INTERDISCIPLINARY EDUCATION: MEMORIALISING LEARNING EXPERIENCES

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Abstract

Over the past few decades, global institutions such as the Organisation for Economic Cooperation and Development (OECD) have helped homogenize educational policy and similarities can now be seen in curricula across the globe (Priestley, 2002: Sahlberg, 2007). One feature of many new curricular models is the emphasis placed on giving students transferable, generic skills through a focus on studying 'cross cutting themes' which blur disciplinary boundaries e.g. France (Baillat & Niclot, 2010), Spain (Segovia *et al*., 2010), Canada (Hasni *et al*., 2015) and Australia (Long *et al*., 2010). It could be said that in preparing students for life in the post-industrial information age, the "what" that students require to know has now changed (Virtue *et al*., 2019). Interdisciplinary learning (IDL) is promoted as something which allows educators to facilitate this change and develop skills building and conceptual creativity in their pupils, factors which are crucial for the twenty-first century education system (Khadri, 2014; Kolmos, 2016). Critics of an integrated approach to learning argue that this can be detrimental to students because it dilutes and weakens the powerful knowledge contained within the disciplines (Young and Muller, 2010, Young *et.al*, 2014). The assumption, here, is that the acquisition of this 'powerful knowledge' is dependent on it being delivered through discrete, specialised subjects. However, others argue that the opposite it true and that by making learning experiential and allowing students to explore relevant problems and questions, knowledge is actually enhanced, memorials of events are created through the experiences and students are prepared more holistically for life beyond the school gates (Dewey: 1938, Guissani, 1995: Beane, 1997). This paper considers the purpose of schools, the nature of IDL in relation to knowledge and explores its usefulness as a tool to help educators to offer students "a response to a question one lives" (Guissani, 1995). It argues that rather than memorising facts for the purpose of passing exams for example, interdisciplinary approaches enable pupils to unitise digital technologies and memorialise learning which they can then use and apply in real life contexts.

Keywords – interdisciplinary, problem-based, knowledge, skills

Introduction

Global policies, such as *Teaching for Global Competence in a Rapidly Changing World* (OECD, 2018), emphasise the need for young people to acquire key skills which cannot be taught discretely, but instead blur disciplinary boundaries, integrate knowledge, and require application within real life contexts (Rychen and Salganik, 2003). Sinnema and Aitken (2013), suggest that, across different countries, the terms competencies, capabilities, capacities, interdisciplinarity and cross curricular all have similar meanings. So, while capacities and interdisciplinarity feature strongly in Scotland's Curriculum for Excellence, the Australian curriculum refers to 'capabilities', New Zealand's national curriculum details five key 'competencies' and Northern Ireland's curriculum outlines 'cross curricular skills'.

This paper will consider the educational context for the development of interdisciplinarity within curricula across the globe. The nature of skills and knowledge will then be explored and the relationship between disciplines and knowledge. Interdisciplinary Learning (IDL) will then be presented as a problem-based approach which can help to develop pupils holistically and prepare them for the world beyond the school gates.

A pragmatic constructivist epistemology has been adopted in this paper as this can take account of the many and varied activities and forms of knowledge that IDL can involve (Boix-Mansilla, 2017). This epistemology recognises knowledge as the product of experience and action and is underpinned by the premise that 'we only know the world as a result of our actions' (Biesta and Burbules, 2003:55).

Skills Development

Over the past few decades, neoliberalism has become the dominant ideology, not only within the economies of countries worldwide, but also in other spheres of public life, including education (Erss, 2015). Apple (2001) argues that the aim of neoliberal education policy is to create a stronger link between the economy and education so that gaps in the skills market can be filled by young people entering the world of work. As a result of this focus on skills, education has seen major changes since the 1980s, with a shift from teacher centred approaches to learner centred ones instead, that is from input to output. Erss (2015) observes that due to the rapidly changing global environment of economy and employment, and the swift advance of technology, which enables factual knowledge (as well as mis-information) to be accessed at the touch of a button, education now places less importance than formerly on the acquisition of knowledge, focussing instead on skills, and this is on a global scale.

Workers need to have strong literacy, numeracy and problem-solving skills, skills in the use of technologies, social and emotional skills and the capacity and motivation to learn. When workers have the mix of skills that is well aligned with the needs of the most technologically advanced industries and

when qualifications reliably reflect what workers can do, countries can develop a comparative advantage by specialising in these industries (OECD, 2017:5).

The development of interdisciplinarity within educational policy can be seen to be directly linked to this growing trend, because it has been closely associated with the development of transferable skills.

Skills V Knowledge

Critics of interdisciplinarity, argue that taking a skills-based approach to learning leads to a concentration on activity-based tasks which serve to undermine deep and meaningful disciplinary knowledge (Paterson, 2009). For example, social realists view schools as places where pupils gain access to powerful knowledge. They differentiate between what they see as every day, ordinary, knowledge and specialised, disciplinary knowledge. Within social realist literature it is recognised that children come to school already having understandings and experiences, but the role of schools is seen as that of providing young people with esoteric knowledge that they would not ordinarily have access to at home (Young and Muller, 2010).

Social realists view the acquisition of powerful, specialised knowledge, as a way of giving young people a chance to become upwardly mobile in social terms. The blurring of disciplinary boundaries is viewed as being a danger in the sense that it may lead to students experiencing a lack of exposure to powerful, intrinsic knowledge contained within the traditional disciplines and hold that this is potentially harmful to young people whose life chances could be adversely affected as a result. The assumption here is that the acquisition of this 'powerful knowledge' is dependent on it being delivered through discrete, specialised subjects with the emphasis on accumulation and memorisation of knowledge facts. Here it will be useful to consider the nature of disciplines and the relationship between disciplines and knowledge.

Disciplines

Gardner (2006) observes that being open to knowledge is one thing, but he highlights that making sense of it and giving it an order is quite another. He points to The Bible and the Ten Commandments, in particular, as an example of early attempts to present a synthesized knowledge about how to live. Later, philosophers such as Socrates, Plato and Aristotle began to delineate knowledge, not only about how to live, but also about the world as they understood it at the time. Organising or disciplining forms of knowledge into separate categories has become the foundational structure of our education system and the traditional disciplines we know today. A discipline can be said to be a way of organising knowledge into a set of objects or subjects using theories, concepts, methods and procedures. Disciplines change and are shaped over time by external influences and intellectual development and come to produce a

particular view of the world which exerts a certain amount of authority and influence. Klein (2009) points out that although the modern system of disciplinarity is little more than a century old, the etymology of the term 'discipline' is ancient with the Latin root of 'disciplina' pertaining to the instruction of disciples in an educational setting. It was not, however, until the late nineteenth and early twentieth centuries that disciplines were delineated and separated into individual academic divisions. As new fields of study are developed however, the lines between the traditional disciplines are often blurred and subjects can become hybrids e.g. biochemistry and geophysics.

Defining a discipline is complicated by the fact that some disciplines are more formal and more structured than others. For example, distinctions have been made between sciences which are highly subject specific and mathematical, such as physics and chemistry, and those which are less formal such as the social sciences. Whitley, (1978) for example, refers to the former as restricted sciences and the latter as configurational sciences. Toulmin (1972) goes a step further and differentiates between what he calls 'compact disciplines' like physics and biology, 'would be disciplines' like the behavioural sciences and 'non-disciplinary activities' such as ethics and philosophy. Lenoir (1997), suggests that disciplines can be categorised into those which are concerned with the construction of reality, those concerned with the expression of that reality and those which ensure we have a relationship that reality.

Klein (1990) makes the point that some disciplines are more receptive to changes and subject to growth than others. Some have a greater propensity to borrow from other disciplines, for example, since its inception psychology has been known to borrow from maths, physics and physiology. In so far then as a discipline has evolved and developed over time, it could be argued that there is no such thing as a 'pure' discipline.

Unity of Knowledge

Interdisciplinary perspectives require a view which holds that all knowledge is somehow whole or can be unified within certain broad fields of experience (Pring, 1972). Newman's (1873) 'circle of knowledge' provides an example of such a view where each discipline is seen to occupy a particular part of the circle and can only answer questions relevant to its own particular field. To gain a holistic education, Newman argued that one had to be familiar with the whole circle and that to acquire a true understanding of reality, engagement with a variety of disciplines is necessary. Those in favour of interdisciplinary learning argue that by providing students with opportunities to explore relevant, real life problems and questions, they are able to apply their disciplinary knowledge and skills and this experiential learning serves to consolidate and further their understanding in a way that merely memorising facts and figures cannot do (Beane, 1997: Boix-Mansilla, 2017: Harvie, 2020).

Teachers as curriculum makers

Deng (2017:16) argues that "teachers are fundamentally curriculum makers – not curriculum deliverers or implementers as conceived in the academic standards and accountability movement". Shulman (2013) suggests that teachers are professionals rather than mere technicians insofar as they can rationalise, justify and explain what they are doing and why. "The teacher is not only a master of procedure but also of content and rationale, and capable of explaining why something is done" (Shulman, 2013:10). So, it could be argued that for teachers to make informed decisions around IDL, the curriculum they deliver and the pedagogical approaches they use in the classroom, they need to engage with questions around the purpose of schools, the role of the teacher, the nature of knowledge and disciplines. Doyle (1992), asserts that effective teachers must be curriculum theorists and that curriculum making requires interpretation, judgment and responsibility.

Priestley and colleagues (2021) advocate that teachers need to engage with the purposes of education as a starting point for curriculum making. Deng and Luke (2008) point to four broad ideologies or orientations around the purpose of education:

- Academic rationalism – traditional/liberal forms of knowledge/content-led education
- Social efficiency – preparation of future citizens and learners – technical-rational
- Anthropology – focused on human development, child centred
- Social reconstructionism - challenging inequality, social justice, redistribution.

It could be argued that these orientations are not mutually exclusive and that aspects of more than one may exist within individual schools. However, the 115ndependen ideological focus will undoubtedly shape the kind of curriculum and educational experience pupils have. In developing a vision and common purpose therefore, it would seem logical for school leaders to spend time engaging staff with questions around what they see to be the main purpose of education.

Problem-based learning

Beane (1997) draws on the work of Dewey (1938) to argue that education is something which should be experiential, relevant and 115ndepend based so that knowledge is embedded and memorialised through the student experience. Giussani (1995) concurred with this view arguing that the purpose of education is to fashion pupils into well rounded human beings who are 115ndependente and able to face the world around them on their own. As a Catholic educator, however, Giussani believed that when educating holistically, the spiritual dimension of students should also be taken account of and that teachers should help pupils develop a personal relationship with Christ on their educational journey by encouraging them to engage with real life problems, questions and issues while being guided by the traditions of the Catholic Church. Franchi states that "The Catholic School is called to be na educational

community which forms the human person in integral unity…" (Franchi, 2016:135) and Catholic teachers have the mission to "..promote human flourishing, through a call to centre everything on God" (Rymarz and Franchi, 2019:15).

Giusanni (1995) proposes that this mission of the Catholic teacher can be realised through adopting a problem-based approach to education. He suggests that although the word 'problem' may have developed negative connotations, its etymology is rooted in the Greek word 'krino' meaning 'to sift through' or 'to sort out' and these are in fact positive and constructive actions. Therefore, by engaging in relevant and purposeful problems, young people can be guided towards autonomy and begin to acquire a deeper understanding of God and their place in the world. Pupil autonomy is described as 'a risk' for the teacher because the freedom of the pupil must ultimately be respected and this poses a risk "…for the teacher's intelligence, and heart and even for his pride" (Giusanni, 1995:81). While it is possible to address real life problems and issues while adopting a disciplinary approach, some problems or issues are too broad or complex to be addressed by one discipline alone. These require insights from more than one discipline and therefore necessitate an interdisciplinary perspective.

Implementing a problem-based interdisciplinary approach means practitioners need to be able to adopt facilitative roles, to manage student work without overly directing it, and to support students' efforts to become self-directed learners (Ertmer and Simons, 2006). One of the biggest challenges that teachers face as they begin using these methods is that of assuming a less directive role (Ward and Lee, 2002). In general, the teacher in a problem-based IDL approach acts as a guide who helps students collaborate to generate solutions to problems (Kolodner *et al.*, 2003). The emphasis shifts from a focus on grades, competition, and public comparison with others to that of enquiry and understanding (Gallagher, 1997). The teacher becomes a facilitator of learning rather than simply a transmitter of knowledge.

Interdisciplinary approaches require different forms of knowledge to be recognised and valued (Harvie, 2020). These forms of knowledge can be categorised into three main areas:
- propositional knowledge – relating to theory, knowing 'what'.
- procedural knowledge - being able to apply what is known, knowing 'how'.
- epistemic knowledge – relating to the conventions and nuances of the different disciplines and how they work.

Viewing knowledge in this way provides a strong counter 116roblema116 to critics of skills-based curricula who often protest that by focusing on the development of skills, knowledge is sacrificed (Paterson, 2009). Here skills are seen as a 116roblem procedural knowledge and are a vital 116roblema116e of the learning process. This is aligned to the view that Dewey held because he did

not believe there to be a stark divide between the theoretical and practical. Instead, he saw the theoretical as na offshoot of the practical and propositions being true only in so far as they were helpful or relevant in addressing problems (Pring, 1972). A 117roblema IDL will now be considered which promotes the idea of a 117roblema-based, experiential approach to learning and knowledge development.

Academic definitions of IDL

IDL involves a fusion of knowledge to a level which would not be possible through working within disciplinary boundaries alone (Boix-Mansilla, 2017). Repko (2008) draws on a number of definitions of interdisciplinary studies and defines it in the following way:

> Interdisciplinary studies is a process of answering a question, solving a problem or addressing a topic that is too broad or complex to be dealt with adequately by a single discipline and draws on disciplinary perspectives and integrates their insights to produce a more comprehensive understanding or cognitive advancement. (Repko, 2008:12)

This definition includes an important theme which is central to IDL in the academic literature, namely that of students being involved in solving problems or finding solutions to questions which are relevant to them. Philosophers such as Augustine (2009) have long seen problems as a source of knowledge creation and influential educational theorists such as Giussani (1995) and Beane (1997) argue that grappling with purposeful problems is a way to give students a holistic education. Problem solving is an important aspect in impelling students to find their own answers, draw their own conclusions, and create their own solutions (Brand and Triplett, 2012).

In terms of developing interdisciplinary competencies and disciplinary knowledge, some research studies have shown that there is a benefit when students are given a purposeful challenge to design or create a product or artefact of some kind using more than one disciplinary insight, (Fortuin & Bush, 2010: Solomon & Salfi, 2011). This can be referred to as a project-based approach to IDL in the literature. However, when comparing project-based to problem-based learning, where a relevant problem is the driving force and problem-solving strategies are developed alongside disciplinary knowledge, Brassler and Dettmers (2017) found that problem-based approaches were much more effective. Their research findings conclude that a problem-based methodology enables students to establish their own interdisciplinary purpose, gain disciplinary insights and develop their ability to synthesize and reflect on learning.

Virtue *et al.* (2019) argue that interdisciplinary lessons are more effective when they are problem based and Klaassen (2019) agrees that 'the problem' should be central to the learning outcomes when designing interdisciplinary activities. Such perspectives on curriculum development can be seen to have

their roots in the foundational work of Dewey whose premise for cognitive development was that throughout history, knowledge has been generated by addressing problems (Pring, 1971). Commentators such as Thorburn (2017:242) draw on Dewey's "learner led ideals", experiential learning and problem-solving principles to argue that Dewey has much to offer in terms of designing an interdisciplinary approach.

Establishing a purpose and making tasks relevant is another important aspect of interdisciplinary work. (Beane, 1997: Boix-Mansilla, 2010: Hedge & McKenzie, 2016). Pring (1971) warns though that merely focusing on practical methods which may be motivating and engaging for pupils, does not necessarily lead to an integration of knowledge and can result in an instrumentalist view of education. However, it could be argued that if the problems and challenges posed are intellectually stimulating enough as well as being relevant, this is what acts as a catalyst for breaking down disciplinary barriers in the mind of the students and helps to unify their knowledge. Unification of knowledge is something in fact that Pring (1971) characterises as core in his 'strong thesis' for IDL.

Holbrook (2013) suggests that it is important to acknowledge that certain disciplines (with their own internal logics, unique vocabularies, discourses and structures) may be hard to integrate. He asserts, however that 'communication' between disciplines is possible when there is a deep understanding of each disciplinary area. Another key component of IDL then is that it needs to be informed by strong disciplinary insights (Boix-Mansilla, 2004). Students must have a grounding in disciplinary knowledge before they can engage in an interdisciplinary task. Beldaro *et al.*, (2017) found that combining certain disciplines (art and science, in particular), enhanced the meaningfulness of tasks for students. Gardner (2006) cites this need for strong disciplinary foundations to argue interdisciplinary activities are not suited to very young children because they do not have sufficient disciplinary knowledge to draw on.

'Cognitive advancement' is another area central to IDL. Students need to be sufficiently challenged so that they further their knowledge and understanding beyond that which would be possible by studying discrete disciplines. This enables them to develop transferrable skills and enables them apply their skills and knowledge to familiar and unfamiliar contexts. This type of learning moves away from the traditional notions of students simply acquiring academic information towards the student being able to apply their knowledge and skills to practical contexts (Humes, 2013). IDL leads to a development in the ability of students to reason in different ways, make judgements, assess and evaluate (Hedge and MacKenzie, 2016).

Interdisciplinary Learning

The interdisciplinary approach then is one which propels students to draw on their existing disciplinary knowledge and skills (from two or more disciplines), in order to complete a sufficiently challenging activity or problem which they have been set or have set for themselves. So, while cross-curricular and multi-disciplinary tasks may blur disciplinary boundaries, IDL goes further and fosters synthesis, resulting in cognitive advancement in the respective disciplines (Repko, 2008). As can be seen from Figure 1 below, during interdisciplinary activities, the disciplines are integrated during the process of undertaking the tasks which may or may not be related to a central theme as this figure shows.

Figure 1: Interdisciplinary Learning
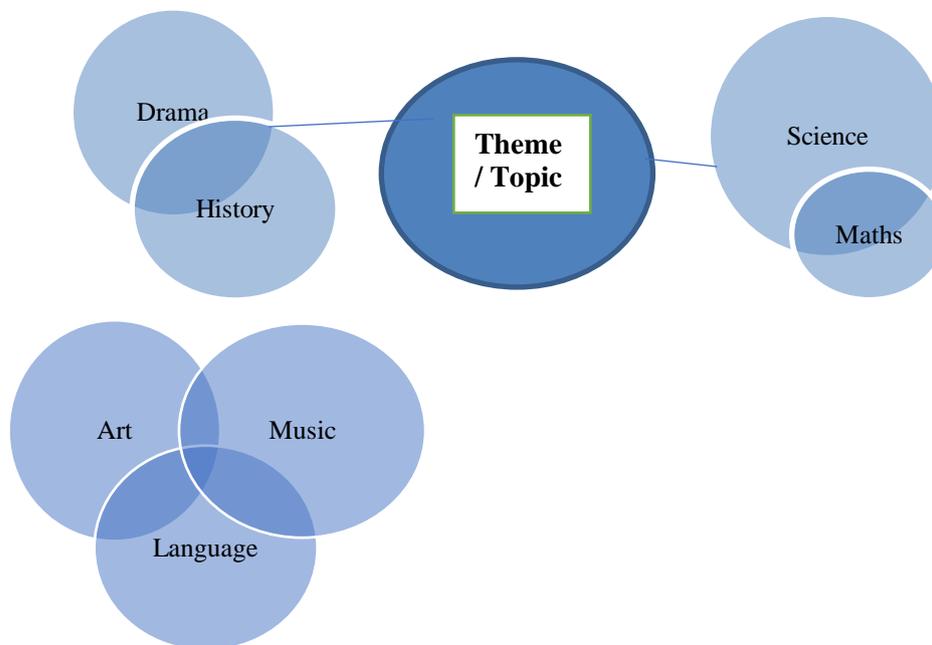
To summarise from the above then, the key elements which emerge from the academic definitions of IDL are that –

- The starting point is a problem or challenge which is too broad to be dealt with by one discipline alone and challenging enough to promote cognitive advancement.
- The IDL activity should be purposeful, meaningful and relevant to the students.
- There should be a grounding in two or more disciplines in order to draw on them to address the interdisciplinary task.
- During the interdisciplinary process knowledge from the different disciplines is applied and integrated in the mind of the learners.

These points align with what Boix-Manislla (2004) terms as the core premises of IDL. The diagram below offers a framework to illustrate the nature of the relationship between the elements outlined above and the experiences students gain in the process.

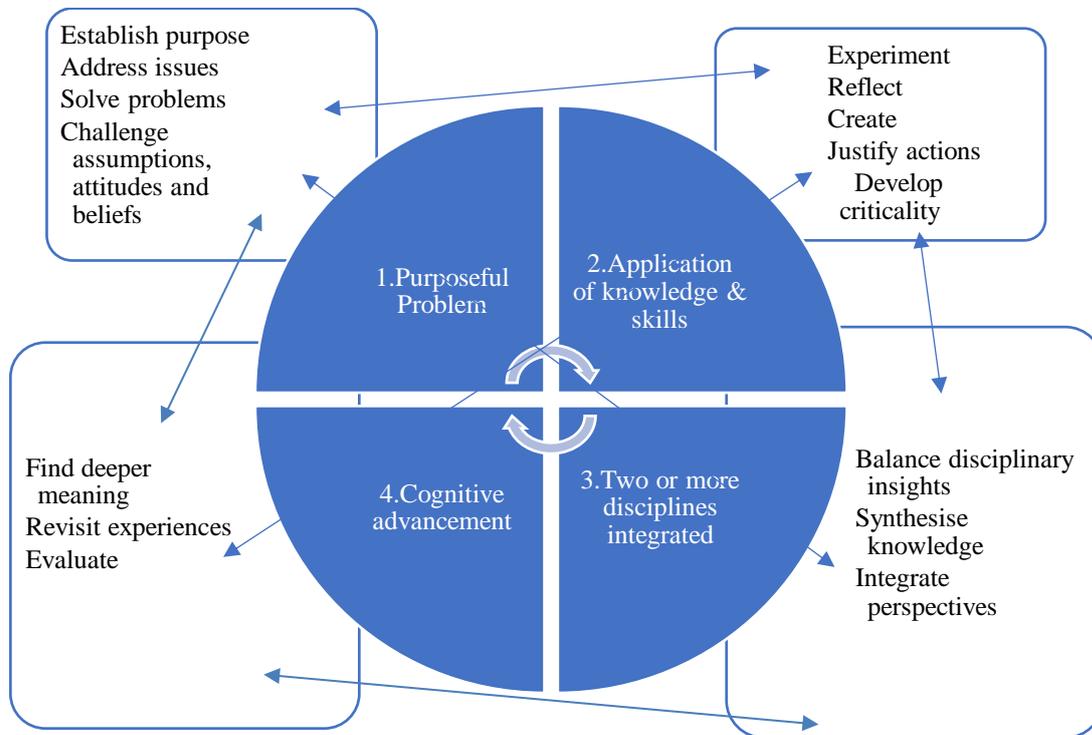**Figure 2: Relationship Between Core Elements of IDL**

Figure 2 demonstrates that an interdisciplinary approach begins with a problem, question or issue which is meaningful to the learner. This has to be sufficiently challenging and purposeful to impel the student to apply and integrate their knowledge and skills from two or more disciplinary areas in order to solve or answer it. During the activity pupils engage in a process of reflective equilibrium, defined by Virvidakis (2015:77) as "….a state of coherence of our thoughts about one or more issues, resulting from a deliberative process of mutual adjustment of beliefs, principles, theories, and arguments". This involves students developing criticality, reflecting, justifying their actions, integrating perspectives, revisiting their experiences and evaluating their findings throughout the process as the diagram shows. The arrows indicate that this is not a linear process but is more rhizomatic in nature.

Benefits of an ID approach

In answer to those who argue that IDL weakens a student's ability to absorb knowledge, supporters of IDL, such as Beane (1997), propose that far from weakening a student's ability to absorb subject knowledge, knowledge is called forth during the contexts of the IDL task. This may be compared to a real-life situation such as fixing a car engine for example. When a mechanic goes to fix a broken-down

engine he or she does not stop to think about whether what they are doing requires mathematical, chemical or disciplinary knowledge from the field of physics, they simply draw upon their existing knowledge and skills to solve the problem facing them. If, therefore, an IDL task is relevant and engaging enough for a child it should mean that disciplinary boundaries are blurred and the application of knowledge and skills means connections are made naturally and instinctively.

Many within the educational spectrum claim that an interdisciplinary approach is beneficial to students. Duran, Duran and Worch (2009) draw upon the work of cognitive psychologists to claim that during IDL work, learning is enhanced through the establishment of connections in the brain. They say that establishing complex learning experiences makes for more effective learning as neurons have to perform multiple operations at once (Cohen, 1995).

Jones (2009) suggests that interdisciplinary techniques go beyond multi-disciplinary or cross curricular approaches (these terms will be explored later) by allowing students to see different perspectives, work in groups and make synthesizing of disciplines the ultimate goal. Interdisciplinarity has been linked with promoting higher order, critical and holistic thinking skills. This holistic thinking is the ability to understand how ideas and information from relevant disciplines, relate to each other and to a particular problem. Duerr (2008) argues that students through interdisciplinary integration are able to apply their knowledge and understanding to real world scenarios. Staples (2005) claims that integration of interdisciplinary studies offers students advanced thinking skills and enhanced ability to solve real life problems. Many argue that this is a powerful and engaging strategy that leads to sustained and transferable learning (Hiebert *et al.,* 1996; Jones *et al.*, 1996).

Research carried out by Hmelo-Silver *et al.* (2009) showed that students who participated in a problem based interdisciplinary approach were able to construct a deeper understanding of the concept of transfer than students who did not. In their study, students involved in this type of work were also able to apply their understandings of the concept to generate recommendations for improvements of instructional methods. Their small-scale quasi-experimental study was conducted in the further education sector so its transferability to a school setting may not be direct. However this evidence provides credence to the results of Derry *et al.* (2006) whose findings demonstrated similar results. Both reports give weight to the claims made that interdisciplinary learning can promote deeper thinking and aid the making of links between disciplines.

Authors such as Youngblood (2007) and Duerr (2008) support the view that interdisciplinarity is a tool and hold that the key to interdisciplinary success is methodology. It is not enough to merely transmit disciplinary knowledge using text books or other means to students but instead students must be

stimulated, challenged and encouraged to apply this knowledge in creative ways. This suggests that pedagogy is important in ensuring the success of IDL. Youngblood and Duerr both claim that interdisciplinary techniques will go further than helping students synthesize and integrate knowledge but will also enrich a student's lifelong learning habits, academic skills and personal growth.

Adler and Flihan (1997) claim that many teachers involved in IDL work also claim benefits such as an increased enthusiasm for teaching and a renewed interest in their profession. Teachers also find students being more engaged in their learning and have increased opportunities for collegiate working which are beneficial. Adler and Flihan acknowledge, however, that the benefits of IDL are not firmly grounded in theory and research as many of the practical accounts are mainly anecdotal and so cannot clearly inform future practice. They say that interested researchers in this area are in an opportune position to expand upon our knowledge of IDL in a number of areas.

Conclusion

To conclude, this paper has considered the global policy context for the current trend in development of interdisciplinary approaches within curricula worldwide. Interdisciplinarity has been linked to skills-based learning and it has been argued in this paper that skills are a form of procedural knowledge which is concerned with the application of knowledge which has been acquired. It has also been argued that teachers as curriculum makers need to engage with questions around the purposes of education and their role as teachers when developing the curriculum for the young people in their care. Giussani (1995:10) states that "an education must be critical. The student must be exposed to the past though life experience…" A problem-based model of IDL has been presented as an approach to give students real life, experiential learning opportunities and a way to memorialise their learning experiences rather than just memorising facts and figures. IDL can therefore be seen as a tool for teachers to use to prepare well rounded, critical thinking adults who are able to flourish and contribute positively to the society in which they live.

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