Approach (vSA)*. Roma, Aracne (pp. 39-59).
- Barile, S., Saviano, M., Simone, C. (2015b). "Service economy, knowledge, and the need for T-shaped innovators". *World Wide Web*, 18(4), 1177-1197.
- Barile, S., Saviano, M., Polese, F., Caputo, F. (2015a). "T-Shaped People for addressing the Global Challenge of Sustainability". In Gummesson, E., Mele, C., Polese, F. (Eds.), *Service Dominant Logic, Network and Systems Theory and Service Science: Integrating three Perspectives for a New Service Agenda*. Napoli: Giannini (pp. 1-23).
- Barile, S., Saviano, M., Caputo, F. (2015c). "How Are Markets Changing? The Emergence of Consumers Market Systems. In 3rd International Symposium Advances in Business Management". In *Towards Systemic Approach*, University of Perugia, 21-23 January.
- Beer, S. (1985). *Diagnosing the system for organizations*. John Wiley & Sons Inc.
- Bloom, B.S. (Ed.), Engelhart, M.D., Furst, E.J., Hill, W.H., Krathwohl, D.R. (1956). *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain*. New York: David McKay Co Inc.
- Bohm, D. (1980). *Wholeness and the Implicate Order*. London: Routledge.
- Boyatzis, R.E. (2006). "An overview of intentional change from a complexity perspective". *Journal of Management Development*, 25(7), 607-623.
- Brown, S.W. (1991). *Service quality: Multidisciplinary and multinational perspectives*. London: Lexington Books.
- Burnes, B. (2004). *Managing change: A strategic approach to organisational dynamics*. New York: Pearson Education.

- Calabrese, M., Iandolo, F., Antonucci, E., Caputo, F. (2013). "Towards a value co-creation based Healthcare System". In Gummesson, E., Mele, C., Polese, F. (eds.), *Service Dominant logic, Network & Systems Theory and Service Science: integrating three perspectives for a new service agenda*. Napoli, Giannini (pp. 1-22).
- Capra, F. (1996). *The web of life: A new scientific understanding of living systems*. London: Anchor.
- Caputo, F., Del Giudice, M., Evangelista, F., Russo, G. (2016). "Corporate disclosure and intellectual capital. The light side of information asymmetry". *International Journal of Managerial and Financial Accounting*, 8(1) pp. 75-96.
- Checkland, P. (1999). *Systems Thinking. Rethinking management information systems: An interdisciplinary perspective*. Oxford: Oxford University Press.
- Coates, D. (2012). A Network of Networks: The Case of the UK Technology Strategy Board. In MacGregor, S.P., Carleton, T. (eds.), *Sustaining Innovation*. New York: Springer (pp. 125-140).
- Coyle, E.J., Jamieson, L.H., Oakes, W.C. (2006). "Integrating engineering education and community service: Themes for the future of engineering education". *Journal of engineering education*, 95(1), 7-19.
- DeLanda, M. (2006). *A new philosophy of society: Assemblage theory and social complexity*. New York: A&C Black.
- Del Giudice, M., Caputo F., Evangelista, F. (2016). "How decision systems changing? The contribution of Social Media to the management decisional liquefaction". *Journal of Decision Systems*, in press.
- Di Nauta, P., Merola, B., Caputo, F., Evangelista, F. (2015). "Reflections on the Role of University to Face the Challenges of Knowledge Society for the Local Economic Development", *Journal of Knowledge Economy*, 1-19.
- Donofrio, N., Sanchez, C., Spohrer, J. (2010). "Collaborative innovation and service systems". In Grasso, D., Brown Burkins, M. (eds.), *Holistic Engineering Education*. New York: Springer (pp. 243-269).
- Doyle, P., Saunders, J. (1985). "Market segmentation and positioning in specialized industrial markets", *The Journal of Marketing*, 49(2), 24-32.
- Elmqvist, L., Johansson, G. (2011). "An approach to foster integrative skills during the engineering studies". In *7th International CDIO Conference*, 20-23 June, 2011, Copenhagen, Denmark.
- Enders, J., de Weert, E. (2009). "Towards a T-shaped profession: Academic work and career in the knowledge society". In Enders J., de Weert, E. (eds.), *The changing face of academic life*. London: Palgrave Macmillan (pp. 251-272).
- Espejo, R. (1994). "What is systemic thinking?". *System Dynamics Review*, 10(2-3), 199-212.
- Evangelista, F., Caputo, F., Russo, G., Buhnova, B. (2016). "Voluntary corporate disclosure in the Era of Social Media". In *4rd International Symposium Advances in Business Management. "Towards Systemic Approach"*, Mikolas Romeris University, Vilnius, Lituania, 24-26 August.
- Eylon, B.S., Linn, M.C. (1988). "Learning and instruction: An examination of four research perspectives in science education". *Review of educational research*, 58(3), 251-301.
- Fisk, R.P., Grove, S.J. (2010). The Evolution and Future of Service. In Maglio, P.P., Kieliszewski, C.A., Spohrer, J.C. (eds.), *Handbook of service science*. New York: Springer (pp. 643-663).
- Foropon, C., Seiple, R., Kerbache, L. (2013). U'sing servqual to examine service quality in the classroom: analyses of undergraduate and executive education operations management courses". *International Journal of Business and Management*, 8(20), 105-121.

- Giddings, B., Hopwood, B., O'Brien, G. (2002). "Environment, economy and society: fitting them together into sustainable development". *Sustainable development*, 10(4), 187-196.
- Glushko, R.J. (2008). "Designing a service science discipline with discipline". *IBM systems journal*, 47(1), 15-27.
- Golinelli, G.M. (2010). *Viable systems approach (VSA): Governing business dynamics*. Padova: Cedam.
- Golinelli, G.M., Barile, S., Saviano, M., Polese, F. (2012). "Perspective Shifts in Marketing: Toward a Paradigm Change?". *Service Science*, 4(2), 121-134.
- Guest, D. (1991). "The hunt is on for the Renaissance Man of computing". *The Independent* (London), September 17.
- Gummesson, E. (1991). "Service quality: a holistic view". In Brown, S.W. (Ed.), *Service quality: Multidisciplinary and multinational perspectives*. London: Lexington Books (pp. 3-22).
- Gupta, A.K., Singhal, A. (1993). "Managing human resources for innovation and creativity". *Research Technology Management*, 36(3), 41-60.
- Hansen, M.T., Von Oetinger, B. (2001). "Introducing T-shaped managers. Knowledge management's next generation". *Harvard business review*, 79(3), 106-16.
- Hefley, B., Murphy, W. (Eds.). (2008). *Service science, management and engineering: education for the 21st century*. New York: Springer Science & Business Media.
- Hill, F.M. (1995). "Managing service quality in higher education: the role of the student as primary consumer". *Quality assurance in education*, 3(3), 10-21.
- Holling, C.S. (2001). "Understanding the complexity of economic, ecological, and social systems". *Ecosystems*, 4(5), 390-405.
- Jackson, S.E., Schuler, R.S. (1995). "Understanding human resource management in the context of organizations and their environments". In Poole M. (Ed.), *Human Resource Management: Critical Perspectives on Business and Management*. London: Taylor & Francis (pp. 45-74).
- Kakabadse, N.K., Kakabadse, A., Kouzmin, A. (2003). "Reviewing the knowledge management literature: towards a taxonomy". *Journal of knowledge management*, 7(4), 75-91.
- Karjalainen, T.M., Salimäki, M. (2008, April). "Do offerings meet expectations? Educating T-shaped professionals in strategic design management". In *Proceedings from International DMI Education Conference Design Thinking: New Challenges for Designers, Managers and Organizations*.
- Kim, D.H. (1995). *Systems thinking tools*. Cambridge: Pegasus.
- Kline, S.J. (1995). *Conceptual foundations for multidisciplinary thinking*. Redwood City: Stanford University Press.
- Kuhn, T.S. (1962). *The Structure of Scientific Revolutions*, Chicago: University of Chicago Press.
- Lawrence, R.J. (2015). "Advances in transdisciplinarity: Epistemologies, methodologies and processes". *Futures*, 65, 1-9.
- Lawson, H.A. (2004). "The logic of collaboration in education and the human services". *Journal of interprofessional care*, 18(3), 225-237.
- Lawson, H., Briar-Lawaon, K. (1997). *Connecting the dots: Integrating school reform, school-linked services, parent involvement and community schools*. Oxford, OH: The Danforth Foundation & The Institute for Educational Renewal at Miami University
- Lepak, D.P., Snell, S. A. (1999). "The human resource architecture: Toward a theory of human capital allocation and development". *Academy of management review*, 24(1), 31-48.

- Lovelock, J.E. (1972). "Gaia as seen through the atmosphere". *Atmospheric Environment*, 6(8), 579-580.
- Lusch, R.F., Vargo, S.L. (2014). *The service-dominant logic of marketing: Dialog, debate, and directions*. London: Routledge.
- Lusch, R.F., Vargo, S.L., Gustafsson, A. (2016). "Fostering a trans-disciplinary perspectives of service ecosystems". *Journal of Business Research*, 69(8), 2957-2963.
- Machlup, F., & Leeson, K. (1979). *Information through the printed word: the dissemination of scholarly, scientific, and intellectual knowledge*. Praeger Publishers Inc., London.
- Malecki, E.J. (1997). "Technology and economic development: the dynamics of local, regional, and national change." *University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship*.
- McMillan, E. (2008). *Complexity, management and the dynamics of change: Challenges for practice*. London: Routledge.
- Mele, C., Pels, J., Polese, F. (2010). "A brief review of systems theories and their managerial applications". *Service Science*, 2(1-2), 126-135.
- Metcalf, A. (Ed.). (2005). *Knowledge Management and Higher Education: A Critical Analysis: A Critical Analysis*. New York: IGI Global.
- Miles, R.E., Snow, C.C. (1984). "Designing strategic human resources systems." *Organizational dynamics*, 13(1), 36-52.
- Ng, I.C., Forbes, J. (2009). "Education as service: The understanding of university experience through the service logic". *Journal of Marketing for Higher Education*, 19(1), 38-64.
- Ng, I., Maull, R., Smith, L. (2011). Embedding the new discipline of service science. In Demirkan, H., Spohrer, J.C., Krishna, V. (eds.), *The science of service systems*. New York: Springer (pp. 13-35).
- Nooteboom, B. (2006). "Cognitive distance in and between COP's and firms: where do exploitation and exploration take place, and how are they connected?". *CentER Disussion Paper Series*, (2007-04).
- Parr, J. (2010). *Sensing changes: technologies, environments, and the everyday, 1953-2003*. UBC Press, London.
- Perkins, D. N. (1993). "Person-plus: A distributed view of thinking and learning". In Salomon G. (Ed.), *Distributed cognitions: Psychological and educational considerations* (pp. 88-110). Cambridge University Press, Cambridge.
- Pfeffer, J., Salancik, G. R. (2003). *The external control of organizations: A resource dependence perspective*. Redwood City: Stanford University Press.
- Porter, M.E. (1990). "The competitive advantage of notions". *Harvard business review*, 68(2), 73-93.
- Ravald, A., Grönroos, C. (1996). "The value concept and relationship marketing". *European journal of marketing*, 30(2), 19-30.
- Rust, R.T., Moorman, C., Bhalla, G. (2010). "Rethinking marketing". *Harvard business review*, 88(1/2), 94-101.
- Sallis, E. (2014). *Total quality management in education*. London: Routledge.
- Saviano, M. (2015), "Multi-actor Co-creation Systems for Progressing Toward Sustainability: Criticalities and Challenges", in *5th International Conference on Sustainability Science (ICSSS), Tokyo*.
- Saviano, M., Caputo, F. (2013). "Managerial choices between Systems, Knowledge and Viability". In Barile, S. (Ed.), *Contributions to theoretical and practical advances in management. A Viable Systems Approach (vSA)*. Roma: Aracne (pp. 219-242).
- Saviano, M., Caputo, F., Formisano, V., Walletzký, L. (2016). "From theory to practice in systems studies: a focus on Smart Cities". In *4rd International Symposium Advances in*

- Business Management. "Towards Systemic Approach"*, Mikolas Romeris University, Vilnius, Lithuania, 24-26 August.
- Saviano, M., Parida, R., Caputo, F., Datta, S.K. (2014), "Health care as a worldwide concern. Insights on the Italian and Indian health care systems and PPPs from a VSA perspective". *EuroMed Journal of Business*, 9(2), 198-220.
- Savory, A., Butterfield, J. (1998). *Holistic management: a new framework for decision making*. Washington: Island Press.
- Schneider, B., Bowen, D. E. (1993). "The service organization: Human resources management is crucial". *Organizational Dynamics*, 21(4), 39-52.
- Schuler, R.S. (1992). "Strategic human resources management: Linking the people with the strategic needs of the business". *Organizational Dynamics*, 21(1), 18-32.
- Senge, P. M., Roberts, C., Ross, R. B., Smith, B. J., & Kleiner, A. (1994). *The fifth discipline fieldbook*. New York: Bantam Doubleday Dell.
- Shiva, V. (1987). "The violence of reductionist science". *Alternatives*, 12(2), 243-260.
- Spohrer, J.C. (2006). "Services Sciences, Management, and Engineering (SSME): An Emerging Multidiscipline", in *Proceedings of the Frontiers in Service Conference*.
- Spohrer, J.C., Maglio, P.P. (2010). Toward a science of service systems. In Maglio, P.P., Kieliszewski, C.A., Spohrer, J.C. (eds.), *Handbook of service science*. New York: Springer (pp. 157-194).
- Spohrer, J., Anderson, L., Pass, N., Ager, T. (2008). Service science and SD logic. In *Proceedings of the Otago Forum*. Univeristy of Otago, pp. 214–237.
- Spohrer, J., Golinelli, G.M., Piciocchi, P., Bassano, C. (2010). "An integrated SS-VSA analysis of changing job roles". *Service Science*, 2(1-2), 1-20.
- Stacey, R.D. (2001). *Complex responsive processes in organizations: Learning and knowledge creation*. London: Psychology Press.
- Tichy, N.M., Devanna, M.A. (1986). *The transformational leader*. New York: Wiley.
- Torraco, R.J., Swanson, R.A. (1995). "The strategic roles of human resource development". *People and Strategy*, 18(4), 10-16.
- Ulrich, D. (1997). "Measuring human resources: an overview of practice and a prescription for results". *Human Resource Management*, 36(3), 303-320.
- Van Der Vegt, G.S., Bunderson, J.S. (2005). "Learning and performance in multidisciplinary teams: The importance of collective team identification". *Academy of Management Journal*, 48(3), 532-547.
- Vargo, S.L., Maglio, P.P., Akaka, M. A. (2008). "On value and value co-creation: A service systems and service logic perspective". *European management journal*, 26(3), 145-152.
- von Bertalanffy, L. (1971). *General System Theory. Foundations Development Applications*. New York: Braziller.
- Wallezký, L. (2013). "Is it possible to teach Service Science?" In Gummesson, E., Mele, C., Polese, F. (Eds.). *Service Dominant Logic, Network and Systems Theory and Service Science: Integrating three Perspectives for a New Service Agenda*. Napoli: Giannini.
- Wallezký, L. (2014). "Education as service system", in *INTED2014 Proceedings*. IATED.
- Wagner, C.S., Roessner, J.D., Bobb, K., Klein, J. T., Boyack, K. W., Keyton, J., Börner, K. (2011). "Approaches to understanding and measuring interdisciplinary scientific research (IDR): A review of the literature". *Journal of Informetrics*, 5(1), 14-26.
- Wicklein, R.C., Schell, J.W. (1995). Case studies of multidisciplinary approaches to integrating mathematics, science, & technology education. *Journal of Technological Education*, 6(2), doi:10.21061/jte.v6i2.a.5.
- Yang, J. (2010). "The knowledge management strategy and its effect on firm performance: A contingency analysis". *International Journal of Production Economics*, 125(2), 215-223.