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PERSPECTIVE THE FUTURE OF GRADUATE EDUCATION AND RESEARCH: DEVELOPING DISCIPLINARY DEPTH OR THE THRUST OF INTERDISCIPLINARITY, TRANSDISCIPLINARITY, AND MULTIDISCIPLINARITY

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ABSTRACT
With the advent of globalization and the complexities of the problems faced by contemporary societies that are multifaceted, there have been calls from governments, organizations, and various stakeholders in education to adopt a cross-disciplinary approach to graduate education and research. However, the disciplinary structures in many Higher Education Institutions pose serious challenges to cross-disciplinary education and research either in interdisciplinarity, transdisciplinarity, or multidisciplinarity. Many instructors jealously guard their disciplinary trajectories and are biased toward other disciplines, even crippling funding opportunities meant for cross-disciplinary projects. This paper analyzes the strict compliance to the development of disciplinary depth or the pursuance of cross-disciplinary thrust promoted in the 21st Century. It presents best practices from institutions promoting the use of a cross-disciplinary approach to graduate education and research. The paper argues that cross-disciplinary training in graduate education is only possible when there are strong backgrounds in discipline-specific areas. While this is true, the paper contends that the future of graduate education and research is enshrined in the innovative fusion of disciplines in a cross-disciplinarity approach, whether interdisciplinary, multidisciplinary, or transdisciplinary- a strong merger that births significant innovations and solutions needed to make our world a better haven to live.

INTRODUCTION

Graduate education is asserted to have started operation in medieval universities in many European institutions beginning from the oldest, the University of Bologna in Italy where learning is said to have begun around 1088, organized into a university in the late 12th century. To systemize knowledge and the conduct of research, the concept of compartmentation of disciplines was birthed (Jiang, 2023). Unfortunately, in an attempt to draw a distinction or boundaries among disciplines and form unique discourse, logic, and principles, connections between disciplines were cut (Liu et al., 2022). Education aimed at offering knowledge specific to a field is believed to produce specialists with foundational knowledge in diverse disciplines essential in giving students a firm foundation in their future professions (Discipline-Specific Knowledge is one of Deakin University's Eight Graduate Learning Outcomes). While a discipline-centric approach to graduate education seems very important, there have been calls to offer students who opt for more than one stream of knowledge from a specific discipline. Lombardo (2010) argues that human existence is not separated into different components as we see in the diverse academic disciplines that only exist as silos. It only makes sense, he admits, to unite the disciplines toward one goal of solving the problems in today's world. The view of Lombardo isn't new, after all, the origin of the concept of 'university' (from the Latin ‘universitas magistrorum et scholarium’) and for that matter, graduate education is meant to happen among a community of teachers and scholars who draw on their diverse expertise to solve the problems of societies. Chhangani and Hussain (2023) posit that the rapidly changing knowledge economy today requires skilled workers and competent leaders with

broad skills such as collaboration, critical thinking, creativity, and adaptability to address the challenges faced by societies and organizations worldwide fully. They assert that it will be highly impossible for a single discipline-centric training to offer graduate students these broad skills. The problems faced by global societies are highly complex and multi-faceted, too complex and too large to be solved from a single-discipline perspective (Maresi, 2010). It requires that graduate education adopt a cross-disciplinary approach where education and research are shaped by different actors and knowledge in diverse cultural, historical, and social contexts (Muro & Jeffrey, 2008). The dialogue among disciplines, Bhushan (2021) believes offers time-tested and stronger solutions to the problems of societies. Graduates should be prepared via their training for the fast-changing, highly fluid, competitive, and demanding world. As Maresi (2010) formulates, knowledge and research skills must lead to innovations that result in direct societal and economic gains. These three important steps can only be undertaken by students who approach the world's problems with multiple discipline lenses.

Lee and Danby, in their edited book published in 2012 titled 'Reshaping Doctoral Education, International Approaches and Pedagogies' sums up the need for cross-disciplinary approach to graduate education as follows:

> *"As our global society faces increasingly complex challenges that defy disciplinary boundaries and demand new and varied ways of engaging with research contexts, doctoral researchers need training that equips them to make useful and ethical responses that are appreciative of complexity (p. 207)."*

Maresi (2010) proposes that because of globalization, higher education institutions that seek to offer graduate education must provide a platform that equips students to look beyond national and academic disciplinary boundaries, giving them the flexibility to move across disciplines and taste the goodies in the diversified term offering students discipline-specific education and research may seem economically advantageous, yet, the long-term results may be very disappointing because society requires students who have widespread interests, capabilities, and training. This makes two important questions arise:

1. Is a discipline-centric approach to graduate education in opposition to a cross-disciplinary approach?
2. Should the future of graduate education and research be based on the development of disciplinary depth or should it be directed to the thrust of interdisciplinarity, transdisciplinarity, and multidisciplinary?

Conceptual Understanding of Disciplinarity, Multidisciplinarity and Transdisciplinarity in the Context of Graduate Education and Research

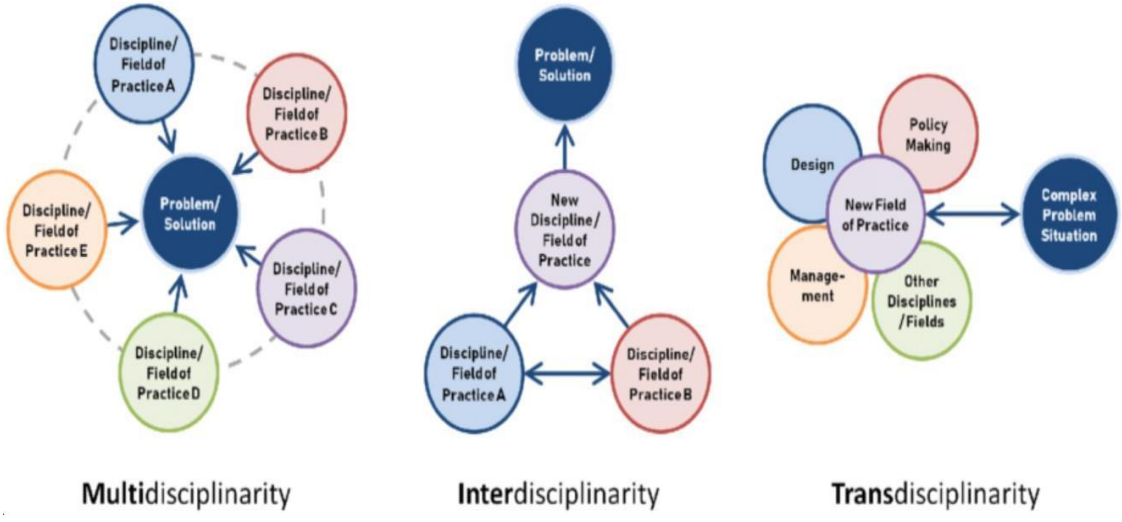

Figure 1 – (a) *A Comparison of Multidisciplinary, Interdisciplinary, and Transdisciplinary Approaches to Innovation*
Source: McPhee et al. (2018)

The term disciplinarity is from the word discipline which refers to a set of knowledge, understanding, and research that aligns itself to a specific academic discipline with its own set boundaries, code of conduct, discourses, logic, vocabulary, principles, and methods accepted and meticulously followed by experts within the fold. It is often referred to as 'silos' because of its jealousy of operating independently within its boundaries. This form of education is aimed at training experts in various specialisations in a known academic discipline or field.

The term multidisciplinarity (Figure 1) also known as 'additive' refers to the juxtaposition of various disciplines with no apparent similarity. As Repko et al. (2017) describe each of the disciplines contributes their perspectives with no precussor for a comprehensive integration. On the other hand, the term interdisciplinarity (Figure 1) also referred to as 'interactive' aims at an integration or amalgamation of two or more different disciplines where the concepts, methods, data, and methodologies in each discipline are brought together to solve common problems (OECD, 1972). When the varied expertise converges, researchers must negotiate the new territory at the disciplinary boundaries where research practices relate specifically to the interdisciplinary work (Boix-Mansilla et al., 2012). Transdisciplinarity (Figure 1) aims at further deeper integration of ideas from different disciplines with inputs from various stakeholders such as government, business, and industrial players to optimize the output from the negotiation to the social context (Keestra, 2019; Klein, 2010) for the benefit of the larger community.

Cross-Disciplinary Graduate Education and Research: A Must in the 21st Century and Beyond

The crossing of disciplines is a must in today's world of high globalization. In truism, the prospects of graduate education and research crossing disciplines overwhelmingly supersede the traditional silos of disciplines. First, the world of work requires graduates who want to offer job placements to exhibit the 5Cs framework for 21st-century key competencies which are cultural competence, critical thinking, creativity, communication, and collaboration (Xu et al., 2020). These essential competencies fit for the 21st century and can only be fully nurtured in graduate students when exposed to cross-disciplinary training (Chhangani & Hussain, 2023). Drawing on and integrating knowledge from multiple disciplines helps in arriving at a more comprehensive insight into a complex problem (Dinov, 2008; Klein & Newell, 1997). Knowledge production in today's world is more socially accountable, moving beyond the usual dead end of most disciplines which is basic research findings to applications to societal needs (Maresi, 2010).

Cross-disciplinary graduate education and research move students from the level of understanding existing sets of knowledge in disciplines to gain the ability to think (together with multiple actors) about how that knowledge could be tailored into solutions to the pressing needs of society (Gayon & d'Avray, 2018; Carr et al., 2018). Cross-disciplinary education and research is a powerful learning motivation tool for students (Joan, 2007) who out of curiosity, can navigate the concepts and principles across disciplines to develop socially relevant projects. Transdisciplinarity, the most fluid of all the cross-disciplinarity forms, offers new-age graduate students the platform to engage in groundbreaking projects by working with different actors who are experts from diverse academic disciplines as well as industrial players, business operators, governments, and local communities. This is what Gibbons and his colleagues refer to as 'the Mode 2 Production' (Gibbons et al., 1994). This promotes the personal development of graduate students and enhances the achievement of organizational goals while ensuring smooth social functioning and progress (Jiang, 2023). Students who engage in cross-disciplinary education and research gain diversified cultural competence when they get the opportunity to learn about another culture, accept cultural differences, develop complex pedagogy in the context of the international community, and build new and productive international networks (Maresi, 2010). This makes them meet the social demand for students to be 'complete' and broadly educated citizens (Dinov, 2008) who are capable of addressing the challenges faced by societies and organizations (Chhangani & Hussain, 2023).

The Path of Disciplinarity in Opposition to the Thrust of Cross-Disciplinarity in Graduate Education and Research?

From the ongoing discussion, it is clear that to marshall solutions that can effectively address today's complex challenges faced by societies, graduate education needs to cross disciplines. However, this does not suggest that the discipline-centric trajectory in graduate education should cease. No. That is not the thesis of this paper. It should be noted that the path of disciplinarity is not in opposition to the thrust of cross-

disciplinarity. The latter is an important extension of the latter as a response to two things. The first, as I have reiterated in this presentation is the search for solutions that can address today's complex and multifaceted problems that need insights from diverse disciplines. Second, graduate students are now in constant demand for education that crosses the boundaries of specific disciplines, with many desiring to embark on cross-disciplinary projects. That said, it should be noted that cross-disciplinary thrives when there is a strong discipline. Bililign (2013) concurs that interdisciplinarity research does not only open up new areas of research but also offers the needed flexibility and possibilities to expand the territories of traditional disciplines. The pursuit of cross-disciplinarity can operate only within the typical framework of a typical discipline-centric zone. The development of the research questions, methods, and syntheses in multidisciplinarity are from the discipline-based methods in the diverse disciplines. Cross-disciplinary graduate education exists to transcend the discipline-centric boundaries, in the confluence of diverse disciplines in the bid to deepen the understanding of social problems and offer better solutions (Golding, 2009). This implies that graduate education must offer both discipline-centric and cross-discipline training. We must understand that cross-disciplinary research can materialize when we have disciplinary experts with strong foundational knowledge in their respective fields who pull their expertise together in the search for solutions to the complex problems faced by societies (Gardner, 2006). So, in effect, the existence of cross-disciplinarity is based on the seed of the disciplinarity.

Challenges with the Co-Habitation of Discipline-Centric and Cross-Disiciplinary Approaches in the Graduate Education and Research Ecosystem

The co-existence of both discipline-centric and cross-disciplinary approaches to graduate education cannot happen without challenges. One such challenge is the institutional commitment to the promotion of cross-disciplinary education and research. They must be willing to enact policies that embrace cross-disciplinary education and research. These policies must mainstream approaches in designing, validating, and disseminating educational materials and research toolkits as well as funding support for cross-disciplinary projects (Bhushan, 2021). Bililign (2013) admits that the existing funding opportunities are tailored to disciplinary structures. Also, grant proposal reviews are often carried out by a panel of disciplinary experts, some of whom may be biased toward cross-disciplinary projects (August et al., 2010). This presents possible unhealthy resource allocation competition between disciplinary and cross-disciplinary projects (Chen, 2021).

Also, the distinctive principles and language of the various disciplines such as terminologies, and methodological protocols including specification of data are likely to create barriers to smooth collaborations between scholars in the diverse disciplines (Bhushan, 2021). Moreover, the dominant traditional disciplinary approach existing in many educational institutions presents faculty who are only knowledgeable with expertise in their narrowed disciplines to act as supervisors to graduate students who embark on cross-disciplinary projects. Their lack of teaching and research experience in cross-disciplinarity (Chen, 2021) is likely to negatively affect their level of supervisory input and limit their contributions to the student's projects. Supervisors who are biased toward a discipline-centric approach to education and research may even unjustly influence graduate students to move into the usual disciplinarity trajectory.

The evaluation of cross-disciplinary education and research projects in the past has been done quantitatively. Yet, this mode of one-stream evaluation has been criticized by scholars in cross-disciplinarity as not eliciting a broad stream of learning experiences. Fortunately, August et al. (2010) have developed the T-Assessment tool for assessing cross-disciplinary graduate education which gathers both quantitative and qualitative evidence in assessing the effects of cross-disciplinary training on its social and economic impacts.

Best Practices for the Smooth Co-Habitation of Discipline-Centric and Cross-Disciplinary Approaches in the Graduate Education and Research Ecosystem

While the pursuance of cross-disciplinary education and research can potentially present some daunting challenges, there are best practices and strategic approaches that can be followed by institutions that want to ensure the smooth and peaceful co-existence of discipline-centric and cross-disciplinary approaches to graduate education. One of the strategic approaches is to develop new cross-disciplinary educational curricula. These educational materials should be able to cross the carpet between different disciplines while promoting the sharing of data, techniques, research tools, etc. (Borgman, 2006). In the developed curricula, a learning outcomes-based curriculum framework spells out both disciplinary and cross-disciplinary learning outcomes to ensure the full development of both streams (Bhushan, 2021).

Still in teaching, since the world is a global village and as such institutions offering graduate education that aim at promoting cross-disciplinary interaction can purposefully leverage technology to assign their domestic students to work with international students on a common research project (Maresi, 2010). In terms of research, it's important for institutions that aim at cross-disciplinary training to encourage their graduate students to develop cross-disciplinary joint research questions (Miller et al., 2008) that are capable of drawing from diverse perspectives in their research projects. Likewise, cross-disciplinary research questions must be related to theories and methods in multiple fields (Carr et al., 2018). There should be a primary supervisor from the core research field and a supporting supervisor from a different research field in joint supervision for students.

Institutions can have a monthly seminar series where leading researchers in diverse fields on topics of interest are invited to interact with the students and offer them cross-disciplinary training that could feed into their interdisciplinary, transdisciplinary, and multidisciplinary research projects. Some institutions that have run successful cross-disciplinary projects organize six-monthly research cluster meetings for groups with members from diverse disciplines to discuss (presentations on their cross-disciplinary projects) for members in other research clusters to make inputs to hone their methodologies and approaches to negotiate for more workable solutions to societal problems.

There are shining examples of various Higher Education institutions that are pursuing cross-disciplinary education and research. For instance, the vision and mission statements of the Institute without Boundaries within the School of Design at George Brown College in Toronto, Canada underscore their dedication and commitment to cross-disciplinary research and education. It states that its vision is to foster a collaborative design practice for a better world while its mission is to foster collaboration between disciplines to create innovative local solutions to 21st Century global challenges. Other institutions such as the National University of Singapore have consciously amalgamated two faculties (the Faculty of Arts and Social Sciences and the Faculty of Science into one college (College of Humanities and Sciences) to ensure cross-disciplinary graduate education and research. Jiang (2023) reiterates the purpose of faculty integration as a step in training graduate students with interdisciplinary thinking and the ability required to solve the challenges in this uncertain and volatile world. The University of California in Los Angeles offers over 500 courses that cross carpets in academic disciplines with 32 interdepartmental program majors just to promote cross-disciplinary graduate education and research.

August et al. (2010) note that the National Science Foundation (NSF) is mounting special funding programs to promote the training and research of scientists working on cross-disciplinary research projects. Walker et al. (2008) observe that the University of Rhode Island's Coastal Institute champions an NSF-IGERT-funded program aimed at offering cross-disciplinary training in coastal ecosystem science and management research. They noted that the beneficiary doctoral students who enrolled in the program had broader views conceptually and practically, developing new ideas and intellectual risk-taking-an important component in cross-disciplinary research.

The Way Forward for the Future of Graduate Education and Research in the 21st Century and Beyond

What should be the way forward for the future of graduate education and research in the 21st century and beyond? Graduate education and research in this 21st Century, according to Jacob (2015), must fuel collaborative approaches promoted through cross-disciplinary training and research, so that graduate students will have a more holistic and inclusive approach to knowledge production that is socially-constructed. Higher education institutions must take pragmatic steps in breaking the silos of the traditional academic disciplines, encouraging students to collaborate and engage in cross-disciplinary projects.

We need not only to develop disciplinary depth in the pursuit of graduate education today. We need to move beyond the boundaries of the silos of these traditional academic disciplines. We need to cross disciplines and move steadily into the thrust of interdisciplinarity, transdisciplinarity, and multidisciplinarity in our quest to train the new age graduates. To borrow the words of Maresi (2010), 'Students must be educated to define and solve societal problems both at home and abroad-collectively-in trans-multi-, and interdisciplinary and international groups. Why? It offers students holistic and inclusive training that welcomes diverse intellectual orientations, and a broad skill set that exists in the spirit of the 5Cs (cultural competence, creativity, critical thinking, communication, and cooperation) for them to be well-rounded individuals to thrive in this ever-demanding, competitive, highly fluid, and complex world. Indeed, the future of graduate education

and research is enshrined in the innovative fusion of disciplines in a cross-disciplinarity approach, whether interdisciplinary, multidisciplinary, or transdisciplinary- a strong merger that births significant innovations and solutions needed to make our world a better haven to live. Yes! The future of graduate education and research is colourfully painted in the Akan philosophy of my motherland Ghana says Ti koro nkɔ agyina which is translated as 'One head doesn't go into counsel.' Indeed, one discipline alone cannot marshall a strong weapon to fight today's socially complex challenges of the world. It requires a concerted effort of stakeholders in society, yes, research scientists from different disciplines, policymakers in government, business, and industrial players as well as representatives in local and urban communities to ignite socially relevant innovations for a brighter future for the world- which can only be made possible through a cross-disciplinary approach to graduate education and research.

METHOD

A cross-disciplinary approach to graduate education and research. However, the disciplinary structures in many Higher Education Institutions pose serious challenges to cross-disciplinary education and research either in interdisciplinarity, transdisciplinarity, or multidisciplinarity. Many instructors jealously guard their disciplinary trajectories and are biased toward other disciplines, even crippling funding opportunities meant for cross-disciplinary projects. This paper analyzes the strict compliance to the development of disciplinary depth or the pursuance of cross-disciplinary thrust promoted in the 21st Century. It presents best practices from institutions promoting the use of a cross-disciplinary approach to graduate education and research.

RESULTS AND DISCUSSION

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REFERENCES

August, P. V., Swift, J. M., Kellogg, D. Q., Page, G., Nelson, P., Opaluch, J., Cobb, J. S., Foster, C. & Gold, A. J. (2010). The T Assessment Tool: A Simple Metric for Assessing Multidisciplinary Graduate Education. Journal of Natural Resources & Life Sciences Education, 39: 15-21.

Bhushan, S. (2021). Multidisciplinary Approach in Higher Education. New Delhi: Commonwealth Educational Media Centre for Asia (CEMCA).

Bililign, S. (2013). The Need for Interdisciplinary Research and Education for Sustainable Human Development to Deal with Global Challenges. International Journal of African Development, 1(1): 82-90.

Boix-Mansilla, V., Lamont, M. & Sato, K. (2012). Successful interdisciplinary collaborations: The contributions of shared socio-Emotional-Cognitive platforms to interdisciplinary synthesis. In: Paper Presented at 4S Annual Meeting. Vancouver, Canada,February 16–20, 2012.

Borga CL, Wallis C, Eedy N. Building digital libraries for scientific data: An exploratory study of data practices in habitat ecology. 10th European Conference on Digital Libraries; Alicante, Spain: Springer; 2006.

Carr, G., Loucks, D. P. & Blöschl, G. (2018). Gaining insight into interdisciplinary research and education programmes: A framework for evaluation. Research Policy, 47: 35–48.

Chen, S. (2014). Interdisciplinary Research and Education in China: Achievements and Challenges. Eighth Annual Strategic Leaders Global Summit. https://legacy.cgsnet.org/ckfinder/userfiles/files/Chen_P1_2014_Global_Summit_web_proceedings.pdf

Chhangani, M. K. S. & Hussain, S. I. (2023). Interdisciplinary Education in Higher Institutions: Trends, Challenges, and Future Directions. International Research Journal of Moderniztion in Engineering Technology and Science, 5(7): 87-90.

Dinov, I. D. (2008). Integrated, Multidisciplinary and Technology-¬Enhanced Science Education: The Next Frontier. MERLOT Journal of Online Learning and Teaching, 4(1): 84-93.

Gardner, H. (2006). Five Minds for the Future. Boston, Mass.: Harvard Business School Press.

Gayson, A. R. & d'Avray, D. (2018). Interdisciplinary research-based teaching: Advocacy for a Change in the Higher Education Paradigm. In: Tong, V.C.H. et al. Shaping Higher Education with Students: Ways to Connect Research with Teaching. University College London. Project MUSE.

Gibbons, M. (1994). The new production of knowledge: the dynamics of science and research in contemporary societies. Thousand Oaks, Calif.: SAGE Publications.

Golding, C. (2009). Integrating the Disciplines: Successful Interdisciplinary Subject. Melbourne, Australia: Centre for the Study of Higher Education, University of Melbourne.

Jacob, W. J. (2015). Interdisciplinary trends in higher education. Palgrave Communications, 1(1), 15001. https://doi.org/10.1057/palcomms.2015.1.

Jiang, Y. (2023). The Causes and the Hindrances of the Development of Interdisciplinary Education. In: M. F. b. Sedon et al. (Eds.): SSHA 2023, ASSEHR 752, pp. 822–829, 2023. https://doi.org/10.2991/978-2-38476-062-6_106.

Joan P, Peter S, Jean-Yves H, Ron H, Miguel E. Increasing student retention in computer science through research programs for undergraduates Proceedings of the 38th SIGCSE technical symposium on Computer science education; Covington, Kentucky, USA: ACM; 2007.

Keestra, M. (2019). Imagination and Actionability: Reflections on the Future of Interdisciplinarity, Inspired by Julie Thompson Klein. Issues in Interdisciplinary Studies, 37(2): 110-129.

Klein, J. T. (2010). Creating interdisciplinary campus cultures: A model for strength and sustainability. San Francisco, CA: Jossey-Bass.

Klein, J. T., & Newell, W. H. (1997). Advancing interdisciplinary studies. In J. Gaff & J. Ratcliff (Eds.), Handbook of the undergraduate curriculum: A comprehensive guide to purposes, structures, practices and change (pp. 393-415). San Francisco, CA: Jossey-Bass.

Lee, A. & Danby, S. (2012). Reshaping Doctoral Education International Approaches and Pedagogies (1st Ed.). U.K.: Routledge

Liu, H., & Xie, R., & Ren, Y. (2022). The Current Dilemma of and the Ideal Path for Interdisciplinary Education. Journal of Graduate Education, 2: 32–36.

Lombardo, T. (2010). Multidisciplinary and Interdisciplinary Approaches to Futures Education. Journal of Futures Studies, 14(4): 121 – 134.

Maresi, N. (2010). Globalization and the Internationalization of Graduate Education: A Macro and Micro View. Canadian Journal of Higher Education, 40(1): 1-12.

McPhee, C. (2018). Editorial: Transdisciplinary Innovation. Technology Innovation Management Review, 8(8): 1-6.

Miller, T.R., T.D., Littlefield, C.M., Kofinas, G., Chapin, F. & Redman, C.L (2008) Epistemological pluralism reorganizing interdisciplinary research. Ecology and Society 13:46 [www document]. URL http://www.ecologyandsociety.org/vol13/iss2/art46/

Muro, M. & Jeffrey, P. (2008). A critical review of the theory and application of social learning in participatory natural resource management processes. Journal of Environmental Planning & Management, 51: 325–344.

OECD (1972). Interdisciplinary: Problems of Teaching and Research in Universities. Organisation for Economic Cooperation and Development, Paris, France (Centre for Educational Research and Innovation).

Repko, A. F. (2008). Interdisciplinary Research: Process and Theory. California, USA: Sage Publications

Walker, G., C.M. Golde, L. Jones, A.C. Bueschel, & P. Hutchings (2008). The formation of scholars: Rethinking doctoral education for the twenty-first century. San Francisco, CA.: Jossey-Bass Publishers

Xu, G., & Wei, R., & Liu, J., & Li, J., & Kang, C., & Ma, L., & Gan, Q., & Liu, Y. (2020). Collaboration Competence: Part V of the 5Cs Framework for Twenty-first Century Key Competences. Journal of East China Normal University (Educational Sciences), 2: 83–96.