Studies in Technology Enhanced Learning

Journal homepage: stel.pubpub.org

ISSN: 2753-2380

Article type
Full paper, double-blind peer review.

Publication history
Received: 03 May 2021. Revised: 16 November 2021. Accepted: 13 December 2021. Online: 27 June 2022.

Cover image
Steve Johnson via Pexels.

Special issue Autoethnography in online doctoral education | **More at** https://doi.org/10.21428/8c225f6e.9415e58d

Embracing humanities in computer science: An autoethnography

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Keywords
interdisciplinary; higher education; humanities; computer science; Trinidad and Tobago

Citation
St. Bernard, F. (2022). Embracing humanities in computer science: An autoethnography. **Studies in Technology Enhanced Learning, 2**(3), 585-597.

https://doi.org/10.21428/8c225f6e.d562588b

Abstract

Humanities enrolment in higher educational institutions across the globe has been falling considerably in favour of STEM (Science, Technology, Engineering and Mathematics) careers, like Computer Science. While students eagerly pursue these disciplines, in doing so, they have simultaneously lost the possible grounding Humanities can provide in contextualising their knowledge. The overall purpose of this study is to use my unique perspective as a student of both disciplines to show the value Humanities can bring to the field of Computer Science and make a case for the need of an interdisciplinary approach for these seemingly unrelated disciplines. Because the study uses my experience as the basis for making this case, the research methodology used was an Autoethnography. The data was sourced from my own recorded self-reflective narratives and supported with my assignment feedback forms, assignments and excavation log. The findings were coded and organised by emergent themes which were then analysed using the interdisciplinary knowledge integration theory. The results show that while Humanities and Computer Science have a polarised approach to methodologies and perspectives that makes it particularly challenging for the integration of knowledge, it does provide significant competencies that can transfer and transform the learning experience and skills of students. These include communication, critical thinking, adaptability, and self-learning skills. It is for

https://doi.org/10.21428/8c225f6e.d562588b

these uncovered benefits to students' development that institutions should consider an interdisciplinary approach to higher education.

1. Introduction

1.1 Background

"*The best of the past, with all the hopes for the future*". It is often my response when I am asked why History and Computer Science. My passion for technology evolved at a young age and though I diverted to History for three years, earning my Bachelor of Arts in History, I quickly returned to my passion and earned my Bachelor of Science and Master's in Computer Science. During my years of working in software development field, I found myself often volunteering to teach kids web development and programming during their school vacation in the months of July and August. This sparked my love for academia, that resulted in me now being employed as a lecturer in the Department of Computer Science, Mathematics and Technology at a local university.

At my current institution, as part of any undergraduate programme, students are introduced to courses outside their field of study. As Computer Science majors, my students were introduced to courses in history, academic writing, theology, and languages, to name a few. Very often students would express their disdain for and lack of interest in doing these courses, for which I would try to assure them that the point is to develop a wider range of ideas and diverse levels of thinking and are just as deserving of their time and effort. My arguments stemmed from my own academic background in History, an experience I held in high esteem as a contributing factor to my academic pursuit in Computer Science. My attempt at bringing to their attention the benefits were quickly met with a lengthy dialogue about these courses contributing nothing to their development. It was in this moment that I questioned my accuracy of my pursuit in promoting Computer Science and wondered if I might have been on the wrong side of the argument all this time.

Fields such as Science, Technology, Engineering and Mathematics, often recognised by the acronym STEM, has often been heralded as progressive fields that are more directly linked to economic development (White, 2014). This possibility of economic prosperity and productivity and international competitiveness have sparked governments and industries to intensify efforts in fields such as these through educational policies (Barkatas et al., 2018). Countries such as Finland, Korea, Taiwan, China, Singapore, and Canada have seen considerable success in boosting the inclusion and performance in schooling and research (Marginson et al., 2013). Perhaps the value that is placed on these disciplines gives the misconception that they are more essential than the humanities, hence the perceptions of the students in my class. Research has shown a steady decline in enrolments, shrinking job prospects, and growing condescension for the field of humanities (Ikype, 2015). In 2013, Harvard University showed a decline in Humanities from 21% to 17% over the period 2012-2013, while an article published in New York Times, showed that graduates in the Humanities plummeted from 165 to 62 between 1991-2013 (Berube & Ruth, 2015). Such a trend has continued to be seen worldwide in countries such as United States, South Africa, Japan, Australia, and Russia (Yu & Pillay, 2011). These perceptions and the glaring decline in enrolment figures in Humanities begs the question of whether our emphasis on promoting the importance of disciplines such as Computer Science simultaneously undermined the importance of Humanities. Though this question is not easily answered, one thing that is often neglected is that the Humanities can be exceptionally important to the development of skills for students in Computer Science.

1.2 Research aims

The value of Humanities can only be fully appreciated through knowing what it contributes to the development of students. Using my own experience, this autoethnographic research attempts to examine the impact of Humanities on Computer Science. This examination will be done through the lens of an interdisciplinary approach to higher education. Computing and computational methods now play a significant role across most industries and as result computer scientists are now required to work in an interdisciplinary environment that requires an understanding of aesthetic, cognitive, ethical, and communicative issues when developing applications. Despite this, students in Computer Science at higher educational institutions are spending their learning years in isolation with a single-minded focus on solely the technical aspects.

Through the exploration and analysis of my personal experience as a student of both disciplines, this research intends to provide a unique perspective on an interdisciplinary approach by examining the impact of Humanities on Computer Science. In knowing its importance, this research intends to raise awareness for the need to revive the emphasis on Humanities and inform of the need to secure its inclusivity with other 'unrelated' disciplines.

2. Literature review

This section evaluates several books, empirical studies, and scholarly articles that were explored while researching the topic of an interdisciplinary approach to higher education in Computer Science. Scopus, Google Scholar and One Search were used, with the initial search of interdisciplin*. A varied number of searches were conducted using a combination of the keywords: learning, teaching, higher education, computer science, and humanities. A total of 64 articles were downloaded; of these, 39 were relevant publications. The sources reviewed and analysed for this research were chosen because they extensively covered the impact of an interdisciplinary approach to higher education.

2.1 Approaches to higher education

2.1.1 Traditional approach

The traditional view of education centres around an academic discipline with its own area of study, process, methods, and content, which sets them apart from other disciplines. Discipline in this sense refers to a self-contained and isolated domain of human experience (Davies & Devlin, 2007; Nissani, 1997). This traditional view offers the benefit of knowledge specialisation, and the refinement of skill sets within a focused discipline and catalyst for productivity (Tarrant & Thiele, 2017). For instance, most Computer Scientists consider the discipline one of perfecting machine computation (Koch, 1991). This can be attributed to the traditional approach to Computer Science in which students are solely trained to become productive software developers capable of innovation by algorithms, representation and reasoning, and human machine relationship (Regli, 2017).

Therefore, it can be agreed that this form of disciplinary approach attributes itself to having the presence of a community of scholars who contribute to its body of knowledge, provides the existence of a tradition of inquiry, methods and interpretation of data and an existence of a communication network (Davies et al., 2010). This approach produces like-minded individuals with a set of codes of conduct, values, and knowledge. While these can be seen as a case for the continuation of the disciplinary approach to education, it is this self-contained and isolated nature that can also lead to the compartmentalization of knowledge (Buchbinder, et al., 2005) and can no longer suffice in the changing nature of knowledge that now requires an incorporation of social, political and economic ideas and values to address problems. Simply put, complex problems do not present themselves in a disciplinary package and neither will their solutions (Tarrant & Thiele, 2017).

Computer Science comprises several specialities that include computer engineering, computer science, software engineering, information systems, domain-specific applications, networking and communication, and computer systems. Each of these specialties have penetrated almost every aspect of other fields such as agriculture, communication, education, manufacturing, and medicine, not only as tools of operations but also as designed solutions and systems (Denning, 1999; Hopcroft, 1987). As a result, when designing solutions for such systems, computer scientists are required to work and operate in an interdisciplinary environment. Drawing on the emerging technology of artificial intelligence as an example, Microsoft Corporation (2018) in their publication The Future Computed: Artificial Intelligence and its role in Society noted that "*as computers behave more like humans, the social sciences and humanities will become even more important. Languages, art, history, economics, ethics, philosophy, psychology and human development courses can teach critical, philosophical and ethics-based skills that will be instrumental in the development and management of AI solutions.*" Therefore, it can be argued that it is necessary for replacing the traditional approach with an interdisciplinary approach.

2.1.2 Interdisciplinary approach

Interdisciplinary education aims to bring together different components of two or more disciplines in a single mind, research or programme and it is done by integrating information, methodologies, techniques, skills, or theoretical perspectives (Songca, 2006; Tarrant & Thiele, 2017). Kidron and Kali (2015) extended the definition of interdisciplinarity by outlining four processes by which learners integrate knowledge. These four processes include:

1. Creating a framework for the integration of knowledge.
2. Identification of relevant knowledge domains that can be transferable.
3. Formulating connections and integrative insight between the disciplines.
4. Refining the insight to develop new knowledge.

This process indicates a symbiotic relationship between the disciplines. Over the years, computer science has increasingly become closely related to other disciplines such as mathematics, physics, chemistry, and biology (Denning, 1999). When examining the literature, most of the research related to an interdisciplinary approach to computer science

https://doi.org/10.21428/8c225f6e.d562588b

was primarily with the related disciplines stated above, rather than humanities. For instance, Klaassen (2018) offered a case study in which their aim was to design interdisciplinary education through the parameters of level and nature of integration, constructive alignment through problem definitions and design and execution of education. However, their study was based on Clinical Technology where there was a logical integration of science, technology, and medicine. Tadmor and Tidor (2005) highlighted MIT's efforts at an interdisciplinary curriculum in which they introduced an undergraduate programme that integrated biological research with approaches from engineering and computer science. The purpose of the programme was to reconceptualise life sciences, such as genome sequencing, based on the development of quantitative and predictive models. Caudill et al. (2010) introduced interdisciplinary research projects at the University of Richmond that integrated biology, chemistry, mathematics, computer science and physics, and found that such interdisciplinary projects served to motivate students and later was used to inform course development.

On the other hand, there were two examples found in literature that integrated Computer Science and Humanities. For instance, the University of Southern California introducing an "Interdisciplinary Teaching Grant Program" to fund the development of interdisciplinary curriculum. The aim of the program is to encourage the development and dissemination of teaching methods that supports interdisciplinary education and to engage in research that utilizes interdisciplinary approaches (Quick, 2018). Similarly, Stanford University in 2014 began offering joint majors in Humanities and Computer Science with the aim of "…cultivating and providing academic structure for a new generation of both humanists who can code and computer engineers whose creativity and adaptability is enhanced by the immersion in the humanities" (Hayward, 2014).

Added to this under representation of interdisciplinary approach between Computer Science and Humanities, there is also an overall lack of research done in an interdisciplinary approach to computer science. Heikkinen and Raisanen (2018) conducted a literature review study of published articles on interdisciplinary higher education between the years 2000 and 2016, and it showed that Computer Science remained less than 3.5% throughout this time, compared to a steady growth from 21.7% to 31.8% in Social Sciences' publications, and nursing publications remained about the same at around 20%. Although publications in the field of Medicine declined by 6.9% over the stated period, it remained the highest at 58.3% in 2000 and 51.4% by 2016.

2.2 Interdisciplinary learning experience

Much of the literature provides insight into the interdisciplinary learning experience from the standpoint of other disciplines. The current literature considers interdisciplinary education as an integration of knowledge that assists in developing a range of skills and thinking (Nissani, 1997; Spelt et al., 2009). These learning outcomes include improved written and oral communication skills, teamwork skills, ethical decision making, critical thinking and the ability to apply knowledge in a real-world setting (Bear & Skorton, 2019). These skills are developed because students become more receptive to new ideas and new ways of addressing solutions and combined it enhances a student's ability for problem-solving, critical thinking and employing multiple perspectives (Lattuca et al., 2004). Lattuca et al . (2004) based this conclusion on the study of two specific courses that had an integrated approach. The first was "Environment Studies" offered by the University of Chicago, which combined the approaches of sciences, social sciences, and humanities and the second was "Toys and a Modern Society" offered by Miami University that combined humanities with arts and creativity. Kali & Kidron (2015) in their study introduced an interdisciplinary course to students at a university in Israel and discovered that 70% of the students reported that they gained the skills of critical thinking, writing skills and time management skills from the course. Nissani (1997) goes further and categorizes these benefits into three categories: growth of knowledge, personal rewards, and social benefits. However, the author also noted that interdisciplinary knowledge and research can have its share of downsides that includes an impossible ideal of the unity of knowledge, and fragmentation of knowledge from each of the disciplines can lead to the mastery of the subject becoming unattainable.

2.3 Research context

The literature has shown that an interdisciplinary approach to education has several benefits that include problem-solving, critical thinking and the ability to employ multiple perspectives, with few drawbacks. However, research related to an interdisciplinary approach in computer suffers from a focus on integrating disciplines that are closely related to computer science, where the methodologies, skills and theoretical perspectives are easily transferable. Unlike the existing literature, this research aims to explore the impact of an interdisciplinary approach between Computer Science and Humanities by reflecting on my educational experience as a student of both disciplines.

3. Research methodology

This section justifies autoethnography as the methodology chosen for undertaking this study and highlights the research questions that will be answered. It also details how the data was collected and analysed. It also addresses the ethical concerns that may arise from conducting this study.

3.1 Autoethnography

The aim of this research is to provide a unique perspective on the impact of an interdisciplinary approach to higher education as a student of two different disciplines. This research explores how and if Humanities can have an impact on the higher educational experience in the field of Computer Science. The research methodology chosen for this research is guided by the research questions that were posed (Denzin & Lincoln, 2003). The research questions that will guide the addressing of this overarching issue are:

- RQ1: What specific methodology or perspective from Humanities was I able to use in my Computer Science studies?
- RQ2: What are the specific competencies did I acquire in my study in Humanities that made my learning experience different from other computer science students?

This research is a personal inquiry and for its undertaking the methodology chosen is autoethnography. Computer Science is not typically integrated with non-related disciplines. Therefore, the autoethnographic method provided a unique opportunity of using my personal experience as a student of both humanities and computer science to present a unique perspective and analysis on the possible benefits of integrating the humanities with computer science.

Autoethnography is an emerging qualitative research methodology that uses a form of self-narrative that places the researcher within a specific social context with the aim of offering a complex and specific knowledge of personal experiences, motivations, emotions, and actions and connects them with relationships, communities, and cultures (Adams et al., 2015; Anderson, 2006; Butz & Besio, 2009). Adams et al. (2015) outlined some of the core principles of doing an autoethnography as: (1) recognising the limits of knowledge regarding identities, experience, and relationships; (2) connecting personal experience, insights and acquired knowledge to the larger conversations about the topic; (3) though narrative in nature, equal importance is placed on intellectual knowledge; and (4) addressing the ethical implications of the research. This research considered these principles in its design. The ethical issues and limits were addressed in sections 3.2 and 6.0, respectively. Principles three and four guided the discussion section (5.0). It is my intention that this research will contribute to the wider discussion that though Computer Science majors – through a discipline-based approach – are learning what is necessary to function in the industry, it certainly does not mean that the humanities are devoid of merit for these students.

3.2 Validity and ethical concerns

One issue that will need to be taken into consideration while undertaking this research is the question of validity. Validity refers to the representation of the data as believable and true (Ellis et al., 2011). Two major threats to validity of this research are overemphasis on the narration rather than its analysis and a negligence of adherence to ethical standards. As part of the doctoral programme, validity was ensured through member checking by two peers. Two colleagues assessed the research project and provided feedback to correct any factual errors (Chang, 2008). Both colleagues are within the same doctoral cohort with Lancaster University and shared similar experiences as me. That is, they are both educators in their respective fields and more importantly their research is also focused on learning experiences. As it relates to ethical standards, although the research is largely based on self-narratives, these narratives will recall institutions and people, which make them an ethical concern. To ensure ethical standards are adhered to, the names of institutions and student names remained confidential and was not revealed in the writing nor its analysis. Additionally, ethical approval was sought through Lancaster University for this research.

3.3 Data collection

The research will place my experience at its centre, making it a self-focused study (Cohen et al., 2018). The data was collected as a narrative and reflective piece by making my personal experiences and emotions the primary object of study and analysis (Butz & Besio, 2009). Using the Microsoft Word dictate feature, 117 pages of narratives about my experience as a Humanities and Computer Science student. The narratives also included my reflections on how I believed my humanities background impacted my educational experience in Computer Science. Approximately 52,534 words were recorded. To support my memory of the narratives, three additional sources of data were used (Table 1).

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Table 1. Additional sources of data used in the study

Data source	Humanities (History Undergraduate)		Computer Science (Undergraduate)	
	Description	#	*Description*	#
Assessment feedback forms	Tutor feedback from final exams – Essay type final exams	14	Tutor feedback from final exams – Written final exams	26
Assignments	Essay assignments and tutorial presentations (these presentations were on a particular topic and presented to students in class)	10	Assignments included essays on emerging technologies, programming assignments, and accompanying documentation.	10
Excavation Log	Archaeology courses required an excavation log/diary for field work.	1	Not applicable	

3.4 Data analysis

In answering the research questions the data was coded and sorted to determine topic commonality and categories for which further discussion can be derived (Chang, 2008). The narratives, assignments, assessment feedback, and excavation logs were read, analysed, and codes were identified based on repeating words. A total of 137 codes were identified after this process. It included and ranged from academic skills such as coding, debugging, writing, analysing, and reading to various forms of engagement that included such themes as confidence, effort, uncertainty, and persistence. Of the 137 codes, 77 were not relevant to the aim of this research. The remaining 60 were grouped by commonality and categorised, where 10 categories were identified. These included critical thinking, attention to detail, communication, motivation, interest, scepticism, adaptability, self-learning, historiography, and inapplicable. These 10 categories were further analysed and, of these, 5 were the most pertinent to answering the research questions. Inapplicable was relevant to Research Question 1, while attention to details, communication, adaptability, and persistence were applicable to Research Question 2.

3.5 Theoretical framework

The data was further analysed, and the discussion section was organised by Shen et al. (2014) three step process of interdisciplinary knowledge integration theory. This theory was used to determine whether Humanities can have an impact in the field of Computer Science, specifically at a higher education level. Moreover, the theoretical framework allowed for explaining and articulating this issue by connecting the research to the existing literature and knowledge (Cohen et al., 2018). The theory was developed specifically for science students and describes the ability to accomplish knowledge integration across disciplinary boundaries. The knowledge integration stresses not only a simple additive of this knowledge but also the ability to integrate ideas from distinctive sources to form explanations and solutions (Shen et al., 2014). The theory is based on three processes: translation, transfer and transform.

1. Translation - the specialised terminologies and jargon developed within each discipline.
2. Transfer - the application of models, concepts, and principles from one discipline to another to make connections or interpret scenarios.
3. Transform - using the application of models, concepts, and principles to completely transform the knowledge of the discipline.

4. Findings

This section reports the findings of the autoethnographic study. The results are structured by the research questions outlined in the research methodology section. Each research question is sub-divided into the emergent themes identified from the coding process of the narratives.

4.1 RQ1 - What specific methodology or perspectives from Humanities was I able to use in my Computer Science studies?

One theme emerged in answering this research question: Inapplicable. This theme stemmed from the recurring view that humanities methodology and/or perspectives were not applicable or could not have been used in learning computer science.

4.1.1 Inapplicable

"*History…all people seem to think of the discipline is that it is a study of the past, but it was much more than that.*" My narratives showed that friends likened my pursuit of a history degree in this light, reading about the past and nothing more. But doing history was more than that and it required more than that. My assessment feedback showed that every presentation I prepared, every paper I wrote and every examination I studied for went and had to go much further than just the mere presentation of "facts". I had to start with evidence and sources but more than this, I also had to look for causes and effects and use these to explain how and why particular events unfolded the way they did. Both my narratives and assessment feedback showed that my process had to be one of understanding and carefully considering the social, cultural, religious, political, and economic environment in which the sources were written, the intent of the source and the intended audience and biases of the writers.

"*…This bias also did not exclude my own biases…*" My narratives and assessment feedback showed that while using these sources, as an aspiring Historian, I had to recognise my own limitations and biases when evaluating the sources. Since the assignments were subjective, recognising your own biases and those of the writers was important to ensure that the assignments were not analysed from my perspective or the perspective of the authors of the source material. As a result, I had to ensure this in all presentations, assignments, and examinations. "*I could not get caught in analysing historical events from the mindset of present-day view, my own values, beliefs and attitudes but instead I had to be aware that this analysis must be in the context or era in which they occurred.*" This was relevant not only to written sources but also to material sources as well. In March 2007, as part of my Archaeology practical, our class was required to assist in archaeological excavations at Marianne Estate in Blanchisseuse, Trinidad, for which we had to keep a daily excavation log. The log showed that for every artefact found, I had to catalogue and, based on my knowledge of the inhabitants within the time (as known through carbon dating), I had to theorize on the purpose of the various artefacts found.

All of these showed a pattern of presenting sources, analysing these sources to make conclusions, but more importantly these conclusions were subjective not objective as is the case with computer science. My narratives were clear that unlike computer science which required an objective approach, for History I had to adopt an interpretative approach to my presentations, assignments, and examinations. "*…getting into computer science meant re-wiring my brain from making subjective assessments and conclusions to an objective statement of probabilistic induction.*" My computer science assignments now showed a change in pattern to a definition of a problem, experimental analysis, and modelling, and finally developing a simulation of the proposed solution. This problem-solving approach required of me precision and reasoning: a far cry from what was required of me when I did History. For me, History focused on people, events, and movements, while computer science focused on technology and innovation. This polarised approach gave me the view that there was no relevance to connection of the two disciplines. "*…Now that I am doing computer science, my history background is irrelevant and offers nothing to my new path*".

To the question of what methodology or perspectives from humanities was I able to use in my computer science studies; the answer is none. The perspectives and methodology of Computer Science and Humanities are quite different and certainly not related. Computer science required a more problem-solving and objective approach, while humanities a more analytical (cause and effect…etc.) and subjective approach.

4.2 RQ2 – What are the specific competencies did I acquire in my Humanities studies that made my learning experience different from Computer Science students?

From the data, four specific competencies emerged that was acquired from my humanities studies that made my learning experience different from my peers in computer science. These were: attention to detail, communication, adaptability, persistence.

4.2.1 Attention to detail

My assignments in Computer Science often consisted of case studies that presented a problem that had to be solved by developing a software and very often these case studies were pages long. It was easy to fall into the trap of "*… analysis paralysis…*", where the problem is over examined to the point of inability to effectively define solutions. However, what I did find myself unconsciously doing was "*…breaking down the problem into smaller parts, examining each part and the factors that affected them and only then would I outline a solution…and at times approached the solution from a different angle.*" As budding developers, solutions were developed by focusing on the problems that need to be solved, however, having a humanities background, I often thought of the consequences of solving the problem a particular way.

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From my documentation for coded assignments, I tried to consider social and ethical issues in handling data, even though it was an assignment. Issues such as downloading communications on forums, developing algorithms that make recommendations based on gender, and collecting profiles of users. These common issues can be easily overlooked, as developers are more concerned about building software and algorithms, rather than the implications of their code: "*…we should not allow ourselves to reach the point where we end up coding our humanity away*." I attributed my consideration of these issues to my background in Humanities, because in doing history "*…I spent a lot of my classes and exams making connections between theories and identifying cause and effect…It was essential for writing any essay or presenting any topic…*".

4.2.2 Communication

Going into Computer Science, especially programming, the first thought is that there is no need for reading, comprehension, and writing: "*…very often you think of someone sitting behind a computer all day writing code…that's it… nothing else necessary, nothing more required…*"

But this ideology was quickly dashed during my studies. Development (programming) relied heavily on a lot of research and documentation that required effectively communicating your solutions via diagrams and explanations. Despite this being a part of Computer Science, there is a running commentary about "*…programmers lack the ability to communicate ideas effectively and simply, especially when it relates to creating documentation of their software solution…*". Contrary to this ideology, I did find it easy to create documentation and communicate my ideas effectively via the diagrams and most importantly explanations of my solutions. "*…much of my assignments (in History), especially those of my tutorial classes were all based on reading, comprehending, and communicating ideas and arguments…*".

To ensure an excellent grade in my assignments, I had to demonstrate my ability to widely read on the topic given, present my arguments logically and to effectively communicate these arguments to my lecturer. I greatly attribute this as being the experience that provided me with the skillset required to write documentation that communicates clear and precise explanations, ideas, and solutions in computer science.

4.2.3 Adaptability

All these, stated above, provided me with the ability to be adaptable. Adaptability in the sense that it allowed me to adjust to new approaches, new people, and new expectations from the varying tutorials. "…with our tutorials we were never in the same group and therefore we were obligated to work with different people both within and outside of our own disciplines. People who were not our friends. This ensured that we were forced to resolve any conflicts with each other (if any occurred) as well as build professional relationships, all the while working, studying, and learning with and from each other…" This technique made it easier to adapt to when I transitioned into Computer Science. My narrative reads, "*…it was much easier adjusting to a new environment, new people, new expectations and a new situation and understanding that if things do not go according to plan, I had the ability to adapt if things didn't go well…I did it before; I can certainly do it again…*".

4.2.4 Persistence

"*…read for your degree…*" that was the idea that was drilled into our minds from the beginning of our courses and that is exactly what I had to do for the next three years of my history studies. Most of the times we would go into a lecture hall, listen to the lecturer who would only introduce the topic but go no further. The onus was on us as students to familiarize ourselves with all the concepts and theories related to the topic and be ready for tutorials and exams: "*…a self-teaching method as I like to call it…*". This persistence was a tremendous asset when doing computer science, especially in programming. Programming has a notorious reputation for being difficult to learn and having a high dropout rate. This dropout rate was seen in my Computer Science schooling years; each year classes would dwindle considerably. For instance, I began my Computer Science degree with approximately 80 students, by the second year the class dwindled to around half of the original enrolment, and by the final year there were only about 20 students left, with 3 of these students being students from a previous year.

Programming cannot be fully taught in the confines of a classroom, "*…the lecturer can only teach the fundamentals of programming and nothing more; it was up to us to go home and learn all we could whether it was online or through the recommended textbooks…*". Therefore, it requires the persistence to be in a constant state of research for understanding the syntax and use of it in developing solutions, but more importantly it requires the ability to brave the frustrations of dealing with coding bugs and faulty logic. This persistence I was already familiar with from my time in Humanities. For me "…it felt quite natural to sit with my computer and textbooks and learn all I could by myself…struggling through any topic that was challenging…and motivating myself to push through…".

5. Discussion

This section seeks to interpret and explain the significance and importance of the findings through the lens of an interdisciplinary approach to higher education and organised by Shen, Lui and Sung's (2014) theory of interdisciplinary knowledge integration.

5.1 Translation

Benson (1982) argues that interdisciplinary studies are nothing more than a borrowing of insights or methods from one discipline by another. As he stated, "*the physicist is lost without mathematics; the political scientist borrows insight from sociology, history and economics; the literary studies scholar makes use of the methods of linguistics and analytic philosophy.*" This borrowing of insight where there is a logical integration of disciplines has already been highlighted in current literature. For instance, Klaassen's (2018) a case study of interdisciplinary educational Bachelor programme on Clinical Technology and MIT's undergraduate in Biological Engineering that integrates the knowledge of Biology and Computer Science (Tadmor & Tidor, 2005).

However, Benson (1982) further claims that interdisciplinary studies rest on serious conceptual confusion, that is, students often lack a clear and coherent sense of purpose. My reflections show that the ease of translation of knowledge between the disciplines within these established studies is not necessarily applicable between Humanities and Computer Science. In the case of Humanities, "the focus is on contextualisation; to perceive other perspectives in depth, to practice critical analysis and interpretation of historical documents in order to form a picture of past events" (Repko et al., 2017). Computer Science, on the other hand, encompasses practical techniques of developing computer software and hardware, as well as expressing instructions necessary to perform useful computation (What is Computer Science?, n.d.).

This stark difference between these two disciplines is clearly seen by the different approaches to assignments, where in the case of History the assignments were more subjective in its approach as compared to a more objective approach with Computer Science assignments. This subjectivity is what many trained in the sciences find alien and have led to the rejection of history as insubstantial; and this thinking is what accounts for the reason why STEM (Science, Technology, Engineering and Mathematics) disciplines is often studied in silos and not in tandem (Skorton, 2018). While it is arguably undeniable from my narratives that there is no clear sense of purpose for integrating Humanities and Computer Science, the rest of my narratives have led me to disagree with Benson claims. Such a connectedness of integrative disciplines does not negate the deeper insights that can be gleaned from integrating 'not-connected' disciplines such as Humanities and Computer Science. Each discipline has its own views, very often conflicting. However, it is these conflicting views that provide the skills that may not be available to someone of any one discipline (Miller, 1982).

5.2 Transfer and transform

It has already been uncovered that Humanities and Computer Science is not conceptually alike and does not provide any means of translating methodologies or perspectives. Therefore, it can be argued that interdisciplinary education may in fact impede a student's ability to develop essential competencies of their own disciplines (Benson, 1982). For instance, the most frequently cited skills necessary for Computer Science students are their ability to solve problems, and mathematical ability (Medeiros et al., 2019). Developing abilities and skills such as these, no doubt cannot be gained from Humanities. However, my narratives show that Humanities can offer several competencies that can transfer and transform the learning experience of Computer Science students. These findings have led me to disagree with Benson' assessment. The narratives highlight two competencies that were transferable between Humanities and Computer Science:

1. Attention to detail, which was the ability to analyse and use creativity to develop solutions. That is the ability to think critically.
2. Communication, which is the ability to read, comprehend and effectively communicate ideas.

These uncovered points have supported the arguments of the current literature as it relates to other disciplines within an integrated approach. For instance, Bear & Skorton (2019) argued that interdisciplinary education allows for improved written and oral communication skills, critical thinking, and ability to apply knowledge in a real-world setting. It is also supported by the results of Kali & Kidron (2015) in which students noted critical thinking and writing skills mostly developed when undertaking a course using an interdisciplinary approach. This is further supported by You (2017) who argued that interdisciplinary learning helps students tap into cognitive processes that creates links between disciplines.

While most points uncovered in the findings support the arguments of current literature as it relates to interdisciplinary higher education, however, these viewpoints (in current

literature) were formulated from a general view or studies that do not directly deal with Humanities and Computer Science. Therefore, it is worth noting the difference an interdisciplinary approach to Humanities and Computer Science can provide that has not already been realised from other related or integrated disciplines. In this regard, Khalid et al. (2013) argues that despite engineers having good critical thinking skills they often lack interpersonal skills and the ability to communicate effectively. In other words, humanities can strengthen the ability of engineers to communicate both written and orally and it enhances their ability to develop creative ideas and solution outside their field of study (Khalid, et al., 2013). Skorton (2018) added to this by claiming that integrating Humanities and STEM disciplines provides the outcomes of higher order thinking, creative problem-solving and enhanced communication. Bear & Skorton (2019) when examining the results of the trend in higher education in the context of a National Academic Consensus report noted that students with an interdisciplinary background in the Humanities and STEM had a greater student motivation and engagement during their studies, as well as an increase in communication and teamwork skill (Bear & Skorton, 2019).

Added to this unique value, the findings also uncovered two additional values not observed in current literature: adaptability and self-teaching:

1. Adaptability, which allowed for an ease of adjustment to new approaches, new people, and new expectations. This was particularly valuable in a changing environment as Computer Science.
2. Self-Learning, which ensured that there was not a reliance on classroom lectures to learn the fundamental concepts and theories related to a topic. This is particularly beneficial in the study of Computer Programming where continuous practice outside the classroom is necessary.

Therefore, it is evident that the Humanities and Computer Science are fundamentally connected more than they are mutually reinforcing (Skorton, 2018). It is these competencies and its impact rather than the conceptual integration that provides value to an interdisciplinary approach to higher education between the disciplines of Humanities and Computer Science. Steve Jobs, when introducing the iPad2 in March of 2011, made the statement "*…technology alone is not enough – it is technology married with liberal arts, married with humanities that yields us (Apple) the results that make our heart sing*."

6. Limitations

The research uncovered various competencies gained while studying Humanities that changed and enhanced the learning experience of Computer Science. However, whether these competencies were a direct result of a previous study in Humanities or because of other factors were not explored in this study.

7. Conclusion

Much of the research that concentrates on an interdisciplinary approach to higher education often focuses on disciplines that have a symbiotic relationship where methodologies and principles are easily transferable between disciplines. However, an analysis of the current research has uncovered two specific gaps. Firstly, not much of the literature has dealt specifically with Computer Science; and secondly, none that I have found dealt specifically with an interdisciplinary approach to Humanities and Computer Science. Using my unique background and experiences as a student of both History and Computer Science, this research intended to contribute to this gap in literature.

This research has shown that although the approach to education between History and Computer Science differs significantly and the actual methodology or perspective are not transferable, it still offers valuable competencies that greatly improves the learning experience of students. These include enhanced communication skills, enhanced critical thinking skills and the ability to be adaptable and self-teaching. For this reason, it is important for higher education institutions to recognise these benefits and move to introduce an interdisciplinary approach to Computer Science. However, this is easier said than done. Introducing such an approach provides new challenges for institutions that requires the introduction of new teaching and learning approach and assessment methods that caters for disciplines that that are pedagogically polarised, such as Computer Science and Humanities.

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Acknowledgements

This paper draws on research undertaken as part of the Doctoral Programme in E-Research and Technology Enhanced Learning in the Department of Educational Research at Lancaster University.

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