Interdisciplinary Fields as Ecological Communities

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Abstract

This work is a discussion, informed by observational field and literature discussions, regarding possible existing conditions that are continuously at play within and between the processes and development of interdisciplinary fields. Specifically, this paper focuses on the virtual intellectual field and the physical field of communities in process. Particular focus has been given to the movement and oscillation of the relationships and interplay, with resources in practice, between fields and states in transition, that respectively, create ongoing processes that may be identifiable as interactive sets of evolving actions. These processes may in turn provide clues/insights into the nexus interdisciplinary breakaways that then go on to formulate new evolving sets of recognizable, ecological community structures. These newly formed sets of community adaptations formulate and develop stability through acquisition of relevant resources, and become new fields of inquiry and disciplines in their own right. The pathways for such investigation are difficult to discover, since much of the interaction is hidden or indecipherable. It is however, still possible to apply rigor to the discussion and argue that the development of ecological communities as understood in existing biological structural discussions (Ing 2016; Nousala 2014; Marlowe et al., 2011; Hall et al., Nousala et al., 2005; Holland 1973) can inform investigations into the developmental processes of interdisciplinary fields.

Keywords: *interdisciplinary fields, ecological communities, biological structures, social dynamic phenomena, hybrid methodological approaches*

1. Introduction

Insights on the birth and flourishing of interdisciplinary fields can be obtained by considering them as persistent ecological communities in the intellectual environment. Interdisciplinary interactions can give rise to a lasting community, depending on the contributing disciplines and their interplay,

including initial sets of conditions that are more-or-less stable. If evolving sets of problems are addressed, then likewise, an initial and stable evolving set of tools and approaches, can deliver significant insights and results. These conditions and approaches can be viewed, respectively, as a set of interacting species, a set of resources, a set of adaptations, and a measure of the evolutionary/ecological fitness of the community (Curtin and Allen 2019).

The development of computer and information science can be considered as a (simplified) example, followed by consideration of the development of other interdisciplinary fields into distinct areas of study or continued communities, and of areas in which that interaction has been either temporarily or permanently less successful.

2. The example of computer science

As an example, consider computer science/informatics. Simplifying, the field began through interaction among mathematicians investigating its logical foundations, applied mathematicians implementing numerical algorithms for applications, electronic engineers and applied scientists building process control, monitoring, and other systems, and business professionals needing to manipulate large amounts of data, together with information specialists such librarians.

Although computer science and information science departments may have been hosted within any of those areas, it was generally viewed as a branch of applied mathematics. However, as the problems, techniques, and results began to differ, it underwent what might be thought of as allopatric speciation—moving away into its own territory, where it specialized and changed, until it was recognizably distinct. Nevertheless, these break away directions of activity continued to interact with its parent disciplines and with others, forming with interested individuals and sub-fields an ecological community within the intellectual landscape.

At some point (continuing the simplified account), the messages that had continually been percolating back into the mathematical community—and, in fact, to the engineering, scientific, and decision science communities as well—became so intriguing that the barriers were relaxed, and the results, techniques, and even more importantly, questions and perspectives were brought back into mathematics and these other disciplines.

This process has in turn resulted in the creation of still more interdisciplinary fields and communities, and of specializations or new focus in existing areas: mathematical investigations that place greater emphasis on the representability of a problem and the complexity of its solution, data science and data analytics, agile management, and other uses of lean and agile methods beyond software development, a rebirth and transformation of artificial intelligence, and more. Beyond these, there is cognitive science, an interdisciplinary field that certainly had its beginnings in the 19th century, or even earlier, but whose development has been strongly influenced by computer science and artificial intelligence.

2.1 Additional examples and views

There are many examples and other tacit combinations of phenomenon that have informed and influenced (which would in itself be an interesting exercise to continue to follow) evolutionary processes along the way, perhaps creating its own sets of protocols that helped to move the thinking beyond the point of no return and breakaway (Hutchins 1984; Holland 2006; Folke 2006).

Traditionally, approaches towards many of the overlapping disciplines of investigations have been "top down". Approaches utilizing aspects of systemic design, social complex adaptive systems, and biological systems with holistic (more bottom up) views, have been less successful in gaining inclusion in wider empirical methodologies (Hall and Nousala 2010; Nousala 2010). These views regarding non-empirical approaches may have existed or persist, not solely as a question of effectiveness, but perhaps more related to the lack of acceptance or understanding regarding applications, rigor, and processes involved (Nousala and Hall 2010). That said, these emergent, holistic, and cyclical approaches remain valuable for their longitudinal data, information, and knowledge processes (Aguirre et al., 1998; Tosey 2006).

A recent study, situated between the fields of land use, biology, ecology, social complex adaptive systems, and systemic design, focused on highlighting elemental preconditions around ideas for sustainable development (Wilson 1975; Garduno et al., 2015a; Dongjin et al., 2015a; Dongjin et al., 2015b; Nousala et al., 2020), in which a discussion and subsequent development of an ontological model followed. The work was informed by a field case study (an ancient pre-Hispanic community of Southern Mexico), focusing on the preconditions as markers for highlighting elements within a range of equilibrium.

This example discussed the value of evaluation and longitudinal processes to provide rigor to the mapping of intangible dynamics, fundamental ongoing

phenomena formulated in many stages/phases of the community, and its resilience so far, as a living, social complex adaptive system (Bateson 1973, 1979; Bredo 1989; Nousala and Hall 2008; Dynes 2005;). This phenomenon is in effect a social complex adaptive system adjusting to its surroundings and creating new conditions, by new iterations of adaptation (Holland 2006; Folke 2006). In a sense, these are extensions from preconditions that have inform new protocols, to achieve and maintain new environmental equilibrium, for action or in the context of this discussion, new states in which disciplinary thinking can continue to evolve.

3. Discussion

Globally, it comes as no surprise that current educational approaches towards learning are more often and more heavily about instructing and compliance, supporting the institutional accounting matrix, with compliance enforced without a doubt via economic, political, and other societal external pressures. Disturbing as the current educational world view is, these conditions may in turn have unwittingly seeded the allopatric speciation. As an example of the emergent behaviour of the interdisciplinary fields evolving as ecological communities, the case of modern mathematics and informatics, a separation if not complete, is well underway. From both sides of the fence, it can be understood that instruction, while valuable on fundamental levels, is not always enough, as our world's boundaries blur into mixtures of various levels of ubiquitous classifications between physical and virtual (big data, networks both social and digital, and more).

The set (as it does not seem that there are ever single or initial transition points) of conditions oscillating between the multidisciplinary phenomena and the evolution of informatics also deserves investigation. Would it be possible to expose sets of protocols that operate using these evolutionary relationships? The question of protocols also lends itself to other questions about the various states of evolutionary developments for other disciplines. It is perhaps not surprising then that modern mathematics and those in close connection to the subject would be well suited to the processes of allopatric speciation, given current global educational conditions—and the meta-scientific, meta-linguistic nature of modern mathematics itself (Krylov 2015, Wells 2020), which can encourage cross-fertilization. There may be other "candidates" which are well underway but are, so to speak, lying under the radar.

Whilst it is possible to focus, highlight, and even map to some extent, a longitudinal, bottom-up phenomenon through representations such as models,

it is not really possible to apply static empirical approaches to data and information. However, that said, it is possible to formulate the longitudinal comparative analysis of social complex adaptive biological and environmental systems, utilizing various stages of preconditions as effective starting points for discussion. Whilst this may seem convoluted, holistic views of intangible, social dynamic phenomena are trackable for the purposes of applying rigor to a set of approaches.

Approaches that ultimately include ranges, sets and series of approaches to social dynamic phenomena are in a sense empirically rigorous, since the parameters include longitudinal, multiple reiterations, leading to possible iteration of adaptations and vice versa. All of these adaptations occur simultaneously, so it is important to apply approaches that contain sets, series in a non-dualistic and non-linear sense, to include possibilities of multiple scales as well (Salthe 1993). (See Figures 1 and 2.) Hence the importance for the longitudinal, holistic approaches to allow for any constraining forces (constraints that are not necessarily positive or negative) creating emergent interactions through differing and changing pressures from and between social and environmental shifts (Nousala et al., 2020; Gunderson 2000).

It is necessary that future investigations into the Intangibles of social dynamic phenomena, continue to expand and include such elements as rhythm, frequency and moment of community activities, and the impact that these hidden connections have longitudinally (Flusser, 2002; Nousala et al., 2008; Ingold, 2007; Nousala & Hall, 2008; Nousala et al., 2014; Nousala, 2014) and on a continuous basis (Simon 1962; Simon 1982; Nousala et al., 2020).

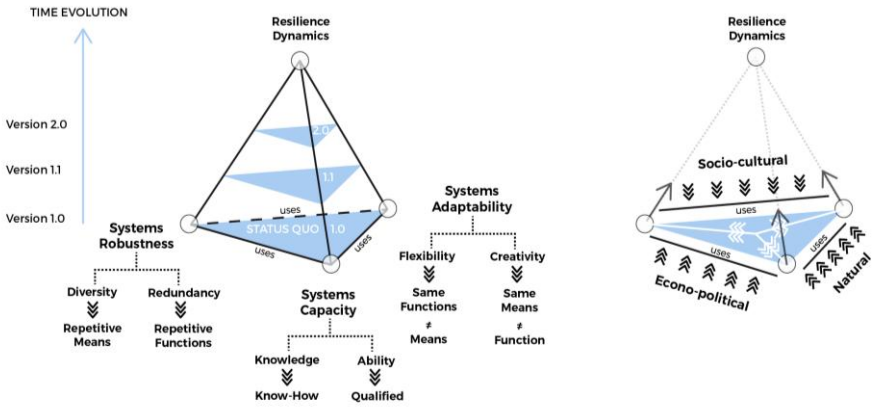

Figure 1. For purposes of this model, this research example focused primarily on changes in the constraining forces that drove complex-systemic adjustments regulating land-use. While researchers may be focused on a particular area or attribute of the complex adaptive system, it is also necessary to view the system in question holistically (Nousala et al., 2020).

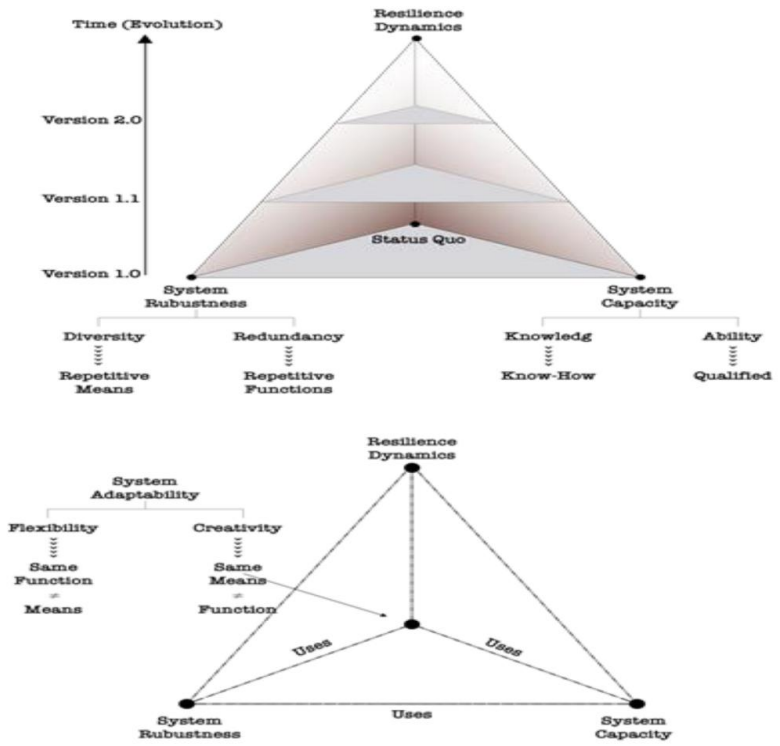

Figure 2. Current research extensions to new dynamic potential.
Sucic (2019) modified from Nousala (et al., 2020)

4. Lessons for the meta-field of interdisciplinary studies

Whilst it may seem unclear as to how to fully comprehend what state any evolutionary phenomenon is in at any given time, it is interesting to think on the some of the active elements that could be considered points of commonality for future investigations, for example:

- The progression of larger complex projects from the longitudinal view,
- Better understanding of knowledge level links and their impact for and on longitudinal networks,
- The re-surfacing and importance of longitudinal (in particular, viewed in a holistic and systemic manner) timelines and (of course for some disciplines this has not and did not diminish) perspectives,
- The impact and reinforcement of true multidisciplinary directions that rely on new emergent approaches of hybrid qualitative and quantitative methodological concepts and practices.

- The eventual effect of these new disciplines on their parent disciplines, and
- The possibility of "speciation" in stages or even cycles.

Finally, when does an interdisciplinary perspective persist after the formation of the new discipline, and, when it does, to what extent does it propagate to or inspire new interdisciplinary formation, or continued and substantial interaction with its parent field(s)?

These suggestions are to be considered statements that highlight nexus points for approaching interdisciplinary development. These points can be taken into consideration regarding relationships that formulate and underpin the intangible, ecological landscape and the multiple, interwoven communities that exist, or are emerging.

5. Conclusions

The model of ecological communities, enhanced by the concept of speciation, as social, dynamic phenomena, provides a useful way to describe interdisciplinary fields and their development, with the understanding that a new intellectual species may have more than one progenitor.. A key aspect will be the continuation of the exploration of relationships between parent disciplines and emergent offspring. It is an area that will require further longitudinal investigation, but would be well worth the effort if future investigations chose to present their findings to include the new emergent, hybrid approaches. It is clear that new approaches will continue to blend qualitative and quantitative methodologies in ever increasing fluid ways.
Comprehension of the key, intangible, transitional points from multiple perspectives will continue to assist with the task of grasping holistically, the value and benefits of longitudinal elements.

In summary, the viewing of the intellectual landscape as an addition to an evolutionary landscape, highlights the birth of an interdisciplinary field, and can be viewed from two perspectives: a speciation event from a siloed perspective, or, holistically, the formation of an ecological community. A number of interdisciplinary areas, in particular, computer science, biology, ecology, land use, social complex adaptive systems and systemic design, have been considered using this lens.
For future investigations, it would be interesting to consider some other current or recent examples in this light, particularly those arising from viewing existing disciplines (such as sociology) through an evolutionary and/or ecological lens, or those emerging from the combination of quantitative and statistical techniques, data science, and artificial intelligence to existing fields, where "digital humanities" (Berry Fagerjord 2017) may provide a set of fruitful examples.

6. Acknowledgments

The authors would like to acknowledge and thank the work by Jelena Sucic for her contribution of the modifications of figure 2 in relation to Figure 1 for use in this publication.

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