Interdisciplinary Research and Collaboration in Education and Engineering

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The main purpose of interdisciplinary learning and research is to make sure that the eventual outcome will be relevant to both society and for human life betterment. This will close the gap between higher education institutions and society needs. Education can fall in the humanities or Social Science research area. If Social Science is viewed from a methodological perspective, Social Science is the field that applies scientific methods to study the human aspects such as human behaviour and social order. On the other hand, the humanities involve analytical and critical approaches. Despite the differences, education can fit in both disciplines, where educational research can investigate how humans learn as in social sciences discipline or educational research can be carried out on how to teach art lessons, which can reflect a humanities discipline. Eventually, as both disciplines are related to humans, it opens up windows for integration and the possibility for integration by other research areas as well such as Engineering.

As one of the pioneer and premiere universities in Malaysia that focuses on the Engineering field, Universiti Teknologi Malaysia, has produced more than 150,000 Engineering and Science and Technology graduates. Most of the graduates held top administrative positions such as CEOs, managers, or leaders in companies and organizations. With the increasing education trend where societies apply the "back to school" concept, there has been increasing number of engineering graduates that pursue their studies at the graduate level. This group of people, consisting of CEOs, leaders or managers, favors interdisciplinary programs such as Innovation in Engineering, Engineering Business Management and etc., where Engineering is integrated into the social sciences and humanities. This integration is a very good opportunity to enrich and add value to the field of social sciences and humanities. More discussions can be carried out to further explore new areas of integration. These discussions will provide better understanding on how the social sciences and humanities can better operate.

Challenges and Opportunities within the Disciplines:
However, although such unification seems feasible and practical, there are also challenges in the integration. One of the main interdisciplinary challenges within humanities and social sciences is the understanding of the differences existing between sub areas in the discipline itself. For example in the Education research area, scholars from Foundations of Education claim that they have better comprehension of theories of learning as compared to those from the Applied Education field such as Educational Technology and Science, Technology, Engineering, and Mathematics (STEM). However, one has to be aware of the fact that, someone who is well-versed and is an expert theoretically is not necessarily an excellent practitioner. In a teaching and learning context, good comprehension about learning theories without having the ability to implement those theories is insufficient for a good educator. We have to be reminded that some

theories need adjustments to the learning settings, students' needs and preferences, as well as adjustments to fit into the content of teaching and learning. If we can minimize the challenges, interdisciplinary opportunities within the disciplines will be expanding as many experts speak a similar language.

Challenges and Opportunities across the Disciplines:
The social sciences and humanities are two disciplines that have the possibility for integration with other disciplines. According to Moran (2010), interdisciplinary remains humanities-driven or necessitated. It has widened the opportunities for the humanities and social sciences disciplines to be integrated with other technical disciplines. Considering the integration of these disciplines and other technical disciplines will serve its own purposes such as:

- To prepare graduates for life in complex and demanding societies and world.
- To fulfil the need of the current program where the focus of current graduate curriculum is on interdisciplinary program.
- To provide more relevant academic programs to adult learners, where most of them are CEOs, managers, or experienced workers of companies coming back to school and looking forward to enrolling in interdisciplinary programs.
- To broaden and sustain the roles of institution. Interdisciplinarity is important for the survival of the discipline—such as in Engineering—interdisciplinary between Business and Engineering will increase the sustainability of the field. As in UTM, our strength is on Engineering and Science and Technology programs and to continue to be the expert in these areas, we have introduced quite a number of interdisciplinary programs such as Engineering Business Management, Engineering Education, Professional Science, Innovative Management in Engineering, Halal Science, etc.

As educators, we have been organized in department-based structures and disciplinary knowledge domains. Therefore, it is a challenge for us to understand interdisciplinary knowledge. Challenges to introduce such interdisciplinary programs, learning, and research can be observed from two different perspectives. From the perspective of the social sciences and humanities, social scientists and humanists will look into how the initiatives will benefit the human condition and therefore they are not going to tolerate any obstacles or limitations due to other factors. However, from the perspectives of other disciplines such as Engineering and Computer Science, the scientific factors are the main focus. With that focus in mind, the question of whether the initiatives such as theory, products, or frameworks will benefit users are not their main interests. This mismatch has created intensive debate among the experts, which is leading everyone to a dead end. Interdisciplinary learning requires experts to understand it from the interdisciplinary context (Moran, 2010).

What structures for interdisciplinary learning and research have proven to be particularly successful within and/or across these fields?
A Few important aspects that have to be considered by the interdisciplinary scholars among faculty members are processes, outcomes, and motivations. First, to assist academicians to understand interdisciplinarity, the structure of the institution must be transformed. According to Holley (2009), the existing institutional structure is only based on the disciplinary knowledge domain where higher education is unable to support interdisciplinary work. The existence

of interdisciplinary structures is thus, required. For example at UTM, to run the Engineering Education Doctoral program, the university has opened the Centre of Engineering Education to initiate the program and play the role of an interdisciplinary organization to put experts from two different fields; Engineering and Education together. At the Centre, experts from both fields share the same goals to engineer the interdisciplinary program. They negotiate ideas and they have to create a mutual understanding so that both Engineering and Education can sit in the same boat. They also have to look for areas at which Engineering and Education can intersect. The intersections help the Center to open up areas of research under the interdisciplinary program. Holley (2009) posted some questions related to challenges that we have to face in introducing interdisciplinary programs. The questions are:

1. How does interdisciplinary research affect standards of faculty tenure and promotion?
2. How do colleges and universities encourage integration among students and faculty located in separate, often isolated departments?
3. How do institutions construct an interdisciplinary course of study that requires students to interact with faculty and areas of knowledge from multiple disciplines?
4. What cognitive, cultural, and social challenges exist as scholars seek to achieve an integrative synthesis?

Therefore, changes in strategies to meet the challenges are suggested by the experts such as:

1. Lattuca (2001) suggested institution to include an action examining tenure and promotion criteria
2. Palmer (2001) suggested institutions alter departmental structures
3. Amey and Brown (2004) mentioned that institutions need to institute collaborative leadership for interdisciplinary activities
4. Klein and Newell (1996) suggested institutions need to experiment with curricular requirements.

Based on our experiences in managing interdisciplinary graduate programs, here are some of the structures:

1. Initiating a unit such as a Centre or Academy that is based on an interdisciplinary nature.
2. As for full research graduate programs, the use of a panel of supervisors consists of 2 to 4 supervisors with different expertise such as a professor in Engineering, a professor in Education, a supervisor from industries, and an expert from a government agency. Using this supervision model, not only will the graduate research fulfil the needs of academic research, but the research findings can be directly applicable to society. This will indirectly solve a particular problem in higher education, where the involvement of industries in a graduate research is frequently questionable.
3. Team-teaching for interdisciplinary courses where the involvement of experts from industries through part-time appointment is encouraged.
4. In UTM, to support interdisciplinary learning across courses, the concept of New Academia, where the transformation of the concept of academia has taken place as the following:

	New Academia	Action
Faculty members	Professors, inventors, entrepreneurs	Adjunct staff, fellows
Learning materials	Books, journals, experiences, Internet, Internship	Internship, students' business ventures
Philosophy	Integration	New pedagogy, Research Alliances
Funding	Grants, fees, VC, endowment	Creative fund raising
Students	School leavers, mid-career, businessmen, early-career, life-long	Top Undergraduate, Postgraduates from corporations, research
Venue	Campus, Internet, incubators, brands	Wifi, 4G, MTDC, Proton
Learning models	Lecturers, tutorials, lab, studios, internship, incubators, experiential learning, 5 minds	NEW PEDAGOGY: learner-centric, Silicon V-culture, GOP, ethics
Outcomes	Degrees, expertise, business models, capital, networks, culture	JOB CREATION; micro-credit, spin-off, projects

Source: Ujang, Z., (2012). New Academia UTM as a Global Brand. Johor: UTM Press.

5. In UTM, rationalization of departments, where two departments have been merged together to build a new interdisciplinary department.
6. Conducting support programs to prepare faculty members for interdisciplinary scholarship so they will better understand the needs and purposes of interdisciplinarity.

References

Amey, M., and Brown, D. (2004). Breaking out of the box: Interdisciplinary collaboration and faculty work. Greenwich, CT: Information Age Publishing.

Holley, K. A., (2009). Understanding Interdisciplinary Challenges and Opportunities in Higher Education: ASHE Higher Education Report, Volume 35, Number 2.

Klein, J. T., and Newell, W. (1996). Advancing interdisciplinary studies. In J. G. Gaff and J. L. Ratcliff (Eds.), Handbook of the undergraduate curriculum: A comprehensive guide to purposes, structures, practices, and change (pp. 393–415). San Francisco: Jossey-Bass.

Lattuca, L. (2001). Creating interdisciplinarity: Interdisciplinary research and teaching among college and university faculty. Nashville, TN: Vanderbilt University Press.

Moran, J., (2010). Interdisciplinarity. 2nd ed. London: Routledge.

Palmer, C. (1996). Navigating among the disciplines: The library and interdisciplinary inquiry. Library Trends, 45, 129–366.