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PHILADELPHIA, USA

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CONTENTS

EDITORIAL NOTE
JAMES OGNLEYE. A varied and diverse collection of papers on Knowledge, Innovation and Enterprise

PAPERS
SETH AGBO. Paradox of Internet and Tradition: Dialogical Integration of Technology and Indigenous Knowledge .................................................................7

HELEN CRIPPS, THOMAS MEJTOFT & ABHAY KUMAR SINGH. The role of Twitter in B2B Knowledge Exchange and Innovation ...................................................27

JOANNA NIEŻURAWSKA, ANNA DziADKIEWICZ, LECH NIEŻURAWSKI, NELSON DUARTE, CARLA SOFIA GONÇALVES PEREIRA & VITOR RICARDO SANTOS. Enablers and Barriers of Knowledge Transfer in selected EU Countries as Viewed by IT enterprises ........................................................................................................47

OLGA NESSIPBAYEVA, LYAZZAT ATYMTAYEVA & TOLKYNAYI SADYKOVA. Expert System for Professional Orientation .................................................................64

TOMISLAV TOPOLOVČAN & MILAN MATIJEVIĆ. Constructivist Learning and Digital Media .............................................................................................................78

MUSTAFA YASSEN & KHALED ALJIBOURY. E-Learning in Mathematical Computer Related Courses at Faculty of Information Technology, Al-Ahliyya Amman University ..........................................................................................................................................................99

CHIJOIKE O. AGOMO, JAMES OGNLEYE & JANE PORTLOCK. A survey to identify strategies to enhance the public health role of community Pharmacists ........................................................................................................117

ZDENEK DYTRT & MIROSLAV NĚMEC. Why is Ethics of Management So Necessary? ..................................................................................................................138

DERYN GRAHAM. Big Data Science Education and the PIPAE Methodology for Big Data Analytics ........................................................................................................144

MUHAMMAD SHARIAT ULLAH & MINHAJUL ISLAM UKIL. Entrepreneurial Intention and Efficacy of Business Graduates in Bangladesh: Do Demographic Factors Matter? ........................................................................................................161
A varied and diverse collection of papers on Knowledge, Innovation and Enterprise

We kick off this volume with a paper by Seith Abgo about the ‘Paradox of Internet and Tradition: Dialogical Integration of Technology and Indigenous Knowledge’. The paper presents us with a ‘model for integrating modern technology and Indigenous knowledge’; and concludes with suggestions on how university-based researchers and indigenous community relations can be mediated. Agbo’s paper is followed by that of Helen Cripps and her colleagues. Their paper focuses on social media technologies specifically the ‘role of Twitter in B2B Knowledge Exchange and Innovation’.

Still on knowledge, in their paper, Joanna Nieżurawska and her colleagues sought to ‘identify both the enablers and barriers of knowledge transfer in selected EU countries’ from the perspectives of IT enterprises. Olga Nessipbayeva and her colleagues, in their paper, examine the application of an expert system for ‘professional orientation’. Their paper concludes that an online expert system not only guides students in their selection of future professions, but also offers information and knowledge about the psychological aspects of their professional choices—necessary for self-realization.

Tomislav Topolovčan’s and Milan Matijević’s paper on ‘Constructivist Learning and Digital Media’ sought to ‘determine the extent to which certain socio-demographic features of the respondents, along with their level of computer self-efficacy and their attitudes (motivation) towards the use of digital media in classrooms.’ The latter paper was followed by that of Mustafa Yassen and Khaled Aljibboury—‘e-learning in Mathematical Computer Related Courses at Faculty of Information Technology, Al-Ahliyya Amman University’.

Chijioke Agomo and his colleagues reported a survey which aims to identify strategies to enhance the public health role of community pharmacists. The findings from the survey highlight the training and skills needs of undergraduate and post-graduate students of pharmacy.

Zdenek Dytrt and Miroslav Němec raise the question of the necessity of ethics in corporate management. The paper highlights management of ethics and its subsystems—morality, competence and its application. The paper draws a number of conclusions—one is that ‘quantitative traits of business phenomena that are presented by corporate indicators are necessary to monitor the impact of their qualitative values’.

Deryn Graham’s paper on ‘Big Data Science Education and the PIPAE Methodology for Big Data Analytics’ identifies ethical and pragmatic issues—particularly those related to education, and opportunities that big data science brings.’ The volume is concluded by Muhammad Ullah’s and Minhajul Ukil’s paper which examines entrepreneurial intention and efficacy of business graduates in with particular reference to Bangladesh. Keeping to the tradition, the volume all adds up to a very diverse and varied collection of papers.

James Ogunleye, Chairman, 2016 KIE Conference
Paradox of Internet and Tradition: Dialogical Integration of Technology and Indigenous Knowledge

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Abstract

This paper describes a model for integrating modern technology and Indigenous knowledge. The paper examines how university-based researchers can create new innovations in Indigenous research by encouraging various Indigenous cultural ideas and grafting them into technology in a way that pools all talents and resources together and allocates these talents and resources efficiently. The paper delineates how shared fundamental values of human rights and social justice can be utilized in a dialogical process for integrating technology and Indigenous knowledge. Specifically, this paper looks more closely at: 1) the origin of the Indigenous research problem; 2) the equitable engagement and fair allocation of responsibilities and resources; 3) participation in decision making and consensus; 4) the understanding of power relationships; 5) the prospects for collective learning; and, 6) how technology can be mediated and defined in terms of culturally structured and shared values, beliefs and symbols. The findings indicate the possibility of dialogical integration of technology and Indigenous knowledge by creating a boundary of learning where there is the need to go beyond Eurocentric technical traditions and culture and to encourage a cross-pollination of insights, practices and mental archetypes of Indigenous knowledge and cultures with technology. The paper concludes that the university-based researcher and indigenous community relations can be mediated and defined in terms of a system of culturally structured and shared values, beliefs and symbols about learning in a participatory research model and, for a meaningful and relevant research in Indigenous communities there is the need for mutual exercise of control and power between the university-based researcher and placing Indigenous knowledge in a conspicuous place in academic research.

Keywords: Internet, tradition, technology, Indigenous knowledge, social justice, dialogical integration, constructionist epistemology
Introduction

Relatively, little attention is given in the more strictly research literature to the significance of technology in Indigenous societies and the significance of Indigenous knowledge in technology. Neither the vast body of work in technology nor in Indigenous research, have yielded much in the way of thoroughgoing analyses of interception between Indigenous epistemology and technology. Such gaps are particularly remarkable seeing that the pervasiveness of technology in contemporary times provides us with a ready-made conceptual tool for the exploration of the integration of all kinds of knowledge including Indigenous epistemology. The concepts, ‘Internet’, ‘tradition’, ‘technology’, and ‘Indigenous knowledge’ that bear the title of this paper carry the usage of a paradox as they seem uneasy bedfellows (Gratani, et al., 2014). These concepts are embedded with contradiction and also linkage between different procedures. The processes of Internet and technology are inevitably interrelated. However, they are distinct from tradition and Indigenous knowledge. Tradition and Indigenous knowledge have not been compatible with academic knowledge generation (Coombes, et al, 2014; Roy, 2014). Contemporary scholarship has demonstrated that Indigenous worldviews approximate important attributes of sustainable development (Bahr, 2015; Briggs, 2013; Friesen & Friesen, 2002; Gratani, et al., 2014). In this context, Indigenous epistemology is a crucial component in the selection of the criteria for sustainable development and the formulation of corresponding goals for sustainability in a global economy (Bahr, 2015; Gratani, et al., 2014). It is therefore important to realistically assess and devise strategies for integrating contemporary technology and Indigenous knowledge.

Social informatics scholars (Kling, 1999, 2000; Star et al., 2003; Bishop et. al, 2003; Van House, 2004) argue that technology and the social are inseparable and mutually constituted and that responsive, well-designed technologies empower users. When digital systems are used in Indigenous societies for educational purposes, models need to be negotiated, and their implementation tested against the needs of the local inhabitants (Tomaselli, 2014). When conventional Eurocentric models fail to measure themselves against the development needs of the people for whom they are intended they become abstract, erudite concepts entirely removed from the practical issues of the everyday lives of people (Van House, 2004). This paper highlights the significance of the complex relations between technology and Indigenous knowledge, the problems with which they come to grips, and demonstrates that technology and Indigenous knowledge can be integrated when mediated by dialogue, problem posing and social justice (Gratani, et al., 2014). Using a community-based project as a point of reference, this paper explores alternatives to contemporary thinking about the role of Indigenous knowledge in academic research. The paper argues for research in Indigenous societies to move in the direction of a more inclusive, social justice approach to research that integrates Indigenous knowledge with technology in ways that knowledge becomes important to social living (Simonds & Christopher, 2013).

In the minds of many, university-based research is associated with the objective, scholarly account of concepts entirely detached from the real world and
traditions of society (Roy, 2014; Stronach & Adair, 2014)). Indigenous people have resented academic research because they consider the researcher as a person whose chief interest is to couch theory, regardless of whether the theory has any useful significance to Indigenous worldview (Coombes, et al., 2014; Stronach & Adair, 2014).

The greatest error that researchers can make is to assume that research is an isolated or secluded establishment to be contested and interpreted and decide on which knowledge is legitimate to be considered as authentic (Kovach, 2009). Because research is an agent of the wider culture that creates and promotes it, the conflicts, confusions, pressures, and counter-pressures that pervade that wider culture are bound to appear also in research. The manifestations of anti-intellectualism that permeate Indigenous epistemologies are therefore manifestations that affect, overtly or covertly, the attitudes and practices of researchers in Indigenous societies (Agbo, 2010; Regmi & Fleming, 2012). Indeed, in various ways, research in Indigenous societies has become the storm centre of research in that university-based research in Indigenous societies has been under attack that it is encapsulated in positivistic, objective principles, which in retrospect, do not tally with the needs of the Indigenous societies (Coombes, et al., 2014; Ebijuwa & Mabawonku, 2015; Regmi & Fleming, 2012; Simonds & Christopher, 2013). These attacks have resulted in the resurgence of what has become known as the ‘Indigenous methodology’ (Wilson, 2001). Advocates of Indigenous methodology argue that elements of positivism in which researchers deal with Indigenous societies from a position of superior knowledge, status identities, and detachment indicate the absence of a working model or conceptual design to guide researchers in understanding Indigenous knowledge (Innes, 2009; Wilson, 2001).

Moreover, research is conducted on bases of power and is not actualized for purposes of community action and change (Regmi & Fleming, 2012). However, there is very little agreement among the advocates as to the forms of research they believe will advance and strengthen research in Indigenous communities. The perennial uncertainty about research has been the question of the researcher’s relation to the researched (Innes, 2009; Tomaselli, 2014). Not only this is one of the oldest questions in the annals of research, but it is also one of the most debated in research. Today, there are several approaches to that question, particularly in reference to Indigenous societies. The question in Indigenous societies is not about empiricism versus interpretation or if you may, objectivism versus relativism, but rather, the question relates to whether the researcher is an ‘insider’ or ‘outsider’, and, ‘colonizer’ or ‘decolonizer’ (Coombes, et al., 2014; Innes, 2009). This has produced a compelling desire in Indigenous scholars to propound Indigenous methodologies and laws stating necessary and unvarying relations between who should, and who should not undertake Indigenous research (Wilson, 2001). My purpose here is neither to contest the Indigenous methodologies nor to add to the Indigenous methodologies. The thesis of this paper is that there is the need for the critical examination and reformulation of beliefs about research and Indigenous knowledge.
The University-based Researcher and Knowledge Differentiation

Since the university’s beginning in Italy and France in the 12th century to its extension into contemporary developing countries, the university maintains traditions that are resistant to change in spite of the exponential changes taking place in society (Perkin, 1984; Altbach, 1992). Traditionally, elite institutions such as the university are reluctant to break the air of mystery surrounding their existence and the codes of behaviour built over time (Tomaselli, 2014). By tradition, the university commemorates particular kinds of intellectual content and certain types of performance in carrying out its missions (Agbo, 2010; Palmer, 2000; Regmi & Fleming, 2012). The university attempts to remain protected from external meddling, maintaining some form of social differentiation with some types of knowledge more valued or rewarded than others (Agbo, 2010; Quinnan, 1997). The degree of such differentiation and its significance for the way knowledge is perceived varies dramatically across disciplines and within academic departments (Agbo, 2010). Moreover, there are many different bases or criteria for such differentiation. Some of the commonest criteria for differentiation are whether knowledge has been couched in theory or in practice and whether knowledge is objective or subjective (Palmer, 2000; Regmi & Fleming, 2012).

In the perspective of Indigenous knowledge, the approach to knowledge differentiation has its positive and negative aspects. Positively, it supports the leading assumption that Indigenous knowledge is sufficiently different in its rudimentary structures and potential abilities to reach a vastly higher level of social development, self-reliance, and achievement than elitism has thus far typically offered (Briggs, 2013; Bahr, 2015; Gratani, et al., 2014). Or still, more relevantly, the capacities of Indigenous knowledge for appreciating the requisites of sustainable development are now proving to be, not merely a pleasant sentiment, but a demonstrable expectation that is supported even by scientific recognition that Indigenous epistemology is embedded in sustainability (Bahr, 2015; Gratani, et al., 2014; Simonds & Christopher, 2013). The problem is thus one of charging these capacities with the kind of recognition that no longer conceals or warps attributes of Indigenous knowledge, but rather reveals and translates Indigenous knowledge into Western ways of knowing (Fielding, 2014; Simonds & Christopher, 2013). Negatively, however, academic research has largely failed to cope with just this problem of translation. For the most part, academic research has neither asked nor answered forthrightly the crucial question of how to integrate Indigenous knowledge into academic ways of knowing so that academic potentialities may flower to the maximum (Bahr, 2015; Regmi & Fleming, 2012; Coombes, et al., 2014). In the degree of its concentration upon the positivistic aspects of research to the neglect of the subjective and cultural, research theory becomes thus far an irresponsible theory (Fielding, 2014; Regmi & Fleming, 2012). Research theory has not clearly recognized but rather has evaded the direct and logical consequence of its own priceless contribution, namely, the double necessity at once to differentiate among some forms of knowledge and to create knowledge generation arrangements according to whether knowledge is couched in theory or in practice (Palmer, 2000; Wilson, 2001; Henderson, 2011). As research theory has frequently rendered conscious or
unconscious support to misunderstanding rather than understanding, to collective acquiescence rather than pursuit, the ‘otherness’ of Indigenous knowledge creates a conflict as to whether Indigenous knowledge can apply scientific evidence to the solution of important problems (Roy, 2014; Fielding, 2014).

**University-based Research in Indigenous Societies**

University-based researchers have long been interested in research in Indigenous societies, not merely from idle curiosity, but as a duty to secure and utilize the resources available to carry on the research agenda of the university (Agbo, 2010). Certainly, university-based research is at a crucial period as many of the methods, designs, and procedures were developed to cope with challenges of another period (Roy, 2014). Indigenous knowledge is subjective and practical and to the academic it is ultimately not an expression of worthy knowledge (Humphrey, 2013; Roy, 2014; Tomaselli, 2014). The academic recognizes Indigenous communities as significant “Others” who live within the fringes of academia. Quinnan (1997) describes significant “Otherness” as “a nameless, faceless attribute forced on disadvantaged groups different from the majority …” (p. 33). Perhaps, the clearest and most striking description of “Otherness” and the Western notion of Indigenous knowledge have been provided by hooks (1990):

> No need to hear your voice when I talk about you better than you can speak about yourself … only tell me about your pain. I want to know your story. And then I will tell it back to you in a new way. Tell it back to you in a way that it has become mine, my own. Re-writing you, I write myself anew. I am still the author, authority. I am still the coloniser, the speak subject, and you are now the centre of my talk. (p. 153)

The above quote indicates that researchers do not avoid Indigenous knowledge altogether, but most of them manage to avoid systematic or searching examination of its meaning and role and few carefully distinguish Indigenous knowledge from their favourite category of academic knowledge (Tomaselli, 2014). There are many signals that the supremacy, and surely the suitability of research traditions thinking and method in university-based research in Indigenous societies are coming to an end (Agbo, 2010; Hall, 2010). It is nevertheless evident that positivistic research traditions are being resisted and replaced by a different, almost undoubtedly a participatory emphasis and therefore by a different approach, however indistinct and uncertain the search for methodical accuracy may still be currently (Whitinui, et al., 2015). Recent changes in the knowledge-based society demand a new sociologically based appraisal of research functions and a more comprehensive consideration of relationships between researchers and Indigenous societies, which may incidentally guide the reformulations of the boundaries of research in Indigenous communities (Whitinui, et al., 2015). The main purpose of this paper is to clarify how research in Indigenous societies can dedicate itself to integrating Indigenous knowledge with modern technology. If however, this objective can be realized, the initial duty is to realistically assess, and devise strategies for surmounting the current inherent obstacles in Indigenous research. The first obstacle
is the argument from some Indigenous scholars that because meaning and understanding are beyond words, Indigenous research must follow the experience of ‘insider’ Indigenous people (Maina, 2004; Coombes, et al., 2014). This ‘insider’ point of view exerts vast influence upon who conducts research in Indigenous communities; indeed, it has slowly become the most single compelling adversary of decisions by scholars to conduct research in Indigenous communities. This quite basic postulate of the ‘insider’-'outsider’ argument (see Blix, 2015; Innes, 2009; Maina, 2004), which in itself makes assumptions about racial and linguistic appropriateness of Indigenous research and no assumptions about ideological orientations of the ‘insider’ and no assumptions about basic fundamental values of human rights and social justice, probably applies more accurately to the past than the present (Innes, 2009; Blix, 2015). As Blix (2015) reminds us, the focus on the ‘insider’-'outsider’ argument only partially reflects evidence of sustaining academic style beyond the terminal point of the actual relevance of research in Indigenous communities.

Another resistance in the path of research in Indigenous communities is the hard realization of the ethics of research. Although there has been a secular historical trend in improving the ethics of research in Indigenous communities, this improvement has been generally limited (Coombes, et al., 2014). Maintenance and speeding up of such a trend would move Indigenous research in a better direction by allowing the formation of partnerships with less alienating undertones, better enabling university-based researchers and communities to work together (Coombes, et al., 2014). This clearly suggests strategies of research concerned with social justice and fundamental human rights, with the prismatic role of researchers in terms of conceptions of what is considered knowledge. Without such considerations about knowledge, no viable attempt at discussing research in Indigenous societies seems possible other than an analysis of the extent to which any one group of scholars justifies the expectations that they choose to set for themselves and their operational concepts. A key element in such consideration must be a sharp focus on the relations between knowledge and sustainable development. A great majority of cultural theorists have consistently pointed out the attributes of Indigenous knowledge in an explicit respect (Coombes, et al., 2014; Friesen & Friesen, 2002; Tomaselli, 2014). As Friesen and Friesen (2002), for example, write: “First Nations have an immensely formidable selling job to do, to convince the Canadian nonNative public that unless we gain respect for the planet Earth, there is no future for the human race” (p. ix). The recent revival of Indigenous methodology based on racial, tribal, and linguistic orientations will make an inadequate contribution to the advance of Indigenous research unless the concrete as opposed to the purely analytical relations between technology and Indigenous knowledge are squarely faced. The way in which I have reformulated the concept of Indigenous epistemology vis-à-vis technology is such as to make the attributes of Indigenous knowledge central to research in Indigenous societies. In what follows, I discuss the dialogical research approach that considers community cultures and protocols in equal terms with the research agenda.
Methodology

The research design for this study drew on participatory action research and Freire’s (1970) concepts of dialogue and problem posing. The use of the term *participatory action research* is akin to Cacari-Stone et al.’s (2014) notion of community-based participatory research:

Community based participatory research is an orientation that emphasizes ‘equitable’ engagement of partners throughout the research process, from problem definition through data collection and analysis, to dissemination and the use of findings to help effect change (p. 1615).

The dialogical integration of technology and Indigenous knowledge is based on Freire's (1970) concepts of dialogue and problem posing. According to Freire:

> Since dialogue is the encounter in which the united reflection and action of the dialoguers are addressed to the world which is to be transformed and humanized, this dialogue cannot be reduced to the act of one person's ‘depositing’ ideas in another, nor can it become a simple exchange of ideas to be 'consumed' by the discussants. (p. 77)

In the dialogical integration of technology and Indigenous knowledge perspective, Freire’s (1970) approach to dialogue basically supports the participatory research methodological assumption that the validation of research in Indigenous societies consists in the categorization of aspects of social interaction in terms of communication. "Without dialogue, there is no communication and without communication, there can be no true education" (Freire, 1970, p. 81). Thus, the dialogical integration of technology and Indigenous knowledge changes the structure and orientation of existing modes of epistemological analysis and attempts to integrate or dissolve them in terms of social justice. Probably one of the major points of significance about the dialogical integration of technology and Indigenous knowledge in the present context is that it brings the problem posing principle to the forefront of research in Indigenous societies, so pushing the previously dominant positivistic principle into the background.

As Freire writes of problem-posing:

> Problem-posing education, as a humanist and liberating praxis, posits as fundamental that men subjected to domination must fight for their emancipation. To that end, it enables teachers and students to become Subjects of the educational process by overcoming authoritarianism and alienating intellectualism; it also enables men to overcome their false perception of reality (p. 74).

An important consequence of these processes is that the power of the university-based researcher is partly replaced by power sharing with the community. In fact, social justice and shared fundamental values of human rights in conceptualization and collaborative decision-making and equitable engagement tendencies are all prominent features of the intellectual uses to which the dialogical integration concept has been put.
Dialogical Integration of Technology and Indigenous Knowledge

I began this discussion by highlighting the methodological structures and processes that constrain the perceived direction of research in Indigenous societies. There are minimal objective conditions that must be met before research can begin in Indigenous societies. Notably, there must be a socially based openness between the researcher and the community. Behind this lies the requirement of a fairly high degree of collaboration so that there is a minimally pervasive sense of participation in the project. What is of utmost importance in research in Indigenous communities is community participation and engagement and what Breen and Darlaston-Jones (2010) term “constructionist epistemology that embraces methodological pluralism” (p. 71). Breen and Darlaston-Jones (2010) define constructionist epistemology as “the notion that phenomena, including psychological phenomena, are interrelational, multiple, and dynamic, and that meanings are derived through our engagement with the social world and, as such there is no one objective truth to be found” (p. 71-72). This constructionist epistemology involves extensive inquiry into the relations between the university-based researcher and the Indigenous community. The process of research and practice in Indigenous communities is so understated, and the relationships in the process are so fragile that it is only a careful analysis of community engagement that can bring all the loose ends together and sustain a logical process of inquiry with Indigenous people. Much work in community research has hinged on taking away from the community without giving anything back (Agbo, 2010). What is crucial at this juncture is community participation with respect to what occurs in all the phases of research. The idea of community participation is both compelling and complex involving “‘equitable’ engagement of partners throughout the research process” (Cacari-Stone, et al., 2014, p. 1615). The purpose here is to outline the grounds for participation. A simple hypothetical conception of community participation in research emphasizing the university-based researcher and community participation is diagrammatically sketched out in Figure 1.

Figure 1 depicts a participatory research model of university-based research in Indigenous communities indicating the links between the community and the university-based researcher. Conditionally, the dialogical integration of technology...
Seth Agbo

and Indigenous knowledge can be imposed on the technology-Indigenous knowledge variable by a simple diagram:

Figure 1 depicts the frontiers and borders of the dialogical integration of technology and Indigenous knowledge. I will attempt to define the boundaries at each end of the dialogical integration more precisely and rationalize the position of the dialogical integration across the centre of the technology-social justice-Indigenous knowledge variable.

Figure 1 shows that the borders or boundaries between the technology, social justice, and Indigenous knowledge dialogical integration are gaps rather than links, indicating a continuum in the dialogical integration. In intellectual situations, the borders between technology and Indigenous knowledge are in fact ‘guarded’ by social justice. Thus in the dialogical integration, it is possible to speak of border crossing in this context. This means that the dialogical integration unites complete positive components of association as well as complete negative components of dissociation. The central role of the social justice sector in positive association is bridge-building, that is of providing a continuous and trustworthy span between the two shores of technology and Indigenous knowledge; sound negative components limit themselves chiefly to social justice considerations. Thus, each of technology and Indigenous knowledge is connected with dialogical integration by the two cables of social justice. In the empirical ordering of this contradiction may be found the key to many of the pre-conditions that govern research in Indigenous communities.

An Indigenous knowledge orientation is border crossing towards the right, in the form of strong identification with social justice and Indigenous culture and knowledge. The temporal divisions in the dialogical integration (Figure 1) provide the analytical phases of pre-research and post-research. The ordering of information by participants and the resulting actions and processes in the dialogical integration can justifiably be explained in the context of leading to, or departing from the actual dialogical integration itself. By taking the dialogical integration as vital to the analysis, time period can be stipulated in relation to the state of social justice that governs it. In this way we can also define technology and Indigenous knowledge more closely. At the core of university-based research lies a foundation embedded in the positivistic concept view of research, underpinned by a particular characterization of objective values, goals and norms that are, in the context of the present analysis, technology-oriented. Thus it is for the technology-oriented legacy of the dialogical integration that makes it necessary to make comparisons (associations) to positivistic research tradition as a value referent. Where technology empowers users, it moves towards social justice hence dialogical integration. In general, it can be stated that Indigenous knowledge-oriented situations, in their view of positivistic research orientation, tend to move from association to dissociation emphasis while technology situations tend to move the other way, from dissociation to association emphasis, but both are mediated by social justice orientations. In technology-oriented situations, when digital systems are used in Indigenous societies for educational purposes, models need to be negotiated, and their implementation tested against the needs of the local inhabitants. Conventional Eurocentric models that fail to measure themselves against the development needs of
the people for whom they are intended may be inadequate and lack dialogical integration.

Technology and Indigenous knowledge thus become contingent orientations from which the dialogical integration may be reached and into which a dialogical integration may develop (see arrows in Figure 1). Integration itself provides the focal point of analysis and in course of time, both before and after, a view of it may shift to more technology or Indigenous knowledge orientations. In Figure 1, the integration of technology and Indigenous knowledge can be viewed as operating horizontally in two directions: towards Indigenous knowledge in the far right, and towards technology in the far left. Instead of viewing dialogical integration simply as importing technology attributes or alternatively as a conflict between technology and Indigenous knowledge, the creating of a boundary of learning where there is the need to go beyond Indigenous traditions and culture and promoting a cross-fertilization of insights, practices and mental archetypes of technology, becomes the central focus of what has become known in this context as dialogical integration. The notion of technology already implies a particular characterization of technical, Eurocentric values, goals and norms. However, the most convenient and realistic characterization of the preferred research situation is dialogical integration (see shaded portion of Figure 1). At this stage of investigating the dialogical integration, however, the problem of how and in what form technology is integrated with Indigenous knowledge may be more crucial, especially in any comparative and theoretical approach. The unshaded right portion of Figure 1 shows complete uncontaminated Indigenous knowledge in the dialogical integration beyond the confines of the influence of technology.

Figure 1 also indicates the pathways of interaction of the university-based researcher with the indigenous community. The interaction is informed by a dynamic symbiotic relationship in which the university-based researcher is represented by technology, and the community represented by Indigenous knowledge. The researcher and the community coexist in a collaborative process tied to social justice. In this participatory model, the indigenous community (Indigenous knowledge) originates the research problem, defines the problem and then requests the university-based researcher (technology) as a participant. The university-based researcher may have assumptions regarding the existence of the research problem in the community and puts oneself out to be requested by the community as a research partner. This putting of oneself out to be requested by the community may be done in several ways including volunteering in the community school, attending conferences with community participants, presenting keynote speeches, and so on. In doing so, all activities and practices are guided by principles of equitable engagement, fairness, equitable participation in decision-making, and the sharing of the fundamental values of human rights and social justice (Cacari-Stone, et al., 2014). Guided by principles of fundamental values of human rights, the community and the university-based researcher lay out the functions that university and community researchers should play in the process; the strategies to be adopted; the understanding of power relationships; the prospects for collective learning; and, the production of knowledge that is linked to action.
Guided by social justice principles of equity and fairness, the community and university-based researcher become a complementary and a connected whole that leads to a participatory research relationship. The participatory research relationship acts like a new kind of enhanced intellectual and social ground that leads to knowledge integration; a kind of reciprocal learning that is transferred back to the community and the university-based researcher. Thus the goal of the participatory research concept is to provide essential infrastructures for what will lead to a collaboration that will eventually transform indigenous communities, aid the development of the communities, improve living conditions for community residents and enhance the university-based researcher’s understanding of the phenomenon under study and the researcher’s work as a whole. The particular characteristics of the collaboration are that the university and the community differ in all aspects, but they are highly interactive, each tending to mold and shape the other. The interdependence of the university and the community means that a significant change in the community would result in some adaptation in university-based research and vice versa.

The Indigenous Knowledge Sector

The indigenous knowledge sector in Figure 1 embodies the Indigenous community and its immediate natural environment (Bahr, 2015; Regmi & Fleming, 2012). As Bahr (2015) argues, “The [Indigenous] environment is not perceived as something that needs to be brought under human control but as an extended, inclusive set of relationships in which all beings are to be respected and cared for” (p. 71). Similarly, Regmi and Fleming draw a parallel between Western scientific knowledge, and Indigenous knowledge stating that “Unlike Western scientific knowledge that is based on reduced and simplified structures, indigenous knowledge is based on more complex and interconnected systems” (482). In the dialogical integration model, the community should be the origin of the research problem (Agbo, 2010). At first sight, there remains the difficult task of casting the indigenous community in new roles and fashioning structures for research. Most people in indigenous communities do not have even nodding acquaintance with university-based researchers, let alone inviting and working with them on research projects. For effective research in indigenous communities, it is required that the research problem should originate from the community (Agbo, 2010). This conception of the bottom up process of research introduces the notion of simultaneously connecting the university to the community as a mechanism self-adjusting to receive information and give information, from, and to the university and the community respectively.

Social Justice

A conclusion to be drawn from Figure 1 concerns the range of options available at each level of research. Clearly, it is greatest at the social justice level that acts as a conduit between Indigenous knowledge and technology. Social justice provides the patterns of resultant research behaviours between different levels,
different roles and between levels and roles. I am, thus concerned here with the major developmental attributes arising out of different levels of collaborative research, especially the extent to which the experiences of researcher and community can be identified and ‘typed’ in accordance with fairness, equity, and fundamental values of human rights. Thus in my discussion of dialogical integration, I utilized the example of community-based participatory research concept and its relevance and saliency in enhancing learning of researcher and the community. It is the patterns of orientations and the relations that actually define the dialogical integration of technology and Indigenous knowledge. The community-based participatory research situation imposes functions of research, learning, and action that differ from those in traditional, typical traditional university-based research both in quality and the degree to which researchers and communities become autonomous, independent partners in research and learning.

**Dialogical Integration**

*Dialogical integration* is a practical approach to university-based research in indigenous communities. By dialogical integration, I mean an alternative vision to traditional positivistic research. Although the term “university-based researcher” is often used, the researcher in the indigenous community does not consider oneself as an adept university-type researcher ready to demonstrate a list of research skills to which researcher and partners must aspire. Rather, in contrast to the traditional role of the university researcher stressing the notion of objectivity to which researchers must strive to become, the researcher attempts a dialogical integration that underscores the primacy of interpersonal reasoning and reflectivity (Maina, 2004). The phenomenon I refer to, as dialogical integration is first, the collaborative educational goal-setting aspects of community-based research, and, secondly, the non-power aspects of the university-based researcher. Thus the common ethos of the dialogical integration in indigenous communities described above consists of a positive attitude towards the community with an emphasis on building a collaborative research community, and a desire for collaborative action, valuing Indigenous knowledge as well as technology. There are actually qualitative differences between organized traditional research and those forms of contact the university-based researcher makes in dialogical integration. On the one hand, the latter involves the building of a collaborative partnership from which both researcher and the community derive meaning (Agbo, 2010; Hall, 2010). These meanings affect the partners but they can establish closer ties with dialogical integration more directly than traditional research. Thus, the learning contained in dialogical integration penetrates the minds of community members in a way that is less discursive and more direct and purposeful. Dialogical integration also includes the current investigation of the relations between researchers and their research assignments including power relationships, collaboration on the elements that bring development to the communities, flexibility and adaptation, and transmitting to communities the meanings of the elements and thus subjecting communities to sustainable development. In short, the difference between traditional research and dialogical integration refers to what has been planned for carrying out research, as opposed to
what has not, although the latter is perhaps structured in a form more directly related to contextual and situational circumstances. In dialogical integration, the influence of the university-based researcher and the community must be viewed as operating prismatically in two directions; externally towards the other (that is, researcher to community and vice versa), and internally against institutional socio-cultural and political obstacles. Simply, dialogical integration involves the creation of a new concept of community research that debunks the existing structures of university research in place of research for sustainable development.

**Implications**

The theses of this paper carry implications for research in Indigenous communities. First, for successful participatory adaptation of modern technology for educational purposes in Indigenous societies, Indigenous communities must become co-decision makers with researchers at every stage of the strategy. Too often, technological design and evaluation are characterized by features that are detrimental to the education of those outside of the social, Eurocentric mainstream (Warschauer, 2003). Secondly, the findings support the notion that technological and curricular designs need to support community determination, flexible cultural interpretations, and adjudication of cultural values across social boundaries. Digital environments hold the promise of richer curricula, enhanced cultural pedagogies, more effective organizational structures, stronger links between institutions of learning and community, and the empowerment of disenfranchised learners and groups (Trotter, 1998; Bishop et al, 2001; Behrmann, 1998). Thirdly, it is important to consider traditional concepts as a viable knowledge source for theorizing and conceptualizing research in Indigenous societies. The study also implies that doing research with and not ‘for’ Indigenous people means research should be dialogic and include the shared experiences of all stakeholders, privilege all forms of knowledge and above all share skills and knowledge between and among the participants.

It follows that the integration of Indigenous knowledge and modern knowledge requires concerted formulations of research arrangements designed on social justice and fundamental human rights (Gratani, et al. 2014; Simonds & Christopher, 2013). This means the denunciation of certain institutions of university-based research practices such as the rejection of objectivism in favor of relativism to which Indigenous knowledge belongs. This implies a normative conception of Indigenous research. A normative conception of Indigenous research requires a research agenda based on a larger degree of a collaborative enterprise between the university-based researcher and the Indigenous community. Equally, a normative conception of Indigenous research should repudiate practices that exploit Indigenous communities for the benefit of university-based scholars, practices that fail to give equal powers and rights to Indigenous communities, and practices that deny the full resources of community knowledge to community people (Freire, 1970; hooks, 1990; Tomaselli, 2014; Strophanch & Adair, 2014). That is to say, dialogical integration requires concern with the goals of social justice, fundamental human rights, and social goals of Indigenous com-
communities just as concrete and magnetic as the research goals of the university-based scholar.

Furthermore, this study implies that the required norms of research in Indigenous communities should consider whatever ingredients of community experience may be compatible with scientific premises of university-based research, and incorporating such qualities of Indigenous people’s epistemology, hope, and reverence as seen essential to the ability of realizing the expectation of university-based research (Ebijuwa & Mabawonku, 2015; Tomaselli, 2014). Such qualities would expectedly express a deep need in university-based scholars for identification with a larger, more encompassing whole than can be found in the transitory surroundings of the academic world.

Conclusion

The order in which the analysis proceeded was, inevitably, arbitrary and therefore concealed some fundamental connections. These may now be clarified. I began this paper by pointing out the shortcomings of university-based research in indigenous communities. Few theoretical works in the field have indicated the significance of Indigenous knowledge as such and only a few appear to have systematically incorporated the impact of Indigenous knowledge on technology (Briggs, 2013; Gratani, et al., 2014; Simonds & Christopher, 2014). Scholars in Indigenous methodology too have neglected the problem, having become increasingly concerned with the deep-rooted ‘insider’-‘outsider’ underpinnings of Indigenous research. When for example Indigenous knowledge has been studied, the tendency has been to concentrate on its socio-cultural constituency rather than the actual uses of Indigenous knowledge to benefit society as a whole in contemporary times (Friesen & Friesen, 2002; Gratani, et al., 2014). In this context, I tried to show that the analytical theory of research in indigenous societies must be placed in a culturally subjective context. I also illustrated that the distribution of power among university-based researchers and communities is of central importance. A study of indigenous communities that excludes power analysis between the researcher and the community provides at best a fragmentary hypothesis of the research. In this context, community-based participatory research helps to transform university-based community research into a dynamic prescription of social justice. I introduced the community participatory research as a dialogical integration model that leads to social justice as a core referent in the analysis of community-based research. In this outline of the dialogical integration model, I have designated participation in decision-making and consensus, social justice and shared fundamental values of human rights as the key elements in research in indigenous communities. I would strongly urge that the notion of dialogical integration should be firmly divorced from any conceptions of Indigenous research in a prescriptive sense, and more particularly should be divorced from any automatic association with the concepts of Indigenous methodology—in whatever way the latter may be defined; it must also be divorced from consensus based on pseudo consultation.

Thus I advocate the shrinking of the concept of dialogical integration to encompass merely the process that involves a change over from a university-based traditional research to an interface with indigenous communities based on genuine
participation and reciprocal learning and girded by social justice and fundamental human rights. The most obvious tendency to note at this point is the frequent argument—sometimes implicit, sometimes explicit—that it is difficult to see the extent to which the university-based researcher could belong to a single and relatively homogeneous group and accept and tolerate multiple and other perspectives. What then, is distinctive about the present analysis is that within the context and through the facilities of effective networks, the university-based researcher and indigenous community relations can be mediated and defined in terms of a system of culturally structured and shared values, beliefs and symbols about learning in a participatory research model. But this mediation is usually constrained by the mystic allegiances and social differentiation conflicts overtly manifested in the university (Bahr, 2015; Stronach & Adair, 2014). There is, therefore, the need for a simultaneous plan of action to attain the proposed dialogical integration. Such a plan borrows from Indigenous epistemology. At the same time it involves socio-cultural, political, and academic strategies capable of overcoming the obstacles between the university-based researcher and the Indigenous community and of powerfully consolidating the relations between them in behalf of dialogical integration of Indigenous epistemology and Western knowledge (Simonds & Christopher, 2013).

Finally some comments on the scope of the dialogical integration model may be needed. As I have already shown, the dialogical integration model provides symbiotic learning opportunities for university-based researchers and indigenous communities. The model portrays the condition of an all-inclusive research process embracing all the elements involved in social justice and shared fundamental values of human rights. Dialogical integration should invoke a seamless web of research that prepares university-based researchers to develop a kaleidoscopic view of research. The questions posed by the processes of research in indigenous communities will not go away and may continue to move back toward the top of the university-based research agenda. Since Indigenous communities are the nexus of sustainable development, this millennium may be a time for some profound and widespread changes in community-based research. In many cases, there are reasons to be optimistic and to continue working on the nuts and bolts of alternative research frameworks for sustainable development. Certainly, dialogical integration through collaboration should be on the agenda of university-based research and that researchers should desist from being miserably obsessed with rationality and objectivism rather than with knowledge integration and meaning making.

References


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The role of Twitter in B2B Knowledge Exchange and Innovation

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Abstract

Today, social media technologies are being used for an array of applications including as platforms to crowdsource funds, information and products. One of the most used social media channels for business communication is Twitter. The objective of this study is to enhance the understanding about the use of Twitter in business relationships. Through 52 interviews conducted across 5 countries in 2015, it was found that Twitter users engaged in business-to-business relationship valued characteristics such as information quality, authenticity and industry influence in the people they followed. One of the primarily uses of Twitter in the B2B context was for information exchange and innovation. The study also conducted textual analysis using the Correlated Topic Modelling Method approach on the open ended responses concerning Twitter strategy and the interviewees’ perception on favouring and retweeting behaviour. It was found that Twitter had a role to play in developing and supporting innovation.

Keywords: Social media, Innovation, Information exchange, Twitter, Topic modelling, Business relationships

Introduction

Using the Internet as a mean of communication has become increasingly popular since the invention of the World Wide Web in the beginning of the 1990s. However, marketing communication on the early web was mostly used for one-way communication with focus on pushing messages from companies to consumer. In line with the visions of Tim Berners-Lee (1999, p. 169) to create “a much more powerful means of collaboration between people”, the web has for the last 20 years gradually moved towards a medium for user generated content (Blackshaw & Nazzaro, 2006; OECD, 2007; Prahalad & Ramaswamy, 2000) and real-time two-way communication based on the ideas of Web 2.0 (O’Reilly, 2005; O’Reilly & Battelle, 2009) and later on Social Media (Boyd & Ellison, 2007; Kaplan & Haenlein,
This development has led customers to “increasingly engaging themselves in an active and explicit dialogue with manufacturers of products and services” (Prahalad & Ramaswamy, 2000, p. 80). Hence, information communications technologies creates new possibilities as a “platform for new mechanisms for widely dispersed agents to adopt radically decentralized cooperation strategies other than by using proprietary and contractual claims to elicit prices or impose managerial commands” (Benkler, 2006, p. 63).

In its current form social media has been used by the general public for over 10 years and there is a vast range of different social media channels in use today. They stretch from “simple” content sharing sites, such as Youtube to full social media networks, for example Facebook (Boyd & Ellison, 2007; Kaplan & Haenlein, 2010). A key factor for the successful use of social media is conversation (Edosomwan, et al., 2011). Social media can be defined as a “group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user generated content” (Kaplan & Haenlein, 2010, p. 61). Even though there are large, and tremendously popular platforms, such as Facebook, that cover most needs, different social media platforms tend to have different target groups, architectures and social focus (Kietzmann, et al., 2011).

Social media are applications that need content and one of the main advantages of social media is their ability to be used as open platforms for information sharing and user generated content. This has, in line with the ideas of the long tail (Anderson, 2004), enabled a tremendous increase in the amount and scope of information being shared. Even more important for social media and the development of open platforms is the shift in control as the “dialogue is no longer being controlled by corporations. Individual consumers can address and learn about businesses either on their own or through the collective knowledge of other customers” (Prahalad, et al., 2009).

According to Modaff, et al., (2007, p. 3), organizational communication is the “process of creating, exchanging, interpreting (correctly or incorrectly), and storing messages within a system of human interrelationships”. This information flow is reflected in the way today’s Social Media is used for communication, content sharing, and networking not only both between companies, governments and customers but, foremost, in-between customers. The potential for social media to be used as an effective and dynamic medium for business-to-consumer (B2C) communication and marketing has been described in research (Leonardi, et al., 2013). Despite its ability to create two-way conversation, the role of Social Media as a means for business-to-business (B2B) communication has not as clearly been investigated (Brennan, Tzempelikos, & Wilson, 2014). The very foundation and construction of social media makes it suitable to support all stages of innovation (Mihalcea et al., 2005). Martini et al., (2013, p. 211) state that companies that are about to use social media for innovation should “clearly define their objectives, constantly monitor the outcome, and be prepared to adjust their objectives over time”. The inherent complexity of both the innovation processes and social media use in a B2B context has led to a lack of existing models and standards. Without clear frameworks for the
application of social media in the innovation process many companies have avoided or overlooked the use of social media in innovation (Martini, et al., 2013). In light of this gap in previous research around innovation and the use of social media to source ideas the current study was devised to ascertain how the social media platform of Twitter is being used to in B2B relationships to support information exchange and innovation between companies.

**The Role Of Innovation In Creating Competitive Advantage**

Innovation is an important part of many companies and is about creating something new either totally new or by combining old elements or into something new or (Schumpeter, 1934; Sundbo, 1997). Different industries and different companies have different innovation processes. In general they can, however, be divided into closed and open innovation (Chesbrough, 2003a). In contrast to open innovation, innovation projects initiated using a closed model are always launched from inside the company. The concept of open innovation (Chesbrough, 2003a) and other forms of user involvement in innovation processes (Ian & Chad, 2002; von Hippel, 1986) became increasingly popular in the 2000s and has grown out of the need for companies to have access to all necessary resources and knowledge for leveraging innovation in today’s fast moving competitive environment (Thomke & von Hippel, 2002). Open innovation is about “harnessing external ideas while leveraging their in-house R&D outside their current operations” (Chesbrough, 2003b, p. 35). Hence, innovation projects may be launched from either internal or external sources and there are many ways for ideas to flow into the process, and many ways for it to flow out into the market.

The general digitalization of society has moved, previously, non-competitive industries closer to each other and innovation and, especially, disruptive innovation has been a major reason for the success and failure of many products and industries (Bower & Christensen, 1995; Christensen, 1997; Brynjolfsson & McAfee, 2014). Today innovation, and especially open innovation, has been deemed important to cope the increasing need for quick moves to gain and sustain competitive advantages in the increasingly aggressive and fast paced competitive environment (Bourgeois & Eisenhardt, 1988; Thomas, 1996; Wiggins & Ruefli, 2005; Chesbrough & Appleyard, 2007; Lee, et al., 2010).

**Crowdsourcing Ideas For Innovation Using Social Media**

In business-to-consumer marketing companies have a “strong motivation to engage in online dialogue with customers, driven by the social marketing strategy” (Vuori, 2012, p. 163). One of ways that companies have found to access innovations is by the use of social software such as blogs to collect innovation ideas from the users. This online exchange has the potential to generate increased “collaboration among the organization employees and giving the organization an image of a more ‘open to critique and new ideas’ kind of organization” (Scupola et al., 2013, p. 35). This concept is often denoted Crowdsourcing (Howe, 2006), a concept which is based on the idea of using the advantage and wisdom of many
individuals (Estellés-Arolas & González-Ladrón-de-Guevara, 2012). Hence, according to Chesbrough (2011, p. xix) “crowdsourcing is thus a powerful resource for innovators … a world of people and organizations is available to assist you, if you have the commitment and care to engage them properly”. According to Howe (2008, p. 280), “crowdsourcing isn’t a single strategy. It’s an umbrella term for a highly varied group of approaches that share one obvious attribute in common: they all depend on some contribution from the crowd”. Today new Internet based technologies and platforms, such as social media, have created new opportunities for crowdsourcing and innovation since “where the knowledge of creativity was once locked up in social structures and codified volumes … it is now widely distributed, accessible throughout the planet” (Sapsed & Tschang, 2014, p. 140). Kozinets, et al., (2008, p. 344) state that “the useful innovations are produced not necessarily as an innovative contribution, but simply as a part of the normal routine of being involved in online communities pertaining to these interests.”

The characteristics of social media also provide a platform for knowledge exchange in-between companies (Chui, et al., 2009). Even though the use of customers, consumers and end-users in crowdsourcing in connection to social media has been commonly discussed in the literature, there still lack research on the use of social media in B2B crowdsourcing situations. Simula, et al., (2013, p. 131) state that “industrial B2B firms seem to be hesitant to start applying SM tools” and security risks along with misinterpretation of information is mentioned as reasons. Since crowdsourcing always are based on some kind of collaboration, participation and use of social media tools when crowdsourcing information are linked to the commitment-trust theory (Morgan & Hunt, 1994).

The real-time information sharing and dialogue enabled by micro blogging platforms and the ability for this information to potentially contribute to open innovation processes motivate the exploration of the role of the microblogging service Twitter as a possible source of innovation.

**The Increasing Power Of Twitter In Information Exchange**

Twitter, founded in 2006, is a social network based on a micro blogging service. The basic functionality is that the system distributes, in real-time, messages (tweets) shared by users on its time-line. The tweets are, in line with traditional SMS-services and other micro-blogging services, short and in the case of Twitter restricted to 140 characters for each message. Consequent with the foundations of social media it is possible to follow other users and then messages posted by a user are subsequently pushed towards the user’s followers. In contrary to e.g. Facebook, Twitter do not use a system for mutual “friendship” but rather followers, which mean that messages posted are not mutually pushed towards each-other but only in the direction towards followers. A user reading a tweet can interact with the sender or with the tweet by forwarding the tweet on their timeline, and, hence, to their followers (retweeting) or by marking the tweet as a favourite. The original user will get notice about these actions. There are two common ways of addressing people or topics in Tweets, either by adding another users tweet handle (@) or by adding a hashtag (#). Using a hashtag is a way to label different topics and make the
post easily accessible for anyone searching for a specific hashtag. Each hashtag can be regarded as a channel (Messina, 2007) that anyone can post to, which makes the Twitter hashtag a democratic channel that is hard for anyone to control (Mejtoft, 2014). A hashtag is a convention that has spread to other social media platforms and channels.

Twitter’s ability to “communicate in real-time short messages has garnered significant attention from individuals and organizations” (Waters & Williams, 2011, p. 354). This is especially through discussing Word-of-Mouth (WOM) marketing, which has become increasingly popular in the light of social media. Since “the business’ engagement in the WOM communication on Twitter enhance the consumers’ engagement in the WOM communication” (Zhang, Jansen, & Chowdhury, 2011, p. 173), it is important for companies to include e.g. Twitter in the dialogue with customers. Compared to other social media, such as Facebook, companies “wanting to disseminate product-related information quickly are better off using Twitter” (Koo, et al., 2014, p. 232).

Even though using Twitter in the dialog with (and in-between) customers, there are risk for companies involved regarding the lack of control of the dialogue. The lack of governmental and corporate control, and democratic use, of Twitter and the hashtags on Twitter became apparent during the “Arab Spring” in 2011 when social media, like Twitter and Facebook, were very important for spreading information (Howard & Hussain, 2011; Khondker, 2011; Papacharissi & de Fatima Oliveira, 2012). Not only democratic use of Twitter has been highlighted, but also the use of Twitter during e.g. natural disasters for real-time tracking and communication (Earle, et al., 2011; Sakaki, et al., 2010). A study by Park, Lim & Park (2015, p. 214) shows that “Twitter provided greater awareness of the movement and empowered individuals to engage in international political issues”. Similar use of Twitter as a mean to spread information to a general public in similar or same channels as marketing messages is the inability to control intentional campaigns on social media, so-called hi-jacking of Twitter hashtags. When Australian airline Qantas launched a campaign, after a dispute with the trade union, in the fall of 2011, the hashtag, proposed by Qantas, unintentionally, ended up with non-favourable tweets (Taylor, 2011). Similarly McDonalds in the US (Curry, 2012) and Starbucks in the UK (Morse, 2012) ended up having their hashtags hijacked during campaigns in 2012. Consequently, the importance of control in social media and the ability and need to respond and delete comments and post have been widely discussed during the last couple of years (Ghaemi, 2011; McDermott, 2012). Hence, even though Twitter is a simple social media network site, the microblogging feature has proven to be an important part of society. In academic research it has been deemed important to study Twitter data to get a better understanding of users and the impact on society, “in addition to its role as a public, instant communication medium, therefore, Twitter has now also become a key source of open data on a wide range of personal and societal practices around the world, and the importance of this role must not be underestimated” (Boyd and Ellison, 2008; Weller, et al., 2014, p. 431).
The Use Of Social Media In Business Relationships

Social media platforms have become an important and integrated part of society and different types of social media, such as wikis, blogs and customer communities, have been considered regarding competitive intelligence and the corporate innovation process (Antikainen, et al., 2010; Floresa, et al., 2015; Singh, et al., 2008; Standing & Kiniiti, 2011). Even though social media is mostly connected to people’s personal life and used in B2C, the benefits of social media in a B2B context have been widely discussed. Looking at the Fortune 500 Companies in the US, 74% of these companies had active Twitter accounts in 2015. Hence, the use of Twitter is higher than the use of Facebook (72%) (Barnes, et al., 2015). However, in 2012 only 5% of B2B marketers’ stated social media as a “fairly mature and well optimized” part of their marketing mix (Giamanco & Gregoire, 2012). Kho (2008) proposes that using social media in B2B “enhance corporate credibility and deepen relationships” in the same manner as in B2C relationships due to the speed of communication and the possibility to personalize interaction. Furthermore, Curran, O’Hara & O’Brien (2011, p. 13) argue that “there is also the option for business to learn from their competitors and their industry as a whole”. Nevertheless, companies from different industry sectors tend to use Twitter for different purposes (Xiong & MacKenzie, 2015).

Even though there are attempts to describe how social media can be used in all phases of innovation (He & Wang, 2015), there are still limited understanding of the effectiveness of using social media for e.g. data mining in innovation processes (Chen, et al., 2012; Liu, et al., 2011). Previous research shows that employees that use Twitter both have better ideas and the diversity of their Twitter network is linked to the quality of their ideas (Parise, Whelan & Todd, 2015). Furthermore, Twitter users who combine idea scouting and idea connecting were the most innovative. Also the use of social media by management has been discussed and by using Twitter, management have an opportunity to initiate and influence online conversations as opposed to letting impressions or opinions be driven by the media or individuals with ulterior motives (Kubowicz et al., 2016).

Methods

The structured interview questions were designed to investigate the use of Twitter in B2B relationships and were administered through face-to-face interviews (Fontana & Frey, 2005). The interview questions were formulated based on the previous literature around social media usability, and included a modified version of the UTAUT2 measuring usability developed by Venkatesh et al. (2012). Due to the lack of academic research around the use of Twitter in B2B relationships, a number of industry white papers were used; including reports from Pew Research Centre (2012 and 2015), and Harvard Business Review Analytical Services (2010). Using this combination of previous academic and industry research, scales were devised to measure the respondents use of Twitter; who the respondents followed or unfollowed, and the benefits and risks of using Twitter in B2B relationships. Finally; the respondents’ reasons for liking and retweeting of other
Twitter uses content and why their own Twitter feed was liked or retweeted by their followers.

Results From The Interviews

The 52 interviews conducted where spread across five European countries - United Kingdom (12), Sweden (8), Germany (11), Norway (8), Finland (13). The age of the respondents ranged between 21 and 60 years of age, with 35% being between 31 and 40 years of age. Over three quarters of the respondents were male, with only 12 of the 52 respondents being female. The majority of the interviewees were involved in a marketing role (40%) and 21% being a founder, 15% chief executive officer and 11% being involved in IT related activities and 75% had worked for in their current role for five years or less. The organisations for which the interviewees worked ranged from consultancy or micro businesses employing less than 10 people to large multinational businesses employing over 2,500 people. Of the 52 companies 75% had 100 or less employees, and 57% had 25 or less employees and these were predominantly IT related start-ups.

Social Media Use

When asked if the respondents had social media guidelines, 48% said they had a formal written policy, 17% had an informal policy, and 35% said they had no policy at all. The respondents were asked to describe the types of guidelines they applied when using Twitter; common responses included being conversational, informative, quality content and the use of common sense when posting information.

Apart from the use of Twitter, LinkedIn (87%), Facebook (81%), Blogs (79%) and YouTube (62%) were the dominant social media platforms used. The interviewees also mentioned a number of regionally focussed platforms such as Weebo, Xing (Germany), VK (Russia), and messaging applications such as SnapChat, WhatsApp and WeeChat. The researchers hypothesised that the use of Twitter for private purpose and business purposes would be distinctly separated. However, it was found that the majority of respondents often used private accounts for business purposes. The respondents were asked the length of time they had been on Twitter for private versus business purposes. From the responses, there seems to be little difference in private and business use, with the majority commencing their use of Twitter for private and business purposes approximately the same time.

It was found that while 85% of the respondents checked their account daily, only 42% interacted by favouring, retweeting or direct messaging on a daily basis. The response was similar for the creation of new tweets with 46% of the respondents tweeting daily. Prior to conducting the research, it was suggested that there might be external factors that influenced the regularity that the respondents used Twitter. It was found that activities such as marketing campaigns, trade shows and events lead to an increase in Twitter activity. While the majority of the respondents were tweeting on behalf of their organisation, current affairs and topics of interest to the general community were also incorporated into their business focused feed.
One of the main focuses of the research was to investigate the kind of activities that companies (involved in B2B relationships) use Twitter. A list of 23 activities was compiled and the respondents were asked to indicate the regularity of their use of Twitter for these activities. The six activities, for which the respondents used Twitter on a daily basis, are contained in Table 1.

<table>
<thead>
<tr>
<th>Purpose for Using of Twitter</th>
<th>Use daily or 2-3 times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring industry trends</td>
<td>55.8%</td>
</tr>
<tr>
<td>Monitoring others in your network</td>
<td>53.8%</td>
</tr>
<tr>
<td>Information distribution to the network</td>
<td>53.8%</td>
</tr>
<tr>
<td>Distributing information about your company</td>
<td>36.5%</td>
</tr>
<tr>
<td>Emerging trends and technologies</td>
<td>44.2%</td>
</tr>
<tr>
<td>Distributing information relevant to the industry</td>
<td>42.3%</td>
</tr>
</tbody>
</table>

*Table 1: Regularity of Twitter use by Purpose*

When asked about the characteristics they considered when deciding to follow someone on Twitter, the respondents’ indicated the highest level of agreement with the six items highlighted in Table 2. Being knowledgeable and influential were also considered to be important characteristics. A number of respondents talked about additional factors in their decision to follow someone and these included “level of innovative thought”, “new inspiration and ideas” and “learning from others”, and “reciprocalation of interests”. This focus on knowledge and quality information supports the previous research of the likes of Howard & Hussain (2011), Khondker (2011), Papacharissi & de Fatima Oliveira (2012) and Sapsed & Tschang (2014).

<table>
<thead>
<tr>
<th>How important are the following in your decision to follow someone on Twitter</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Their level of authenticity</td>
<td>5.86</td>
</tr>
<tr>
<td>Quality of Information they share</td>
<td>5.84</td>
</tr>
<tr>
<td>Their relevance to your business</td>
<td>5.67</td>
</tr>
<tr>
<td>Their expert knowledge</td>
<td>5.33</td>
</tr>
<tr>
<td>Their level of integrity</td>
<td>5.29</td>
</tr>
<tr>
<td>Their level of influence in my industry</td>
<td>4.92</td>
</tr>
</tbody>
</table>

*Table 2: Characteristics Important in the Decision to Follow*
The respondents’ were asked to rate possible benefits of Twitter and this highlighted the importance of information distribution and also exchange (see Table 3). Other benefits that were rated highly were, in line with the commitment-trust theory of Morgan & Hunt (1994), building trust and linking or collaborating with others in the industry.

<table>
<thead>
<tr>
<th>Rate the importance of these possible benefits of Twitter</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builds your company’s brand</td>
<td>6.06</td>
</tr>
<tr>
<td>Quick way to distribute information</td>
<td>6.04</td>
</tr>
<tr>
<td>Builds trust with others</td>
<td>5.87</td>
</tr>
<tr>
<td>Put you at the “Top of mind” for your customers</td>
<td>5.56</td>
</tr>
<tr>
<td>Linking to others in the industry</td>
<td>5.54</td>
</tr>
<tr>
<td>Gathering business intelligence</td>
<td>5.02</td>
</tr>
</tbody>
</table>

Table 3: Importance of the benefits of Twitter

As part of the interview the respondents were asked about their experience of using Twitter and 92% agreed that “using Twitter enhances your creditability”, and 75% agreed that using Twitter makes it easier to gather information. When asked about the possible benefits of Twitter 90% of the respondents considered Twitter to be a “Quick way to distribute information” and 65% agreed that it was beneficial for “gathering business intelligence”. Additional comments also included “creating a community - our company started with a tweet to the world”, “crowd sourced way of finding interesting stuff”, and “Identifying trends, what's next” which is important within the B2B business environment (Simula, et al., 2013).

Tweeting Behaviour

To further investigate the perceptions of the value of being on Twitter the respondents were asked a series of open-ended questions about their Twitter accounts and tweeting behaviour. In response to the question “which of your tweets have been highly favoured or re-tweeted by your network?” answers centred around the words information (informed informative, informing, informational) and interesting (interest, interested, interesting, interests). In response to “Why do you think your tweets were highly favoured?” time (time, timely, times, timing) interesting (interest, interested, interesting) and information (information, informational, informative) were the most common responses. There was also a cluster of responses around event, current and new. This would indicate the respondents considered that themes of their own Tweets focussing on interesting information that was current, was well regarded by their network. In relation to the respondents
retweeting and favouring of Tweets from their feeds; they were more likely to in-
teract with Tweets that contained news, events, and up to date information.

Further analysis was undertaken on these open-ended responses using the Cor-
related Topic Modelling Method (CTMM) (Blei & Lafferty, 2007). This produced
five topics, in relation to the respondents tweeting and favouring behaviour. These
topics are displayed in Figure 1 words such as engage, help, support, and favour
appeared to be linked in the topics. The concept of reciprocity, although not stated
specifically was implied by a number of the interviewees.

The CTMM was also applied to questions concerning the respondents Twitter
marketing strategy. Of the five topics derived the themes of return on investment,
engagement, community and network were highlighted. A number of the respond-
ents struggle to articulate clear measures for return on investment and strategic
direction for the use of Twitter as a marketing channel. Despite this, all of the re-
spondents considered Twitter as a valuable channel for community building, infor-
mation gathering/distribution and marketing. Topic Two in Figure 1 below illus-
trates the discussion around the measurement of the return on investment for the
use of Twitter. Topic 3 focuses on marketing strategy and the use of Twitter to
build engaged communities of followers. Topic 4 contains words around the con-
tent, information and quality that are measures of the success for the use of Twitter.

![Figure 1: Five Top Topics for Twitter Strategy and ROI](image)

As highlighted by the analysis much of the respondents’ Tweeting behaviours
are around reciprocating and helping others in their network in the hope that they
would do the same for their Tweets as illustrated in topic 1 in Figure 2. According
to topic 4 timeliness and newness of information was also valued by the respond-
ents and others in their network.
Figure 2: Five Top Topics relating to Twitting Behaviour

This use of Twitter as a source of credible knowledge, information and innovative ideas is consistent with the previous research of authors such as Boyd & Ellison (2007), Kaplan & Haenlein (2010), Kietzmann et al., (2011). The instantaneousness of the Twitter feed as conduit for awareness and information exchange supports the findings of Taylor (2011), Curry (2012), Morse (2012), Sapsed & Tschang (2014) and Park, et al., (2015).

Managerial Implications

While Twitter is prevalent in B2B communications in the United States of America, it is generally not as widely used in Australia and Europe. The research illustrated how Twitter could be used to build business relationships through the exchange of high quality, relevant and current information. Twitter was not primarily for recruiting clients, but as a means of supporting and enhancing business relationships. The research found that the conversational and egalitarian nature of Twitter enabled interviewees to use it as a channel for customer and peer conversations that supported the development of product and service innovations.

The respondents felt that Twitter should not be used as a direct marketing channel for products and services, instead for informing and engaging customers and peers in their network on wider topics. Particularly successful was the use of Twitter for promoting events, recognition of others in the network and for building the brand of individuals and companies. The research identifies that Twitter is used more extensively by particular industries such as those around the Internet of Things and software development. The number of followers is not necessarily a measure of the success of a company’s Twitter account, as small well-connected communities were considered to be more effective by the interviewees.

Discussion and Conclusions

Innovation is central to competitive advantage, and this research social media channels such as Twitter, have a role to play in the development and support of
innovation (Chesbrough & Appleyard, 2007; Lee, Park, Yoon & Park, 2010). This study investigated the use of Twitter in B2B marketing using two different methods; face-to-face interviews and text analysis through machine based CTMM. The results strengthen previous findings that social media channel of Twitter can be used as a source of information, ideas and innovation (Antikainen, et al., 2010; Floresa, et al., 2015; Singh, Veron-Jackson & Cullinane, 2008; Standing & Kiniti, 2011). The immediate nature of the information exchange on the Twitter feed enables collaboration in real time between companies and their suppliers, customers and peers (Mangold & Faulds, 2009; Edosomwan, et al., 2011). The importance of peer-to-peer discussion or communications and access to experts and thought leaders was evident from the interviews conducted (Leonardi, et al., 2013). Although Twitter was used for the exchange of new, up to date and interesting information, very few of the companies interviewed had any formal framework for the measurement of the return on investment for their use of Twitter. They considered it to be “worthwhile and important to be there” but lacked clearly defined objectives for their participation and on going development of their participation on Twitter (Martini, et al., 2013).

As an exploratory piece of research there were some research limitations such as a relatively small sample size of 52 interviewees. It is proposed to extend the research using modified scales developed during this research project, and to administer them in the form of an international online survey to test the validity of the measures proposed in this research. The researchers will also plan to further investigate the use, and role of Twitter in the innovation process using a model developed from the exploratory interviews and machine based text-mining tools. Globalisation, increased competition and the rise of peer-to-peer business models such as Airbnb continues place pressure on companies and economies to innovative. It would seem that the rise of phenomenon such as start-ups, crowdsourcing platforms and open source innovation will continue to stimulate the use of social media in the innovation process.

References


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**Dr Abhay Kumar Singh** is a big believer in open source software and has been using R for statistical computing including quantitative research methods for over...
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Enablers and Barriers of Knowledge Transfer in selected EU Countries as Viewed by IT enterprises

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Anna Dziadkiewicz, University of Gdansk, Poland
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Abstract

Knowledge transfer constitutes the basis of the learning process in an organization and the creation of permanent relationships between the science and business worlds is the fundamental factor which improves its efficiency. The relationship should be characterized by balancing the benefits and avoiding conflicts of interests. Considerations relating to the knowledge transfer to enterprises and economy must include identifying all factors which determine the process, especially pointing out the potential barriers and manners of passing the knowledge. The aim of the paper is to identify both the enablers (premises) and barriers (blockers) of knowledge transfer in selected EU countries. The additional aim of the article is to prioritize particular types of the IT enterprise’s perspective using the importance index, as well as to identify the factors which determine the development of knowledge transfer in Poland, Sweden and Portugal. The structured interview method is used in the paper as well as comparative analysis method. The research was conducted in January 2016, among 18 IT enterprises from Sweden, Poland and Portugal. The paper presents part of the results. The study was carried out as part of an international project COTRANS (Conditionings of Knowledge Transfers and Innovative Activity of Enterprises). The main conclusion is that in Poland, Sweden, and Portugal differences can be observed in both the factors and their hierarchy which condition the knowledge transfer, but the differences among the respondents are not fundamental. The discrepancy mainly stems from national regulations and tools which each country can use to assist the knowledge transfer. Grants available from the EU are of most importance in each of the countries, as are knowledge of entrepreneurs considering cooperation, efficient communication between entrepreneurs and R&D units, and the level of trust of this kind of cooperation. The main barriers of knowledge transfer in the researched countries include:
terminology discrepancies and lack of communication between entrepreneurs and R&D units.

Keywords: knowledge transfer, enablers, barriers, determinants of knowledge transfer

Introduction

Development is an intrinsic feature of enterprises of the future. Nowadays, both development and the organization’s ability to survive are largely dependent on its ability to gain knowledge and use it effectively. In a dynamic competitive environment, knowledge becomes the key source of constant advantage over the competition and the main condition of reaching success. In recent years, the search for competitive advantage has led us to conclusion that we all might benefit from intensive cooperation in the fields of economy and science. Currently, more and more enterprises make the decision to invest in new technologies by cooperating with various businesses which represent the scientific world. Undoubtedly, effective use of knowledge assists enterprises in having the competitive edge. Thus, knowledge transfer to enterprises plays an important role in knowledge management.

Knowledge transfer is the foundation of learning process in an organization (Dryl, et al. 2015, pp. 37-46). Creating strong relationships between the business and the science worlds is the fundamental factor which improves the efficiency of knowledge transfer. The relationships should be characterized both by balancing the benefits and avoiding conflicts of interests. In competition dependent on knowledge, it is all about obtaining and keeping the best qualified employees. The more products and services from a given enterprise are based on intensive usage of knowledge, the bigger part the employees play in creating its value. One should be aware of barriers which are created in the process of knowledge transfer. They can come up in a variety of fields e.g. social, cultural, economic, technical etc. Examples of such barriers may include organizational climate which doesn’t favour sharing knowledge, lack of systems for gathering and spreading knowledge in an organization, big fluctuation of employees’ knowledge, organizational structure which makes sharing knowledge difficult, organization not being prepared to absorbing knowledge, or over-complicated system of passing it. Therefore, a question comes to mind—how to break the barriers to knowledge transfer in an organization.

Considerations regarding knowledge transfer to enterprises and economy must include identification of all factors which determine the process, especially, point out potential barriers to knowledge transfer and ways of breaking them.

The aim of the paper is to identify both the enablers (premises) and blockers (barriers) of knowledge transfer in selected EU countries, as well as to identify the determinants of knowledge transfer.

The additional aim of the article is to prioritize particular types of the IT enterprise’s perspective using the importance index, as well as to identify the fac-
tors which determine the development of knowledge transfer in Poland, Sweden and Portugal. The research was conducted in January 2016, among 6 IT enterprises from selected EU countries. The structured interview method is used in the paper as well as comparative analysis method. The paper presents part of the results.

This study was carried out as part of COTRANS (Conditionings of Knowledge Transfers and Innovative Activity of Enterprises), an international project with project partners in Portugal and Poland. Three universities have participated in the project, which has been carried out since February 2015: Faculty of Management at University of Gdansk, Faculty of Finance and Management at Torun School of Banking and School of Management and Technology of Felgueiras at Porto Polytechnic.

The concept and types of knowledge transfer

Knowledge transfer is a process which puts knowledge into practice. It relies on the flow by which largely tacit knowledge, not technology per se, is transmitted among people from one unit (the source: a single person, group or organisation) to another (the recipient), with all kinds of feedback loops (Formica, et al. 2008, pp. 289–311).

The knowledge transfer should be perceived as an essential component of economic growth and development of the society. The market success is determined by a skill of efficient, mostly effective, transfer of knowledge provided in the organizational procedures to economic practice. The knowledge transfer thus facilitates increasing the productivity and effectiveness of the operation of enterprises thanks to the assimilation of new technologies (Albino, et al. 1998, pp. 53–63). In the academic context, knowledge transfer encompasses the processes of transferring research, skills, experience and ideas within universities and from universities to a greater community of users (HMSO, London, 2003).

Knowledge transfer contributes to the increase of economic returns from this investment and achieving cultural, educational and social benefits for the society. This definition covers the forms of knowledge transfer and technology transfer (HMSO, London, 2003). Effective knowledge transfer means accumulation or acquisition of new knowledge by the recipient. Knowledge transfer pertains to "transmitting of well-organised and interpreted pieces of information; however, not always must this information be of a strictly technical kind, it can be the knowledge of economy or production management, organization and marketing" (Weresa, 2007).

Knowledge transfer is not easy to understand or practise, especially in the face of a lack of a clear-cut definition or a proven best practice for the transfer of knowledge. In general, knowledge transfer is about identifying the knowledge that already exists (the accessible knowledge), acquiring it and subsequently applying this knowledge to develop new ideas or enhance the existing ideas in order to make a process faster, better or safer than it would otherwise be.

Moreover, knowledge transfer is not only about exploiting accessible resources i.e. knowledge, but also about how to acquire and absorb it well to make things more efficient and effective (Liyanage, et al. 2009, pp. 118-131). Dixon
(2000) distinguished 5 types of knowledge transfer (tab.1): serial, near (imitation), far (imitative), strategic and expert, basing on the following criteria:
- the character of knowledge which is transmitted in a given manner,
- the repetitiveness of the circumstances in which knowledge becomes needed,
- the degree of similarity of the tasks in the realisation of which knowledge becomes indispensable.

In the case of serial knowledge transfer, the team, being both the source and the recipient of knowledge, may learn to avoid repeating costly mistakes, achieving at the same time an increase in the effectiveness of their performance and in the speed and quality of their decision-making.

<table>
<thead>
<tr>
<th>Serial Transfer</th>
<th>Near Transfer</th>
<th>Far Transfer</th>
<th>Strategic Transfer</th>
<th>Expert Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td>The knowledge a team has gained from doing its task in one setting is transferred to the next time that team does the task in a different setting.</td>
<td>Explicit knowledge a team has gained from doing a frequent and repeat task is reused by other teams doing very similar work</td>
<td>Tacit knowledge a team has gained from doing a non-routine task is made available to other teams doing similar work in another part of organization.</td>
<td>The collective knowledge of the organization is needed to accomplish a strategy that occurs infrequently but is critical to the whole organization.</td>
</tr>
<tr>
<td>Similarity of task and context</td>
<td>The receiving team (which is also the source team) does a similar task in a new context.</td>
<td>The receiving team does a task similar to that of the source team and in a similar context.</td>
<td>The receiving team does a task similar to that of the source team but in a different context.</td>
<td>The receiving team does a different task from that of the source team, but in a similar context.</td>
</tr>
<tr>
<td>Nature of the task</td>
<td>Frequent and non-routine.</td>
<td>Frequent and routine.</td>
<td>Infrequent and non-routine.</td>
<td>Infrequent and routine.</td>
</tr>
<tr>
<td>Type of knowledge</td>
<td>Tacit and explicit</td>
<td>Explicit</td>
<td>Tacit</td>
<td>Tacit and explicit</td>
</tr>
<tr>
<td>Design guidelines</td>
<td>Meetings are held regularly.</td>
<td>Knowledge is disseminated electronically.</td>
<td>Exchange is reciprocal.</td>
<td>Knowledge needed is identified by senior-level managers.</td>
</tr>
</tbody>
</table>

*Table 1: Five types of knowledge transfer*
Source: (Dixon 2000).

Near transfer allows for relocation and, consequently, for the application of explicit knowledge from one location to another. In the economic reality, transfer of this type normally occurs in the course of transmission of the so-called Best Practices.

Far transfer is mostly based on reciprocal interpersonal relations. It normally occurs at the recipient’s wish. Basically, it is oriented at the acquisition of knowledge crucial in solving a specific problem, often very narrowly specialised. In principle, using this type of knowledge transfer leads to achievement of significant effects in case of costly decision-making. Strategic transfer is used in case of very complex problem solving. The use of this kind of knowledge transfer, and, consequently, of the knowledge characteristic for this model of transmission, sometimes results in effects for the system as a whole, which distinguishes this manner of knowledge transmission from the far transfer, whose effects have a more limited range—they usually relate to the particular teams or organisational units.

Expert transfer of knowledge is inevitably connected with specific problems exceeding the range of knowledge of the team facing them - in such situations expert knowledge from a given field turns out indispensable. In such situations there appears a fear of not being able to grasp or properly receive the transmitted information because of the varying levels of abstraction in the transmitter and in the recipient.

Knowledge transfer assumes different shapes depending on the type of knowledge transmitted and on the kind of tasks for the execution of which the given range of expertise is needed. Also, the circumstances under which the given range of expertise is to be exploited are of great importance. Nevertheless, it seems that what counts most is not the division itself but the comprehension of the differences resulting from its use and, at the same time, determining it—only adequate selection of the manner of transfer will make it effective.

Problems connected with knowledge transfer in selected EU countries

Characteristics of knowledge transfer in Sweden

Since 1997, Scandinavian universities have realized the knowledge transfer as "the third mission", next to teaching and scientific studies (Johannessson, 2008). Researchers have good cooperation in these fields with foundations and associations. Each university researcher knows a great deal about methods and ways of knowledge dissemination. In the case of invention patent receiving (professor's privilege), the researcher gains every kind of returns, but he also bears all the costs associated with creating them. Therefore, the situation when the researcher is the owner of intellectual property and research commercialization is more frequent is undoubtedly a huge advantage for the development of innovation. What is more, because of the government’s support for research activity and com-
Commercialization process, Scandinavian researchers are not afraid of taking risks. There are also capital investors who are happy to take part in funding science. Besides profit, connected with career development and remuneration, researchers have an opportunity to get a third mission realization bonus in different forms e.g. appearance fee for books or lectures, consulting remuneration that comes from commercial patent use. There is a great selection of knowledge and technology transfer. Especially consulting is important and often practiced. Moreover, benefits connected with consulting activity are less risky than potential patent profits.

Companies as well as universities need knowledge to succeed and to sustain their competitive advantages. Society is characterised by continuously shifting technologies and a growing number of competitors and products risk becoming obsolete almost overnight. In such a reality, companies and their employees need to be at the forefront of the knowledge available to them in pursuit of competitive advantage.

VINNOVA (The Swedish Governmental Agency for Innovation Systems) launched the Key Actors Programme in 2006 entitled “University strategies for knowledge transfer and commercialization”. All of the 24 universities were visited by a group of international and national experts, i.e. the peer group. On site, they met during two days with university management, professors, students and external stakeholders, in order to make an assessment of the collaborative task of the university. The programme was aimed at strengthening the role of the universities as engines for renewal and development of business, enterprise and society in Sweden. The long-term goal of the programme has been to contribute to the development of skills, methods and structures, to make universities in Sweden more professional with regards to cooperation with enterprises and other actors in the surrounding society, as well as in valorisation of knowledge and commercialisation of research outcome; i.e. all aspects of what is usually referred to as “Knowledge Transfer” (Johannessson, 2008).

The universities are suffering from insufficient and decreasing economic resources. Some of the underlying causes are a reduced share of government subsidies; a decreasing number of students; a very small or a decreasing amount of co-financing and commissions from the business sector; and finally, a weak financial situation for the universities’ holding companies with very few successful exits so far. On one hand, universities consider collaboration strategic to reach their vision and claim that the numerous strategies and policies have made collaboration mainstream and a well-integrated tool in the performance management at all levels of universities.

On the other hand, it would seem that this logic of attracting more funds has not yet lived up to its promise. Currently, collaboration in general and commercialisation in particular is regarded first and foremost of interest to the researcher, rather than an opportunity for the university. Hence, the innovation support system is organised in special units or projects oriented towards the researchers and with non-transparent connections to the university’s vision and economy. The “Professor’s Privilege” gives a researcher the full right over his/her research and prohibits Swedish universities to commercialise research results unless an agree-
ment is made with the researcher. This is a common excuse for the lack of strategies and involvement by university management. Regarding the university’s role in the (global) knowledge economy and the clear international ambitions stated in almost every university’s vision, there are obvious reasons for updating and revising the strategies for collaboration and managing the innovation support system (Temple & Chisholm, 2002, pp. 75-80). Regardless of what kind of inquiries, dialogues and “evaluations” they are used, the information does not seem to be documented, structured, validated or circulated, to serve as a tool for a university’s interaction and selection of strategic stakeholders (Sun & Scott, 2005, pp. 75-90). As a result, the knowledge about collaboration and who is accountable for what is rather ad hoc.

To investigate the deeper consequences of knowledge transfer through university-industry collaboration over time, a longitudinal study measuring changes in variables over time is recommended. Thus, it is argued that individual and team-level knowledge transfer has positive effects for those involved, which again can lead to increased motivation and thereby benefit the overall organisation. In due course, expected positive consequences also relate to the creation of university spin-outs and a higher degree of entrepreneurialism in students (Rasmussen & Sørheim, 2006, pp. 185-194).

As it can be seen, it is becoming more and more important for universities to constantly develop their competitiveness in teaching, research and third-stream activities not just in the case of publicly funded universities that most research tends to focus on, but to an equal extent, in private research institutions (Kwiek 2006, pp. 287-300), for example Chalmers University of Technology in Sweden, and to both Central and Eastern European universities experiencing greater market orientation (Kwiek 2008, pp. 757-770).

Problems of relatively low transfer of knowledge in Poland

Cooperation between the science and the business worlds is not as popular as in other highly developed countries. Knowledge transfer from universities to the economy is still a process which is valued low by entrepreneurs. The issue of relatively low knowledge transfer from universities to businesses mostly refers to economic knowledge. OECD, in their reports, emphasises that the knowledge transfer is far too little (OECD, Poland, p. 41, 78-80). Although it seems that the diagnosis is not quite right as knowledge transfer in Poland has been taking place, but it has not been strongly connected with innovation, nor has it been controlled by universities’ authorities. It is rather a consequence of individual activity of scientists or teams of scientists who happen to work at universities.

In Poland, the expenditure related to the scientific activity inputs should show a growing tendency due to a low share of such science expenditure, as compared with other European countries. A share of such expenditure in Polish GDP increases slowly (as is the case of most other European countries) (Eurostat, 2003-2014). Besides, their value can be connected with high accumulation of EU subsidies by Poland and Polish reporting bodies factoring them in the inputs for scientific activity. The authors here mean the fact that in industrialised countries, Fin-
land or Great Britain, the expenditure for scientific research is not usually connected with the infrastructure; e.g., the construction of new facilities, refurbishment of the existing facilities, and in Poland, over the recent years, considerable funds have been spent for that purpose. Any potential factoring in of such inputs borne by higher education schools and scientific facilities as inputs for science can distort the image of financing Polish science.

Universities and schools of higher education play an important role both in Polish society and in Polish economy. One of the more essential functions of universities, technology universities and non-public schools of higher education is education of the society and stimulating the economic development by performing scientific research. Although the two primary objectives of higher education seemingly differ from each other, however, they show some co-dependence since the education system of Polish schools of higher education is based on access to current results of scientific research which, in turn, motivate students to a creative economic problems solving and performing own scientific research.

Polish universities of learning survived the period of transformation maintaining in fact their status quo, i.e. trying to conduct scientific research at increasingly smaller factual expenditure on scientists’ payments, and therefore contending with the problem of researchers leaving for work in business enterprises. However, scientists did not go to businesses in order to conduct research there, but simply to get a better salary than they were getting in higher academic institutions. Thus, a great number of talented Polish researchers fell out of the stream of scientific life, sacrificing their skills for work at workstations characterized by relatively low requirements as compared to their qualifications. At present Poland is making up for that period, increasing the total number of researchers per thousand labour force. However, value 3.5 is the total number of researchers per thousand in the labour force in Poland, in comparison to 5.6 in the EU, 9.3 in the US or as much as 15.3 in Finland, the country to be discussed later on, which leaves a lot to be desired (European Commission, 2008).

Nowadays, facing the reality of Polish economy, the relationship between science and business is highly desired in terms of economy and the society. On the one hand, knowledge is a precious resource for economic enterprises which enhances their competitiveness and effectiveness as well as allows the enterprise to stand out on the market. However, transfer of knowledge affects the operation of higher education and practical development of knowledge. It thus acts as a link which combines science with business and, at the same time, gives grounds for a common formation of innovative solutions in economy and popularising knowledge in the Polish society (Klimczuk-Kochańska, 2011).

In Poland, two leading projects i.e. Strategia rozwoju szkolnictwa wyższego w Polsce do 2020 roku (Strategy for development of higher education in Poland by 2020) prepared by Ernst&Young in collaboration with IBnGR and Strategii rozwoju szkolnictwa wyższego: 2010-2020 (Strategy for development of higher education: 2010-2020) prepared by Polish Rectors Foundation pointed out a mission whose aim is cooperation of universities with their surroundings, including increase in productivity and effectiveness of scientific research activity.

Premises for development of knowledge transfer in Portugal
Innovation and Knowledge Transfer play an important role in most of developed economies. Under the Triple Helix Model (Etzkowitz & Leydesdorff, 1995, pp.14-19) many different studies and models have been applied for a long time in different countries (Khan & Park, 2013, pp. 182–193; Sarpong et al. 2015).

It is quite interesting to study knowledge transfer in Portugal because during the recent years (decade) there were some changes that reshaped the role of universities in this matter (Pinto 2012, pp. 27-35). However, according to the European Commission (European Commission, 2010, pp. 26-31), the country is lagging behind compared to other European Countries.

Due to political issues both at National and European level, knowledge transfer investments have been growing in Portugal, according to the Eurostat (Eurostat, 2016) since 2003, reaching the highest value in 2009: 1.58% of GDP. However, this figure started to decrease in 2010, again due to internal political options. Since then, the percentage has been decreasing reaching a figure of 1.29% in 2014. Recently (2015 and 2016) the investment is starting to increase once again (Pordata, 2016).

Currently, Portugal is under the European Support Framework – Europe 2020, a strategy for smart, sustainable and inclusive growth were knowledge transfer and cooperation among universities – businesses – local government is obliged to fund applications. Interesting results might be achieved under the strategy, but final results remain to be seen.

Enablers and Barriers of Knowledge Transfer in selected EU Countries—empirical results

Methodology of the Research

The research was conducted in January 2016, among 18 IT enterprises from Sweden, Poland and Portugal (6 enterprises from each country). Structured interview method was used in the research. We have chosen the interview method due to the fact that it allows the research to be done quickly, have direct contact with the respondents, and increases the effectiveness of the collected data.

The paper presents only part of the results. The study was carried out as part of COTRANS (Conditionings of Knowledge Transfers and Innovative Activity of Enterprises), an international project with project partners in Portugal and Poland.

The respondents were asked to prioritize selected barriers and enablers of knowledge transfer following the rule: -2 – significant barrier, -1 barrier, 0 - unimportant factor, 1- important but not crucial factor, 2 – a crucial factor. In order to prioritise them, an importance index was used.

Empirical Results
The same questionnaire of structured interview was given to enterprises in Sweden (SWE), Poland (POL), and Portugal (PRT). The enterprises represent small and medium businesses in the IT industry.

All of the companies are innovative-activity orientated (100%-SWE, 100%-POL, 100%-PRT). Majority of the enterprises believe that cooperation between enterprise and R&D units and institutions from the business environment is important, but not crucial (50% - POL, PRT – 83.33%), only Sweden believed the factor to be vital (100% - SWE). Moreover, all of the businesses cooperate with R&D institutions and/or business angels associations (100% - SWE, 100% - POL, 100% - PRT), but this cooperation is mostly occasional (POL – 100% and PRT – 83.4%) and frequent only in Sweden (SWE – 100%).

Figure 1 Enablers of knowledge transfer in Sweden, Poland and Portugal as Viewed by IT enterprises (importance index)
Source: results of own research.
The respondents were asked to prioritize the selected stimulants of knowledge transfer.

According to the respondents, the enablers of knowledge transfer with biggest significance are the grants available from the EU (importance index SWE – 2.00, POL – 2.00, PRT – 1.84). There’s no ministerial financial support of knowledge transfer in Portugal, thus (importance index PRT=0.00). The second place in the hierarchy is taken by knowledge of entrepreneurs considering cooperation (importance index SWE – 1.50, POL – 1.34 PRT – 1.50), as well as communication between entrepreneurs and R&D units (importance index SWE – 1.84, POL – 1.50, PRT – 1.34). Access to Technological Centres/Parks (importance index SWE – 1.00, POL – 0.67, PRT – 1.84) was considered the least important (Fig 1).

According to our research, the most vital barriers of knowledge transfer are terminology discrepancies (importance index SWE -0.67, POL -0.83, PRT -0.83) and differences between organizational cultures (importance index SWE -0.36, POL -0.67, PRT -0.17), as well as lack of communication between entrepreneurs and R&D units (importance index SWE -0.50, POL -0.67, PRT -0.33).

**Figure 2: Barriers of knowledge transfer in Sweden, Poland and Portugal as Viewed by IT enterprises (importance index)**

Source: results of own research.
The next barrier is the cost of cooperation – which is an interesting fact as in Poland it has significant meaning, in Portugal minor meaning as a barrier, but in Sweden it is of no importance at all (importance index SWE – 0.00, POL – -0.83, PRT – 0.17). Administration and management attitude towards cooperation constitutes the biggest barrier in Poland (importance index POL – -0.50) and it is of lesser significance in Sweden and Portugal (importance index SWE – -0.15, PRT – -0.15). Formal and law/regulation do not constitute a barrier for Portuguese entrepreneurs, whereas in Poland it is a significant barrier (importance index POL – -0.50, SWE – -0.17) (Fig. 2).

According to the respondents the most vital factors which determine the knowledge transfer are financial resources/grants (importance index SWE – 2.00, POL – 2.00, PRT – 1.84), knowledge of entrepreneurs considering cooperation (importance index SWE – 1.50, POL – 1.34 PRT – 1.50) and law/regulation (importance index SWE – 1.50, POL – 0.67, PRT – 1.00). The least important, according to the respondents, is internationalization of enterprises (importance index SWE – 0.83, POL – 0.83, PRT – 0.67).

**Summery of results**

The research illustrated both similarities and differences in the researched countries, but the differences among the respondents were not fundamental. The discrepancy mainly steams from national regulations and tools which each country can use to assist the knowledge transfer.

Grants available from the EU are of most importance in each of the countries. According to the respondents, the enablers of knowledge transfer with biggest significance are also ministerial grants, but in Portugal there is no ministerial financial support. Additionally, some of the barriers only exist in a given country e.g. formal and legal regulations are a big barrier in Poland, whereas they have no importance in Sweden. The idea is assisted by having university-friendly law and regulations, as well as active forms of supporting knowledge transfer by the Swedish government, such as founding a Swedish Governmental Agency for Innovation Systems – VINNOVA, which strengthens the role of the universities as engines for renewal and development of business, enterprises and society in Sweden.

The similarities in all the countries boil down to the fact that knowledge transfer requires: knowledge of entrepreneurs considering cooperation, efficient communication between entrepreneurs and R&D units and level of trust of this kind of cooperation.

Main enablers of knowledge transfer in the researched countries include:
- for Poland (grants available from the EU, ministerial grants, levels of trust for this kind of cooperation and proper communication between entrepreneurs and R&D units, knowledge of entrepreneurs considering cooperation),
- for Sweden (grants available from the EU, ministerial grants, levels of trust for this kind of cooperation and proper communication between entrepreneurs and R&D units business, partners’ and employees’ competences,
- for Portugal (grants available from the EU, knowledge of entrepreneurs considering cooperation).
Main barriers of knowledge transfer in the researched countries include:
- for Poland (terminology discrepancies, costs of cooperation, differences between organizational cultures, lack of communication between entrepreneurs and R&D units),
- for Sweden (terminology discrepancies, lack of communication between entrepreneurs and R&D units),
- for Portugal (terminology discrepancies).
According to our research the most vital factors which determine the knowledge transfer are financial resources/grants, knowledge of entrepreneurs considering cooperation and law/regulation.

Implications

Tightening the bond between universities and economy is crucial in a dynamically developing society. Modernization of higher education in the context of socio-economic development is one of the priorities of European Union’s educational policy—Lisbon Strategy and Europe 2020 strategy. Therefore, projects aimed at reforming or self-reforming universities in the EU have to include the implementation of goals established by the aforementioned strategies.

However, the cooperation between enterprises and R&D units and institutions is not of equal importance in all of the countries. In Sweden, the cooperation between enterprises and R&D units and institutions from the business environment is an important factor. In Poland and in Portugal, the cooperation between enterprises and R&D units and institutions from the business environment is not crucial. It may be safely assumed, that under the European Support Framework – Europe 2020 – the knowledge transfer will play a more and more important role in Sweden, Poland, Portugal, as well as all other EU member states. Nowadays universities tend to intensify the attempts of collaboration between the scientific and the economic world (these actions can be seen clearly in Scandinavian countries). In Poland and Portugal, the range of activities of universities’ research units partnering with businesses depends on the school’s authorities. As consequence, the freedom of action is limited and the decision making process is prolonged. Activities undertaken by the academia are often characterised by little flexibility and small adjustability to the market needs, which in turn translates to low level of cooperation between university and the economy, as it is extremely hard for the academia to respond quickly to changes in the labour market or the needs reported by employers.

Knowledge transfer is inevitable. However, for it to proceed smoothly, knowledge of entrepreneurs considering cooperation should be increased, and tools merging the cooperation should be created, such as e.g. information points, where qualified staff would help in creating an effective collaboration and would assist in communication between entrepreneurs and R&D units. Additional changes are needed in the country’s legal systems. The state should support knowledge transfer
not only financially, but also by creating the right type of legal system. Those changes should take place especially in Poland and Portugal.

References


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Expert System for Professional Orientation

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Abstract
Understanding the inclinations of university students and graduates towards their future professions is an important step in self-actualization. To this end, this paper examines the application of an expert system for professional orientation. Adapting a research methodological approach developed by Klimovan (2005), the paper uses online questionnaire survey to collect data from the participants. The paper presents the analysis of results. Overall, the findings highlight the importance of professional choices made by information technology professionals—especially, now that jobs in the IT industry are in demand globally. The findings show that IT professionals not only require appropriate technical skills and experience, but also a broad understanding of the context in which they work. The paper concludes that an online expert system not only guides students in their selection of future professions, but also offers information and knowledge about the psychological aspects of their professional choices—necessary for self-realization.

Keywords: professional orientation, expert system, inclinations/predispositions, differential-diagnostic questionnaire, self-determination, self-realization

Introduction
A profession should bring a pleasure, positive emotions, ensure the maximum realization of human opportunities to benefit the society. The modern perception of a ‘professional success’ is one that takes place in employment—certainly not something that was ascribed at birth. And it is necessary to have an appropriate capacity to master the professional craftsmanship on the basis of acquired skills, a positive attitude, professional motivation and an interest in the work.

An essential factor in the development of human capabilities is personnel permanent special interest. A special interest is an interest in the particular field of human activity, which develops into a professional inclination to do this kind of profession. Effective mastery of techniques and methods of an activity promotes a person’s cognitive interest. The occurrence of interest in a particular employment or training activity is closely connected with the awakening of the ability to that profession and serves as a starting point for professional development.
And, in the light of foregoing, the problem of self-actualization becomes important mainly in the performance of adult workers (university students, graduates) in given work contexts. In this research, we use “The differential-diagnostic questionnaire” developed by Klimov (2005) to test the inclinations of the university students and graduates to their professions and to analyze contradictions in the generated results.

Klimov reveals the essence of “a professional psychology” paying attention to the fact that “professional should be seen as a complex system that has not only the external functions, but also necessary and, as a rule, complex and diverse internal, in particular mental functions”. These include the following: construction of an image of future actions’ results, “nurturing” ideas about ways and means, options to achieve results, emotional presetting for work and general consciousness of protection in society, confidence in the future, etc. Klimov sees the professionalism as a systemic organization of consciousness, a human psyche, a structure of which includes components that provide the knowledge, the person as a whole (the person, the subject of activity), his image of the world, the focus and creative attitude, his praxis and gnosis, his awareness of the profession, knowledge, experience and culture of professional; his psychodynamics and emotionally-strong-willed regulation in complicated professional situations (Klimov, 2005).

**Existing Expert Systems in Career Determination**

Klimov (2005) developed the defining test on professional-pedagogical inclinations to assess professional orientation of people. The problem of professional’s self-determination in the psycho-pedagogical literature is closely linked with the problem of a young man activity (student, graduate) in the process of choosing a future profession.


There are a number of psycho-diagnostic tests on the career orientation of an individual: "The career anchors" questionnaire by E. Shane, "The career goals" questionnaire by E.G. Moll, the methodology of T.P. Maralova "The essay about my life after 10 years", the methodology of I.G. Senin "The terminal values' questionnaire", the methodology of F. Noe, R. Noe, D. Bahuber "Motivation for a career" (adapted by E.A. Mogilevkina), "The diagnostics of motivation" test, the methodology of Sh. Richi and P. Martin "The study of motivational profile of a person" (adapted by E.A. Klimov), the methodology of E.A. Mogilevkin "The career advancement factors", the methodology of I.A. Pankratova "The career picture" (Zhuina, 2014, p. 540). All of these tests are aimed at psycho-diagnostical, acmeological structural components of the career orientation of an individual: ca-
The market of Expert Systems for different problems is very huge and usually each development of such systems relates to the narrow field of research. We have some experience in the development of security audit expert systems (Atymtayeva, Kozhakhmet, Bortsova, Inoue, 2012, pp. 238-243), (Kanatov, Atymtayeva, Yagaliyeva, 2014, pp. 896-899), but in this case of research we have to analyze the existing expert systems for career choice, for example, such famous systems as “X-222” and “Profi” (Profix – find your profession) in terms of functionality, the order of testing, types of reports are generated. We investigated the structure and functional model of the systems. According to these analyzes it was revealed that the systems gather information about the client, including gender, age, education, preferred areas of activity, reveals his professional interests and inclinations. This is realized in the form of a dialogue with user (survey). After the finishing this survey the system generates a list of professions the most relevant for the certain user. For the generation of recommendations system uses tendencies and interests of the users by taking into account his age, level and type of education. By the process of getting result the system gives the explanation and conclusions why this certain recommendation was chosen for this user and introduces the main characteristics of the professional activity. The main principles of such systems are to use the knowledge about the logical, cause-effect relationships between professions and inclinations, personal qualities, patterns and "reasoning" heuristics (Jackson, 1990, p. 21-27).

However, the existing systems for choosing IT profession cannot be called so effective. The difficulty lies in the dynamic build-up of knowledge in the industry and significant isolation from the learning process. They have some gaps in terms of expanding the knowledge base.

**Methodology**

The choice of profession—is an individual choice to receive socially significant result: the entry into adult life as an employee, a member of social labor. Professional self-determination may match with the choice of profession, if a person chooses a profession in accordance with their interests, inclinations, aspirations and abilities. The choice of profession does not coincide with the professional self-determination process in cases where a person "chooses" the profession by accident, for example, by a factor of proximity to the work place of residence, public fashion for a profession, according to an acquaintance, and others.

The methodology of “The differential-diagnostic questionnaire” by Klimov (2005) designed to detect a person’s predisposition to a certain type of profession. It is a short questionnaire consisting of 20 items with two alternative statements in each item. The respondent should select one of the two statements in 20 items. For example, “2 a. Helping sick people, to treat them”, “2 b. To make tables, charts, computer programs” (see Appendix). The methodology was based on the criteria of "the labor object", to what or to who directs active, transforming activity of a person-professional. There are five main objects of the professional activities of a per-
son according to Klimov’s methodology of “The differential-diagnostic questionnaire”: a nature (meaning "living" nature, or biological objects), techniques (machines, mechanisms, materials, different forms of energy), a person (child, adult, old man), a sign system (various information systems, numbers, formulas, texts) and an artistic image. Moreover, the descriptive statistics were used to analyze the personal information characteristics (gender, age, current occupation) of the participants for general analysis.

**Description of Klimov's five professional fields of labor**

The five professional fields of labor can be selected accordingly - "a man-nature", "a man-technique", "a man-man", "a man-sign system" and "a man-artistic image". "A man-nature"—if you love working in the garden, vegetable garden, take care of plants, animals, love biology, so check professions such as "a man-nature". The sphere of activity for the majority representatives of professions such as "a man-nature" is: animals, conditions for their growth and life; plants.

People with skills in this sphere have to perform the following activities: to learn, to research, to analyze the conditions of plants’ or animals’ lives (an agronomist, a microbiologist, a livestock specialist, a hydrobiologist, an agricultural chemist, a plant pathologist); to grow plants, to care for animals (a forester, a field crop specialist, a grower, a fancier, a breeder, a beekeeper); to carry out preventive maintenance of plants’ and animals’ diseases (a veterinary doctor quarantine service).

The psychological requirements for "a man-nature" professions: developed imagination, spatial visualization ability, good visual memory, observation, the ability to anticipate and evaluate the variability of natural factors; as the results of operations are detected after a fairly long time, the expert must have patience, perseverance, must be willing to work outside of groups, sometimes in difficult weather conditions, in mud (Klimov, 2005).

"A man-technique"—if you like the labs for physics, chemistry, electrical engineering, if you make models, you are good in household appliances, if you want to create, operate, or maintain machines, equipment, vehicles, so check with the professions of "a man-technique" type. The object of work for the majority of representatives of "a man-technique" professions is: technical objects (machines, equipment); materials and forms of energy. People with skills in this sphere have to perform the following activities: creating, mounting, assembly of technical devices (experts design, construct technical systems, devices, develop processes for their manufacture). They assemble cars, machinery, devices from the separate components, parts, assemble, regulate and adjust them; operation of technical devices (specialists work on machines, operate transport, automatic systems); repair of technical devices (specialists identify, recognize malfunctions of technical systems, equipment, mechanisms, repair, adjust and establish them) (Ibid.).

The psychological requirements of "a man-technique" professions: good coordination of movements; accurate visual, auditory, and kinesthetic perception of vibration; development of technical and creative thinking and imagination; and the ability to switch focus; observation.
"A man-sign system"—If you like to perform calculations, drawings, diagrams, keep a card file, organize various information if you want to do programming, economics and statistics, etc., and then get acquainted with professions such as "a man-sign system". Most of this type of occupations associated with information processing. The object of the work for the majority of the representatives of professions such as "a man-sign system" is: texts in their native or foreign languages (an editor, a proof-reader, a typist, a clerk, a telegraphist, a compositor); numbers, formulas, tables (a programmer, the operator of the SBUs, an economist, an accountant, a statistics); drawings, diagrams, maps (a designer, an engineer, a draftsman, a copier, a navigator, a surveyor); audio signals (a radio operator, a stenographer, a telephone operator, a sound technician) (Ibid.).

The psychological requirements to "a man-sign system" professions: a good operational and mechanical memory; the ability to focus on long abstract (landmark) materials; good distribution and switching of attention; the accuracy of perception, the ability to see what is behind the conventional signs; perseverance, patience; and logical thinking.

"A man-artistic image"—The object of work for the majority of representatives of these professions such as "a man-artistic image" is: an artistic image, methods of its construction. Those professionals which skilled in the art have to perform the following activities: creation, design artistic works (a writer, a painter, a composer, a designer, an architect, a sculptor, a journalist, a choreographer); reproduction, production of various products on the model (a jeweler, a restorer, a printmaker, a musician, an actor, a cabinetmaker); reproduction of art works in a mass production (a master paintings, a grinder stone and crystal, a painter, a printmaker).

The psychological requirements of "a man-artistic image" professions: artistic ability; development of visual perception; observation, and visual memory; spatial visualization ability; creative imagination; knowledge of psychological laws of emotional impact on people (Ibid.).

"A man-man"—The object of work for the majority of "a man-man" professions is: people. Those individuals which skilled in the art have to perform the following activities: education, educating people (a tutor, a teacher, a sports coach); medical care (a doctor, a paramedic, a nurse); consumer services (a seller, a barber, a waiter, a janitor); information services (a librarian, a guide, a lecturer); protection of a society and the state (a lawyer, a policeman, an inspector, a soldier). The psychological requirements to "a man-man" professions: a desire to communicate, an ability to come into contact with strangers easily; sustainable well-being when dealing with people; kindness, compassion; excerpt; an ability to restrain emotions (Ibid.). Besides, an ability to analyze behavior of others and their own, to understand the intentions and the mood of others, an ability to deal in human relations, an ability to settle disputes between them, organize their interaction; an ability to put themselves in somebody’s shoes mentally, an ability to listen, to take into account an opinion of another person; an ability to control speech, facial expressions, gestures; an ability to find common language with different people; an ability to persuade people; an accuracy, a punctuality, a self-discipline; knowledge of human psychology.
**Expert systems development**

In order to automate the process of professional orientation we stopped on the technology of the expert system development. The expert systems are currently the most widely used type of systems based on the rules. The rule-based system consists of IF-THEN rules, facts and interpreter, which controls how the rule should be called depending on the availability of the facts in the working memory.

We can consider the expert system for professional orientation as consisting of three main components (Jackson, 1990) (see Fig.1):

- A knowledge-base (KB);
- An inference engine (IE);
- A user interface (UI).

The knowledge-base (KB), the construction which requires the choosing of a strategy leading to a model of knowledge gathering, the aim of which is to collect orderly and symbolically and represent the available information for professional orientation. As the knowledge-base became more complex so the techniques developed into more sophisticated too.

The inference engine (IE) verifies the consistency of the KB and extracts consequences automatically from the symbolic formulation of model information.

The interactive graphic user’s interface (UI) that is used by users not necessarily familiar with the logical and mathematical details of the system construction. The general structure of considering the expert system can be showed in the figure 1.

![Figure 1: The structure of the expert system for professional orientation.](image)

To create the knowledge-base (KB) we have to find the main categories of professional orientation based on Klimov’s characteristics of a person’s types. We can mark the five professional fields of labor as numbers like “0” as Nature, “1” – Technique, “2” – Sign System, “3” - Artistic Image, and “4” as a Man. During the construction of an appropriate independent questions (see Fig. 2) we can distribute the special weights for each category. After the selection of answers by users these special weights will be stored in database at the special fields.
Thus, by using the sorted set of different m-elements chosen from the bunch of n-elements we can get the set of different questions for identification of the professional fields of labor. For each question we can consider only 2 answers and by using the combinatory analysis we get the appropriate number of questions:

$$A_m^n = \frac{m!}{(m-n)!}$$  \hspace{1cm} (1)

$$A_5^2 = \frac{5!}{(5-2)!} = \frac{5!}{3!} = \frac{120}{6} = 20$$ \hspace{1cm} (2)

The general links between the professional fields of labor may be showed as a graph (see Fig.3). The various combinations between these fields will lead to the different human characteristics in the professional orientation. This graph gives us opportunity to extend the number of professional fields of labor and thereby getting new human characteristics of professional orientation.
This theory and constructed graph may help in consideration of the specific areas of professional activity, for example, how to identify the specific skills and abilities for IT-specialists.

In this field we take into account the different types of IT-specialists, for example, “IT programmer”, “Designer”, “Project Manager” and etc., and try to identify the professional orientation based on the special survey by the proposed principles with a definition of weights for different answers.

**Discussions**

Among the respondents (N=42) participating in this study, seventy percent (n=28) were male and approximately one-third (n=14) were female. About eighty-six percent (n=36) of them were from 20- to 25 years old. And fourteen percent (n=6) were 30 and 40 years old respectively. The specializations of the respondents are technical - IT (n=28), oil and gas industry (n=12) and finance (n=2) accordingly.

Their predispositions to the definite type of profession were determined by the composite score on "The differential-diagnostic questionnaire" calculated from each individual item results. Out of one hundred percent (N=42) – about sixty percent of participants (N=25) have the predispositions to "a man - technique" or "a man - sign" types of professions. Other forty percentage of respondents (N=17) have inclinations to "a man - man" type of profession. To analyze the received results we may see that the most of respondents have inclinations to technical types of professions and it is logical and corresponded to their specializations. But, about forty percent of the participants received the results opposite to their future professions.
We have informed all the participants about the results and asked them to answer two questions after the finishing Klimov's questionnaire “Was the result surprising for you?”, “If yes, can you explain your predispositions to the definite type of professions?” Most of the participants were sure in their results and their inclinations to the technical types of professions. They were happy to receive the confirmations of their predispositions to the future professions. The rest of participants, those who received inclinations to "a man - man" type of profession explained us their reasons. In general, we can conclude their answers are as following: the choice of future profession was parents’ advice/recommendation (80%); active participation in students’ out of class activities changed their inclinations to future professions (15%); other changes happened in their lives (5%).

Implications

A career choice is a developmental process that extends throughout life; it involves series of decisions. In reality, a career decision is not just a matter of selecting an occupation, but it is a good match with a person’s characteristics. That is why by giving advice in a career determination we give them the base for their decisions to develop career according to their professional predispositions. Professional orientation is important because it lays a foundation for the entire career. Moreover, it makes comfortable in the job, help faster adaptation to the future job and finally contribute to a more effective, productive work in general.

The value of the implications of the research results for career choice and professional development is obvious. An effective orientation serves to acclimate the employee and speed up the time it takes for him/her to become a productive member of the future organization. It can also increase the employee's comfort level regarding him/her decision to join the IT industry.

Limitations

To specify our professional orientation among IT specialists the second stage of our research will be the psychological testing for a career guidance taking into account the preferences of users and selects the profession that most suitable for them in IT industry. There are many specializations for every taste and character in the field of information technology. Firstly, the combination occurs in very close to each other profession: for example, "Web Developer" and "Web Designer". Answering to questions may be repeated several times and you can choose among them - one or two of the most popular. It can be assumed that the test in relation to these professions is a clear interest and possible addiction. If there is no a clear leader among professions, all the answers can be classified on the meaningful base. By using psychological analysis we identified skills and characters that IT programmers should have and created the 15 questions’ test determining the percentage of a human suitability for IT sphere. There are “Yes/No” answers in the test. Further, we plan to extend the scope of answers by making them fuzzier because real human answers usually have some degree between “Yes” or “No”. The testing contains the questions about the attitude to this or that activity and phenomenon.
Some experience in the development of fuzzy expert systems may help us in this research.

**Summary and Conclusion**

It is obvious that the expert system in a career determination has a great significance, because it provides accurate and proper career choice based on the character performance. The career choice is a delicate decision making problem since it has an effect on efficiency and competency if it is not properly handled. Person who has chosen a profession and does not meet his nature often feels frustration in his profession. In this way a right choice of future profession as early as possible may help to build a suitable career. And the construction of an expert system in this area may serve as an excellent instrument for this purpose.

These findings provide useful information for the choosing career guidance. It is not always an easy task for people to choose their future professions. Especially nowadays, IT sphere is a sphere of professions of the future, where modern jobs appear more and more as the replacement manual to computer-automated processes. We can also confirm that nowadays, there is a high level of demands for professionals in IT industry according to the analysis of labour market and based on the information of recruitment agencies in Kazakhstan and other rest of the world. Thereby, IT professionals need not only appropriate technical skills and experience, but also a broad understanding of the context in which they operate. For this purpose we have developed an Online Expert System which guides students for the selection of their suitable future professions in IT sphere by special type of survey which contains the psychological aspects.

**References**


**Appendix**

**Test for vocational guidance on the method of an academician E.A. Klimov.**

We offer you 20 pairs of statements. Carefully read both statements, select the one that best suits your wishes.

The choice needs to be done in each pair of statements, and then click "Get Results".

Choose what is closer, more liking to you:
<table>
<thead>
<tr>
<th></th>
<th>A)</th>
<th>B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Caring for animals</td>
<td>Serve machines, devices (monitor, regulate)</td>
</tr>
<tr>
<td>2.</td>
<td>Helping sick people, to treat them</td>
<td>To make tables, charts, computer programs.</td>
</tr>
<tr>
<td>3.</td>
<td>Ensure quality of book illustrations, posters, art cards, phonograph records</td>
<td>Follow the state of plant development</td>
</tr>
<tr>
<td>4.</td>
<td>Treating materials (wood, fabric, plastic, etc.)</td>
<td>Bring products to consumers (advertising, selling)</td>
</tr>
<tr>
<td>5.</td>
<td>Discuss scientific-popular books, articles</td>
<td>Discuss art books</td>
</tr>
<tr>
<td>6.</td>
<td>Grow young animals of any breed</td>
<td>Coaching peers (and junior) in the performance of any action (employment, education, sports)</td>
</tr>
<tr>
<td>7.</td>
<td>Copy pictures, images, customize musical instruments.</td>
<td>Manage any cargo, lifting, vehicle (trailer trucks, car and so on.)</td>
</tr>
<tr>
<td>8.</td>
<td>Communicate and explain to people the necessary information for them at the information desk during the excursions, etc.</td>
<td>Artistically arrange exhibitions, showcases, participate in the preparation of concerts, plays, etc.</td>
</tr>
<tr>
<td>9.</td>
<td>Repairing the product items (clothing, equipment), home</td>
<td>Find and correct errors in the text, tables, figures</td>
</tr>
<tr>
<td>10.</td>
<td>To treat animals</td>
<td>Perform calculations, computations</td>
</tr>
<tr>
<td>11.</td>
<td>Find out new varieties of plants</td>
<td>Designing new types of industrial products (cars, clothes, houses, etc.)</td>
</tr>
<tr>
<td>12.</td>
<td>Disassemble disputes, quarrels between people, persuade, explain, encourage, punish</td>
<td>To understand the drawings, diagrams, tables (check, refine, put in order)</td>
</tr>
<tr>
<td>13.</td>
<td>Watch, learn the work of amateur clubs</td>
<td>Observe, study the life of microbes</td>
</tr>
<tr>
<td>14.</td>
<td>Serve, build medical devices and instruments</td>
<td>Provide medical assistance to people with wounds, bruises, burns, etc.</td>
</tr>
<tr>
<td>15.</td>
<td>Prepare an accurate description of the report of the observed phenomena, the events of the measured object, and others.</td>
<td>To describe art, depict events observed or presented</td>
</tr>
<tr>
<td>16.</td>
<td>Make laboratory tests in hospital</td>
<td>Take care and examine patients, talk to them, prescribe treatment</td>
</tr>
<tr>
<td>17.</td>
<td>Dye or paint the walls of rooms and the surface of products</td>
<td>To carry out installation of the building or assembly machines, instruments</td>
</tr>
<tr>
<td>18.</td>
<td>Organize trips for people to theaters, museums, excursions, tourist trips, and so on.</td>
<td>Play on stage, to show concerts</td>
</tr>
<tr>
<td>19.</td>
<td>Produce drawings for parts, accessories (clothes), and construct buildings</td>
<td>To be engaged in plotting, copying maps, drawings</td>
</tr>
<tr>
<td>20.</td>
<td>To fight with plant diseases, pests of forest and garden</td>
<td>Work on the machines (typewriter, computer, telex, telefax).</td>
</tr>
</tbody>
</table>

*Adopted from Klimov E.A. (2005)*
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Constructivist Learning and Digital Media

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Abstract

The aim of this study was to determine the extent to which certain socio-demographic features of the respondents, along with their level of computer self-efficacy and their attitudes (motivation) towards the use of digital media in class, can be regarded as predictors of constructivist learning. The research was conducted on a sample of eighth grade compulsory school pupils (N = 235). The results show that certain socio-demographic features are either not significant or are significant to a small extent in constructivist learning. The level of computer self-efficacy was a somewhat more significant predictor, especially in terms of the use of computer software and the internet. The most significant predictors are attitudes towards the use of digital media in classroom instruction and the benefits thereof for pupils, especially in the sense of the expectation of better learning outcomes. The results and the implications of the results are discussed in this paper.

Keywords: digital media in classroom instruction, innovative learning, constructivist learning, compulsory education, computer self-efficacy, attitudes towards the media

Introduction

Creativity can be regarded as a skill for the 21st century, so it is justified to include it in school curricula (Piirto, 2011). Regardless of the theoretical basis of approaches to creativity (Kozbelt, Beghetto and Runco, 2010), researchers working in the field of creativity hold that innovation is its immanent feature (Piirto, 2011; Sawyer, 2006; Weisberg, 2006). From the aspect of didactics, innovativeness can be considered as innovative learning. The term innovative learning was defined by Botkin, Elmandjra and Malitza in the well-known Report to the Club of Rome titled “No Limits to Learning – Bridging the Human Gap (1979/1998). The authors define innovative learning as “…the type of learning that can bring change, renewal, restructuring, and problem reformulation” (Botkin et al., 1979/1998, p. 10). Besides, prominent features of innovative learning are participation and anticipation (Bognar and Matijević, 2002; Botkin, et al., 1979/1998). On the other hand, learning for the future, redefining and restructuring problems, and forming change are some of the characteristics of what has been established over the last three decades as constructivist learning (e.g. Fosnot & Perry, 2005; Schwartz, Lindgren &
Lewis, 2009). We cannot claim that innovative learning and constructivist learning are the same concepts, but they are nonetheless complementary. From the viewpoint of didactic theories, it is justified to say that innovative learning, as the implementation of creative ideas, the construction of one's own reality, or the creation of new ideas, is also one of the features of constructivist learning. This paper will analyse the link between constructivist learning and innovative learning as one of its features.

When we examine contemporary constructivist learning, it is necessary to take into account contemporary digital media (UNESCO, 2002). This primarily means that schools today have pupils who are members of the Net Generation (Tapscott, 1999). They should have access to active learning in which they cooperate, resolve problems, play, research, build, but with the assistance of digital technology. Therefore, it is justified to think about ways to organise constructivist learning via digital media.

Although there are various theoretical approaches to creativity (Kozbelt, Beghetto and Runco, 2010), one of its important aspects is divergent thinking, which is recognised from both the pedagogic and didactic aspect. The characteristics of divergent thinking, according to Guilford (1967) are: problem finding and solving, flexibility, fluency, elaboration, transformation, objectivity and selectivity, and aesthetic appreciation. Although not recent, Guilford's characteristics are current even in contemporary theories (Wright, 2010, p. 5). Jenkins (2006), in his explanation of pupils’ skills in the digital and participatory culture of learning, offered a similar classification that might be regarded as manifest forms of the characteristics of creativity. In this sense, he mentions: play, performance, simulation, appropriation, multitasking, distributed cognition, collective intelligence, judgement, transmedia navigation, and negotiation. Therefore, it is justified to presume that digital media can be significant for the development of innovation and can feature as an important variable in constructivist learning, especially in children of the Net Generation.

On the other hand, digital media are still mostly used in the paradigm of teacher-centred classroom instruction (Petko 2012). Issues that arise here concern what the significant factors of constructivist learning are and how these factors relate to one another. Such questions primarily include the role played by digital media, and the individual characteristics of pupils, such as the ability and motivation to use digital media in constructivist learning.

**Constructivist learning and teaching in the digital age**

We can analyse constructivism as philosophical, didactic and psychological theory (Kanselaar et al., 2002). Regardless of the type of theory, constructivism can generally be defined as the construction of one’s own knowledge of the world and knowledge based on understanding and interpreting one’s own experiences and interaction with the physical and social environment (e.g. Ernst, 1998, 2005; von Glasersfeld, 2003). The ideas and theories of constructivism are not new – they are a few thousand years old, especially in the philosophical (epistemological) context. It was only at the beginning of the 20th century that constructivism was differenti-
ated from philosophy (Prichard and Woollard, 2010; von Glasersfeld, 2003). Since then, constructivism has been seen as the didactic and psychological theory of learning and teaching. There are two types of constructivism. The first is radical constructivism, defined as the wholly individual construction of reality and knowledge based on one’s own experiences, prior knowledge and experience, and an understanding of interaction with the environment. The second type is social constructivism, defined as the individual construction of reality and knowledge, but greatly influenced by social interaction with other persons, and the social, cultural and historical context of the individual. Proponents of constructivism (irrespective of the type) are Ernst von Glasersfeld, Jean Piaget, Paul Ernst, Paul Watzlawick, Lev Vygotsky, etc. It is important to emphasise that this paper focuses on the didactic theory of constructivism and its features in learning, teaching and classroom instruction.

Constructivist learning and teaching can be defined as individual and cooperative, and the self-regulated and interpretative construction of one's own thoughts via active interaction with the social and physical environment (Fosnot and Perry, 2005). Yilmaz (2008, pp. 167-168), in his summary of the results of other studies, mentions the following features of constructivist teaching:

1) learning is an active process;
2) learning is an adaptive activity;
3) learning is situated in the context in which it occurs;
4) knowledge is not innate, passively absorbed, or invented but constructed by the learner;
5) all knowledge is personal and idiosyncratic;
6) all knowledge is socially constructed;
7) learning is essentially a process of making sense of the world;
8) experience and prior understanding play a role in learning;
9) social interaction plays a role in learning; and
10) effective learning requires meaningful, open-ended, challenging problems for the learner to solve (Boethel and Dimock 2000; Fox 2001, according to Yilmaz, 2008)

The didactic strategies of constructivist learning are inquiry-based learning, problem-based learning, cooperative learning, play-based learning, learning-by-doing, and project-based learning. They have been known since the early 20th century in the directions and movements of reform pedagogy, that is, in the ideas of Celestin Freinet, Maria Montessori, Rudolf Steiner, Georg Kerschensteiner, Alfred Lichtwark, Hugo Gaudig, Peter Petersen, and others (Matijević, 2001; Skiera, 2009). In this respect, it is justified to claim that the didactic elements of reform pedagogy are a precursor of what is now established under the term constructivist and innovative learning. In a more detailed analysis of the characteristics of reform pedagogy (Matijević, 2001; Skiera, 2009), we recognise what is referred to in creativity as the “four Ps” and, more recently, as the “six Ps” (Kozbelt, Beghetto and Runco, 2010), which stand for: process, product, person (personality), place, persuasion and potential. These are some of the didactic elements emphasised by the directions and movements of reform pedagogy. On the other hand, they are also the elements of constructivist learning. In constructivist learning, it is important not
only to learn something that is already known (discovered) but to create new knowledge, new information, to create and construct something new. It is precisely this creation of something new and useful that is the basic feature of innovation and creativity (Kozbelt, Beghetto and Runco, 2010).

Further, in terms of the question about the role of digital media in learning and teaching, one should start with what novelty digital media in classroom instruction offer in comparison with traditional media. When we abstract all the technological and functional characteristics of digital (new) media, what is really new is, according to Kanselaar et al. (2002): 1) the digital delivery and presentation of information in multimodal and simultaneous forms; 2) the performance of actions and actions via digital technologies that were until recently performed manually; and 3) computer mediated communication. In the didactic context, these novelties allow for: 1) situational learning in “real” situations; 2) inquiry-based learning and problem-based learning with the help of digital media; 3) cooperative learning with digital media; 4) individualisation of classroom instruction; and 5) learning-by-doing (Kanselaar et al., 2002; Schulz-Zander and Tulodziecki, 2011). These are constructivist strategies of learning (Reich, 2006).

Acknowledging the mentioned premises on the role of digital media in constructivist learning, the results of empirical research show that in such teaching and learning the individual characteristics and differences of pupils must be taken into account (Leutner, 1993). Further, it is justified to claim that digital media encourage cooperative learning (Swak, Van Joolingen and De Jong, 1998). Intuitive knowledge can also be regarded as a characteristic of constructivist learning; Swak, Van Joolingen and De Jong (1998) claim that it develops through constructivist learning. It is precisely the use of digital media in constructivist classroom instruction that encourages the development of intuitive understanding, reflexive learning, flexibility, and knowledge integration (Reid, Zhang and Chen, 2003). The role of digital media should be viewed in terms of the motivation to learn, their role in cooperative learning, and the like (e.g., Schamburg and Issing, 2002). In other words, it is best to observe them as one of the variables of (constructivist) learning and teaching, and not as a predictor of efficiency in achieving learning outcomes (Tamim et al., 2011).

Although the role of digital media as a significant variable of (constructivist) lifelong learning has been recognised, the question still remains of how to implement such media in learning and in class. The question arises about what pupils’ individual reasons to use digital media are when learning and when in class.

**Use of digital media in class and in learning**

Certain studies show that the human factor is more important for the optimum use of digital media in learning than the mere possession of such media (Beetham and Sharpe, 2007; Tamim et al., 2011). This is supported by Moos and Azevedo (2009) who claim that it is precisely motivation operating via computer self-efficacy and attitude that is significant for successful use of digital media. Pintrich
and De Groot (1990) state the same thing when they include self-efficacy and the intrinsic values of learning as aspects of motivation and self-regulated learning.

The concept of computer self-efficacy is based on Bandura’s theory of self-efficacy, and it is defined as conviction in one’s own ability to perform a task (Bandura, 1977). It has been shown that the concept of self-efficacy is applicable in a number of fields, such as health, sports, business career, etc. (Bandura, 1997), but also in learning, teaching and classroom instruction (Tschannen-Moran, Woolfolk and Hoy, 1998). The concept of computer self-efficacy emerged in the mid-1980s as a result of the development of computer technologies (Murphy, Coover and Owen, 1989). Computer self-efficacy is defined as an assessment of one’s own ability to use a computer for the purpose of achieving certain tasks and problem-solving (Whitley, 1997). It is interesting that younger persons apply a higher level of computer self-efficacy than older individuals (Topolovčan, Matijević and Dumančić, 2015; Whitley, 1997), which is significant in the context of classroom instruction. It is also interesting to mention that a higher level of computer self-efficacy can be connected with higher work control (Brosnan, 1998) and with self-regulated learning, cooperative learning, intrinsic motivation, and personal autonomy in work (Deng, Dool and Troung, 2004), which can be significant for constructivist learning.

Based on the well-known theory of motivation, that is, the expectancy-value theory of motivation, developed by Jacquelynne S. Eccles et al. (Eccles, 2005), which is often used in the context of classroom instruction and learning, Wozney, Venkatesh and Abrami (2006) developed a model of implementation and use of digital media in classroom instruction. Namely, they posited as their starting point that attitudes such as value and expectancy are important for the successful use of digital media. Value and expectancy relate to what digital media can bring about in the classroom. These authors added a third dimension of cost to the dimensions of value and expectancy. In their view, in terms of attitudes and the motivation to implement and use media in classroom instruction, expectancy, value, and cost are what are relevant. Accordingly, they constructed an instrument to examine the implementation of new technologies in the classroom, the Technology Implementation Questionnaire (TIQ), although they used it on a sample of teachers. The question is whether it applies to a sample of pupils.

Based on an analysis of the results of previous research, it is evident that the use of digital media in (constructivist) learning should be considered with regard to other factors, primarily motivation and the ability to use such media. In this respect, it is apparent that motivation and the ability to use digital media are significant but separate factors of constructivist learning and teaching. The question is what their role and relationship are when they are observed together as predictors of constructivist learning. The empirical research presented below was conducted to investigate this.

**Methodology**

The aim of this research was to examine whether certain demographic characteristics of pupils, the possession of digital media at home, computer self-
efficacy, and attitudes towards the use of digital media (motivation) in the classroom can be regarded as significant predictors of constructivist learning.

Sample

The study included eighth-grade (ISCED level 2) compulsory school pupils ($N = 235$) from three counties in north-western Croatia (the County of Bjelovar-Bilogora, the County of Zagreb, including the City of Zagreb, and the County of Međimurje). The sample included 118 (50.2%) male and 117 (49.8%) female pupils. A total of 205 (87.2%) live in towns, and 30 (12.8%) pupils live in the country. Their final average results at the end of the previous grade were as follows: excellent for 91 (38.7%) pupils, very good for 105 (44.7%) pupils, good for 33 (14%), satisfactory for 5 (2.1%) pupils, and unsatisfactory for 1 (0.4%) pupil.

Instruments

Along with demographic data on gender (male/female), permanent residence (town/village), and the average overall mark in the previous grade, data were also collected on the possession of digital media at home, relating to the computer, access to the internet, mobile phone, smart phone, multimedia software, tablet, and a profile on one of the social networks, as recorded by a Yes/No answer. To collect data on computer self-efficacy, to the implementation of digital media in the classroom, and constructivist learning, relevant scales were used: the Constructivist Learning Environment Scale (Taylor, Fraser & Fischer, 1997), the Computer Self-efficacy Scale (Teo & Ling Koh, 2010) and the Technology Implementation Questionnaire (Wozney, Venkatesh and Abrami, 2006).

Constructivist Learning Environment Scale

Data on constructivist learning were collected through the instrument Constructivist Learning Environment Scale (CLES) developed by Taylor, Fraser and Fischer (1997). The scale was translated into the Croatian language, with the permission of the authors, and, following back-translation into English, certain terms were modified. The scale originally consists of thirty-five items on a four-point Likert scale (1 – strongly disagree to 4 – strongly agree), where seven of them form five latent dimensions/subscales: personal relevance, uncertainty, critical voice, shared control, and student negotiation. In this paper, in view of the nature of the problem and cultural differences, only four dimensions were used. The dimension of uncertainty of learning was not used. Considering that the scale was translated and that certain parts were modified, the exploratory factor analysis was conducted with a Varimax rotation and an eigenvalue greater than 1.0 and a saturation of 4.0. It was shown that the data are suitable for analysis (KMO = .843; and Bartlett's test of sphericity was significant, $\chi^2 = 2073.91; p = .000$). Seven latent factors were obtained which together account for 57.67% of the total variance. In the original factor structure, there are four factors, and the scree plot test also revealed a potential four factors, so a confirmatory factor analysis with four factors
was conducted. The four factors account for 45.43% of the total variance and they replicate the original factor structure (the number and distribution of items based on the original latent factors). For this reason, the original factor structure of the scale with the original number of dimensions and their items was retained. The factors show satisfactory internal reliability according to the Cronbach alpha test (Table 1). The possibility of using the original factor structure is also indicated by the intercorrelation of factors (Table 2).

**Computer Self-efficacy Scale**

To collect data on computer self-efficacy, we used the Computer Self-efficacy Scale (CSES) developed by Teo and Ling Koh (2010). With their permission, it was back-translated. The scale consists of twelve items on a four-point Likert scale (1 – strongly disagree, to 4 – strongly agree) which include three latent dimensions/subscales of computer self-efficacy. The first dimension is basic computer skills that consist of five statements, the second one is media-related skills with four statements, and the third one is web-based skills with three statements. The exploratory factor analysis was conducted with a Varimax rotation and an eigenvalue greater than 1.0 and a saturation of 4.0. Data were suitable for analysis (KMO = .891; and Bartlett’s test of sphericity was significant, \( \chi^2 = 1343.91; p = .000 \)). Two factors together were shown to account for 59.55% of the total variance. Considering that the original factor structure consists of three factors, a confirmatory factor analysis with three factors was conducted. The three factors account for 67.13% of the total variance and they replicate the original factor structure, where the new third factor has an eigenvalue less than 1.0, that is, .91. This is why the original factor structure of the scale with an identical number of manifest statements and latent dimensions was retained. Based on the Cronbach alpha test, it was shown that the factors have mostly satisfactory internal reliability (Table 1). The justifiability of using the original factors is also confirmed by their significant intercorrelations (Table 2).

**Technology Implementation Questionnaire**

Data on attitudes and motivation to use digital media in the classroom were collected through the Technology Implementation Questionnaire (TIQ) developed by Wozney, Venkatesh and Abrami (2006). The scale was translated following permission from the authors and, considering that it was originally constructed for a sample of teachers, it was modified for a sample of pupils. The scale consists of thirty-three items distributed into three latent dimensions/subscales. The first dimension is expectancy and includes ten statements; the second one is value and consists of fourteen statements; and the third one is cost and consists of nine statements. The statements are constructed in the form of the original six-point Likert scale, but for the purposes of this paper four points were used (1 – strongly disagree, to 4 – strongly agree). Considering that the scale was translated, and that certain parts were modified, an exploratory factor analysis with a Varimax rotation and an eigenvalue greater than 1.0 and a saturation of 4.0 was performed. Data
were suitable for analysis (KMO = .91; and Bartlett’s test of sphericity was significant, $\chi^2 = 2707.71; p = .000$). Seven latent factors were obtained that account for 54.37% of the total variance. Considering that the original factor structure includes three factors, and that the scree plot test indicated a potential three factors, a confirmatory factor analysis with three factors was conducted. The set three factors account for 39.71% of the total variance and they replicate the original factor structure in a satisfactory manner, that is, the factors obtained can be interpreted. This is why the original factor structure of the scale was retained with the original distribution of items and latent factors. According to the Cronbach alpha test, the factors showed low internal reliability (Table 1), but the intercorrelations of the factors were statistically significant (Table 2).

Table 1: Characteristics of used scales (on the next page)
The procedure

The data were collected in January 2016 in a survey questionnaire using the paper-pen method. The research was conducted in line with the code of ethics for research with children and young people. The completion of the questionnaire was
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completely voluntary and anonymous, and the respondents could decide to discontinue the questionnaire at any time.

Results

In terms of the possession of individual digital media at home, it was seen that 229 (97.4%) pupils own a computer, 226 (96.2%) have access to the internet, 227 (96.6%) have a mobile phone, 208 (88.5%) multimedia software, 224 (95.3%) pupils own a smart phone, 162 (68.9%) a tablet, and 220 (93.6%) have a social network profile. Further, it was revealed that pupils show an above-average level of computer self-efficacy, an interest in constructivist classroom instruction in most of its dimensions, and positive attitudes and motivation to use digital media in most of their dimensions (Table 1).

Table 2: Factor intercorrelations

*\(p<.5\); **\(p<.01\)

\(\text{Table 2: Factor intercorrelations} \)
Considering that there are satisfactory preconditions, a hierarchical three-step regression analysis was conducted. The correlations between factors are also satisfactory (Table 2). The steps of the hierarchical analysis followed the logic that the first step should entail fewer variable socio-demographic variables (such as pupils’ gender, residence, marks, and the possession of digital media). The second step includes computer self-efficacy. The third step, as a possible consequence of computer self-efficacy, includes attitudes and motivation to use digital media in learning and classroom instruction.

The hierarchical regression analysis (Table 3) showed that socio-demographic characteristics are important factors ($F(10, 224) = 1.874; p = .050; R = .278; R^2 = .077$), but they account for only 7.7% of the personal relevance of learning variance, where pupils who have access to the internet at home were shown to indicate more personal relevance. The second step of the analysis included computer self-efficacy that proved to be a significant predictor, along with the socio-demographic characteristics ($F(13, 221) = 2.433; p < .001; R = .354; R^2 = .125$), and accounts for a total of 12.5% of the variance. Computer self-efficacy on its own further increases the accuracy of the prediction of personal relevance of learning by 4.8% at a statistically relevant level ($F$ changes $(3, 221) = 4.043; p < .001$). It can be seen that pupils who have access to the internet and who have a higher level of self-efficacy in using computer programmes are more likely to indicate a higher personal relevance of learning. In the final step of the analysis, attitudes to the implementation (use) of digital media in classroom instruction along with the previous two series of factors are significant predictors of the personal relevance of learning ($F(16, 218) = 4.525; p < .001; R = .499; R^2 = .249$), and they account for 24.9% of the total variance of the personal relevance of learning. At a statistically significant level, attitudes to the implementation of digital media in classroom instruction increase the accuracy of the prediction of personal relevance of learning on their own by 12.4% ($F$ changes $(3, 218) = 12.013; p < .001$). In the final step of the analysis, it was shown that pupils who own a computer to a lesser extent, but who have greater access to the internet, who have a higher level of self-efficacy in using computer programmes and more positive values and expectations from the use of digital media in instruction are more likely to have a higher level of personal relevance of (constructivist) learning.

Socio-demographic characteristics are not significant predictors ($F(10, 224) = 1.057; p > .05; R = .212; R^2 = .045$), and they account for only 4.5% of the variance of critical voice. Further, computer self-efficacy and socio-demographic characteristics are statistically significant predictors ($F(13, 221) = 1.856; p < .05; R = .314; R^2 = .098$), and they account for a total of 9.8% of the variance. Computer self-efficacy further increases the accuracy of the prediction of critical voice in learning by 5.3% at a statistically significant level ($F$ changes $(3, 221) = 4.362; p < .01$). In the third step, attitudes to the implementation (use) of digital media in classroom instruction along with the previous two series of factors are significant predictors of critical voice in learning ($F(16, 218) = 4.131; p < .001; R = .482; R^2 = .233$), and they account for 23.3% of the total variance. Attitudes to the implementation of digital media in instruction increase on their own the accuracy of the prediction of critical voice in learning by 13.4%, which is statistically significant ($F$ changes
It was shown that pupils who own multimedia software to a greater extent and who have more positive expectations from the use of digital media in classroom instruction are more likely to have a higher level of critical voice in (constructivist) learning.

It was shown that socio-demographic characteristics are significant predictors ($F (10, 224) = 2.800; p < .01; R = .333; R^2 = .111$), and they account for 11.1% of the shared control in learning variance. Pupils who own a mobile phone and those who live in towns are more likely to have shared control in learning. Computer self-efficacy along with socio-demographic characteristics are statistically significant predictors ($F (13, 221) = 2.772; p < .01; R = .374; R^2 = .14$) of shared control in learning and they account for a total of 14% of the variance. Computer self-efficacy further accounts for 2.9% of the total prediction, which is not a statistically significant increase ($F$ changes (3, 221) = 2.494; $p > .05$). It should be noted that male pupils, those who live in towns, and to a lesser extent those who own mobile phones are more likely to have shared control in learning. In the third step of the analysis, the attitudes on the implementation (use) of digital media in classroom instruction, along with the previous two series of factors, are significant predictors of shared control in learning ($F (16, 218) = 3.72; p < .001; R = .463; R^2 = .214$), and they account for 21.4% of the total variance. Attitudes to the implementation of digital media in classroom instruction, on their own, account for 7.4% of the prediction of shared control in learning at a statistically significant level ($F$ changes (3, 218) = 6.87; $p < .001$). It was shown that male pupils and those who own a mobile phone to a lesser extent and who have more positive expectations from the use of digital media in classroom instruction are more likely to have a higher level of shared control in (constructivist) learning.

It was shown that socio-demographic characteristics are not significant predictors ($F (10, 224) = 1.246; p > .05; R = .230; R^2 = .053$) and they account for only 5.3% of the student negotiation variance. In the second step of the analysis, we included computer self-efficacy that together with socio-demographic characteristics is not a statistically significant predictor ($F (13, 221) = 1.663; p > .05; R = .299; R^2 = .089$) and it accounts for a total of 8.9% of the variance. Computer self-efficacy, on its own, accounts at a statistically significant level for 3.6% of the student negotiation prediction ($F$ changes (3, 221) = 2.947; $p < .05$). It is evident that pupils who have a higher level of self-efficacy in using the internet are more likely to have better student negotiation. In the final step of the analysis, attitudes to the implementation of digital media in classroom instruction, along with the previous two series of factors, are significant predictors for student negotiation ($F (16, 218) = 2.506; p < .001; R = .394; R^2 = .155$), and account for 15.5% of the total student negotiation variance. Attitudes to the implementation of digital media in classroom instruction on their own further account at a statistically significant level for 6.6% of the student negotiation prediction ($F$ changes (3, 218) = 5.699; $p < .01$). It is evident that pupils with a higher level of self-efficacy in using the internet and more positive expectations from the use of digital media in classroom instruction are more likely to have better student negotiation in (constructivist) learning.
<table>
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<th>Factor</th>
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<td>Gender</td>
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<td>.04</td>
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<td>-.08</td>
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*p*<.05; **p**<.01

Table 3: Hierarchical regression analysis
Discussion

It is evident that over 95% of pupils own a computer, have access to the internet, have a mobile phone, smart phone, and a profile on one of the social networks, while to a lesser extent they own multimedia software and a tablet. The results are in line with previous studies (Topolovčan, Matijević and Dumančić, 2015), especially as confirmed by the growing trend of owning a tablet computer (ibid.). On the other hand, it was shown that pupils have an above-average level of computer self-efficacy in all its dimensions; this, along with possession, asserts that they are members of the Net Generation. This interpretation is confirmed by the result that pupils are likely to engage in constructivist learning and have positive attitudes and motivation to use digital media in learning and classroom instruction (see the arithmetic means in Table 1). This simply confirms that pupils of the Net Generation, either deliberately or unconsciously, seek classroom instruction that is student-centred via digital media.

It is evident that socio-demographic characteristics, including the possession of digital media as a major determinant of socio-economic status, are significant only in two dimensions of constructivist learning (personal relevance and shared control), while in the other two they are not, which can be explained in a way that for critical voice and student negotiation the possession of media is not of crucial significance. Even when they are significant as predictors, socio-demographic characteristics account for an extremely small variance of the prediction of the dimensions of constructivist learning, as confirmed by the fact that the possession of digital media in itself does not have much significance in learning (Beetham and Sharpe, 2007; Tamim et al., 2011).

On the other hand, computer self-efficacy, especially in the dimensions of personal relevance, critical voice and student negotiation, is more significant for constructivist learning. This can be explained by the fact that today many activities are connected with work via digital media, including searches for information as an important segment of critical voice, as well as cooperation and communication taking place via digital media, which is to a certain extent in line with some of the results of other research (Deng, Doll and Troung, 2004; Johnson, 2005; Teo and Ling Koh, 2010), while control of learning is not so connected with digital competence, although Brosnan (1998) claims otherwise.

The most significant and the highest percentage of prediction of all dimensions of constructivist learning relates to attitudes and the motivation to use digital media in learning and classroom instruction, especially the factor of expectation of improvement of learning with digital media. It is desirable to point out that two of the three dimensions had a lower level of scale reliability, which can have an impact on the result. Attention should be paid to the last step of the regression analysis where significant factors are visible amongst everything included in the analysis. Thus, the lower incidence of possession of a computer is relevant for the dimension of personal relevance of learning. This can be interpreted in that today’s pupils do not regard the computer as an important element of holistic learning, but more of an everyday tool that they use unconsciously, inter alia, for learning. On the other hand, the significance of the male gender in shared control of learning can be ex-
plained by gender roles, where boys are still expected to control various situations. In the same dimension, a lower level of possession of a mobile phone is significant, that is, a higher level of possession of a mobile phone is connected with less shared control of learning. This can be explained by the fact that ordinary mobile phones have fewer functional possibilities than smart phones that are some sort of mini computers. Thus, smart phones, it can be presumed, enable better shared control of learning.

At the level of comparative analysis, positive attitudes and a higher level of computer self-efficacy are more significant for constructivist learning than certain basic socio-demographic characteristics and the possession of digital media. This only confirms previous findings stating that the human factor is more significant for learning with digital media than technology (Beetham and Sharpe, 2007; Tamim et al., 2011; Topolovčan, Matijević and Dumančić, 2015).

Conclusion

On the basis of this research, we can state that today almost all pupils own a computer, have access to the internet, have a mobile phone and smart phone, and a profile on one of the social networks, while they own multimedia software and tablets to a lesser extent, although possession of these last two is on the rise. Pupils also state that they have an above-average level of computer self-efficacy in all its dimensions and mostly have positive attitudes towards and motivation to use digital media in classroom instruction. This asserts that they are members of the Net Generation, and that they have a high level of possession of digital media.

The results show that pupils are more likely to engage in constructivist learning, which can to a certain extent be regarded as a good indicator of their readiness for lifelong (informal) learning in the digital age, although the extent to which such classroom instruction is organised for them is not known. The socio-demographic characteristics of pupils, including the possession of digital media, computer self-efficacy and attitudes to the use of digital media in classroom instruction, account mainly for one quarter of the variance of the dimensions of constructivist learning, indicating that there are some other significant factors in learning other than the role of digital media (such as prior knowledge, type of material, learning outcomes, etc.). In the part that is accounted for, it is evident that the socio-demographic characteristics of pupils and the possession of digital media are the least significant for constructivist learning. On the other hand, a higher level of computer self-efficacy, especially in the skills of using computer programmes and the internet and more positive attitudes and motivation to use them in classroom instruction, and especially greater expectations in terms of improved learning with digital media, are more significant.

Overall, this research confirms that media are not the most significant factor in learning with such media, but that they are only one of the factors in the learning process. In this regard, and considering that they were not the subject-matter of this study, it is recommended that a wider spectrum of factors of potential significance for learning, and not only the issue of digital media, be encompassed in future re-
search. Such research would yield much more complete knowledge about constructivist learning.

Finally, caution is necessary concerning certain limitations of this research. One of the possible limitations is that the instruments used in this study were constructed in different social, cultural and value contexts from those in Croatia, which might have caused slightly different factor structures. Another limitation is that the sample includes only eighth grade pupils of compulsory education. It is possible that the results would have been different if the study had included pupils from other grades, as well as secondary school pupils (ISCED level 3). These limitations also open new challenges for further research into these issues.

References


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E-Learning in Mathematical Computer Related Courses at Faculty of Information Technology, Al-Ahliyya Amman University

Mustafa Yassen & Khaled Aljiboury
Al-Ahliyya Amman University, Amman, Jordan

Abstract

This paper deals with the utilization of a new version of technology in teaching mathematics-computer related courses to encourage instructors to make use of e-Mathematics in teaching their courses at university level. As a case study, we selected Discrete Mathematics course to apply the approach. This course is a basic compulsory course for the all Information Technology majors. We introduced Maple, the Computer Algebraic System in demonstrating and explaining pure mathematics abstract concepts, and make it appreciated, understood and more relevant to students in their majors. We explore issues in mathematical-computer related concepts of students learning; we describe our experience on blended e-learning via the utilization of Maple. Concluded outcomes from this pilot project indicate the Effectiveness, Ease of Use and Self-Efficacy of the platform. Students were satisfied and accepted the new structure of the course. Students depend on e-lab as central component of the course. The approach would be extended to all math courses offered in the Faculty of Information Technology majors’ curricula.

Keywords: discrete mathematics, maple, blended e-Learning, student centric

Introduction

Al-Ahliyya Amman University (AAU), is the first privately owned university in Jordan, it was established in 1991, it has 32 undergraduate majors and 7 graduate programs distributed on 9 faculties; more than 22000 students graduated from the university since its opening. AAU strives to provide and maintain quality education system, to achieve this, the administration and top management of the university put a strategy to utilize information technology in the education process from both sides: the teaching/learning activities and the management. On top of that a rigorous quality assurance system is followed to guarantee that the objectives are achieved, the quality of education is maintained and the improvements are always in line with the development and planning for the future. From the university management and operations point of view, a total integrated Management Information System is implemented covering all the activities available in the universi-
ty, covering the three levels of operations, namely: daily departmental operations, middle management requirements and the higher level governance body for planning and high level top management. The covered areas include: Admission and Registration, Students’ Information, Academic Staff Management, Research and Graduate School Management, Human Resources Management, Administrative Affairs, Financial Affairs, Material and Stores Management, Transportation, Clinic, Security, and some other subsidiary modules.

On the academic side, and since more than four years ago AAU launched a massive e-learning project through establishing Horani e-Learning Center (HEC), that aims at building the digital content of the courses offered at the university, and providing e-learning platforms to build, manage and maintain the new environment and the new methodology in learning. This includes a Learning Management System (LMS), Assessment Management System (AMS), Learning Objects Repository Management System (LO-RMS), Content Management (CM), Document Flow Management (DFM), and some development tools, utilities and applications. Both the Education Management Systems and the Learning Management Suite are seamlessly integrated, accessed via a Portal, with single sign on capabilities.

As any other institution who launches e-learning projects, Horani e-Learning Center at AAU developed policies and guidelines for development and usage of e-learning content hosted by the center and used internally in the offered courses at academic departments in various colleges at the university. Those manuals were used in induction and training of instructors and used as reference in developing content and publishing them as learning material. The work related to developing those manuals was result of efforts of committees formed for this purpose who tried to adopt best practices in the domain, also there were many material used as samples and references to guide instructors in preparing their material. The guidance and policies were applied on university level and not on specific department, it also goes in line with the university policies in using technology and utilities at the university provided and supported by the computer center. Guidelines included issues such as: application processes for creating online course; approvals; guidelines for creating an online course; evaluation and assessment; teaching and learning using technology; how to interact with class in the e-learning blended model and related teaching methods; online: instructions, procedures, guidelines and resources; e-courses policies.

The strategy followed in the e-learning project is based on the Blended e-Learning Model (Elkins and Pinder 2015); the pedagogy is focusing on the student and not on the instructor, it is a student centric model, where learning is the target and not teaching as in the old conventional model. In the conventional educational model, the instructor was the center of activities while the student is just a passive receiver. It is basically a blending of technology with face-to-face interaction in the classroom teaching experience.

There are five attributes considered in the e-learning agendas of institutions (Sharpe et.al. 2006), at AAU, we considered four of them to be part of the Blended e-Learning Mode of teaching agenda, those are: Widening Participation of Students, Enhancing Learning Experience, Flexibility of Provision, and Computer Aided Assessment (Sharpe et.al. 2006). The blended e-learning model, utilizes
technology, providing learning objects within the material, depending on the nature and necessity of the material at hand, and allowing the instructor to be a facilitator and director of the learning process among the students. In this model, the Face-to-Face methodology is still available, but students have to come prepared, already learned the concepts by themselves through reviewing the digital content of the specific topic assigned to them, and the instructor will act as facilitator who stimulates thinking and directs discussions. Students are not anymore memorizing the text, but rather they are trained on the critical thinking skills and generation of knowledge.

One important aspect in measuring success in any information system application in general, is how users will perceive the system, how they will use it and when it will be used. This is a critical factor to look at especially in e-learning projects, it involves users from both sides, the receiving; i.e. “Students” and the sending/creators; i.e. “Instructors”. Technology Acceptance Model (TAM) explains how users accept and use Information Technology. (Davis 1989) started with two models, Perceived Usefulness (PU) and Perceived Ease-of-Use (PEOU). Those models were developed further and expanded to consider other factors that might affect the decision about how and when using technology will be useful; TAM2 (Venkatesh and Davis 2000) and (Venkatesh 2000), TAM3; UTAUT Unified Theory of Acceptance and Use of Technology (Venkatesh et al. 2003). TAM has been effective for explaining many kinds of systems use (i.e E-learning, Learning Management Systems, Webportals, etc.) (Fathema, Sutton, 2013). This model was used in a similar environment in an Egyptian University, Mansoura University; the results reveal that students' perception of ease of use, usefulness, attitudes towards online learning, and the social influence of students' referent group were identified as significant determinants of students' intention to practice online learning (Farahat 2012).

Moreover, results from evaluating the TAM framework in the e-learning project in Konkuk Universit, South Korea, proved that TAM is a good theoretical tool to understand users’ acceptance of e-learning. E-learning self-efficacy was the most important construct, followed by subjective norm in explicating the causal process in the model (Park 2009). This basic model that focuses on the users, in our case “Students” and how they use computers, and “Instructors” and how they create content is used, the model developed by (Davis, Bagozzi, Warshaw, 1989) is mostly applied model, a conceptual framework was developed using this model for evaluation of students interaction with the system and acceptance of the system in our e-Learning project at AAU.

Challenges faced AAU in this project were like any other similar experience in developed or developing countries (Anderson and Gronlund 2009), those are classified into four categories: Courses, Individuals, Technology and Context (Anderson and Gronlund 2009). A very critical part in this project is the training and preparation of instructors to adopt the new methodology and to change their old teaching style and conventional pedagogies to a new non-conventional approach in teaching, preparing the material and interacting with their students. This was major challenge that has to be taken to guarantee involvement of instructors and gain their support. Many training and orientation courses took place, deanships
at all faculties where involved heavily in the process along with the management of Hourani e-learning center. As a pilot, each faculty at AAU selected several courses to start with in creating the e-content and to construct the e-learning material for the blended e-learning method. For each course, an instructor (in some cases more than one participated in a course) attended the training courses so they become ready to develop the electronic course material.

The perception, enthusiasm and readiness to change varied among faculty members in the university. This also applies to the academic staff at Faculty of Information Technology. The professors are encouraged to participate and start adopting the new methodologies, as any newly ideas there is always some resistance and needs for mechanisms to manage the change. Mathematics professors are among those who have the same orientation; some are enthusiastic about getting into this experience while others are conventional and a bit reluctant resisting the change. In this paper we will cover one of the success stories related to Math professors in utilizing the new technologies related to e-learning in developing material for a very basic course in information technology majors’ curricula. The course under consideration in this paper is Discrete Mathematics, we will demonstrate how Maple, the Computer Algebraic System (Rosen 2015, Maple 2016, Scherger 2009 and Yaseen and Aljiboury 2010), is utilized effectively in this course, it will be a basis and example for using Maple in other applied mathematics courses that involve computational methods and they are part of the Faculty of Information majors’ curricula. This pilot study was conducted based on the experience of one of the authors who has been teaching Discrete Mathematics for IT students for many years following the old conventional method, and now he is shifting to the new trend, using the blended e-learning model and utilizing Maple in this course.

Overview and Background

This paper explores issues in e-mathematical computer oriented courses and the aspects of students’ learning. The difficulties in teaching mathematics (especially for non-mathematicians) are well known, moreover the usage of new technologies in such domains is important inducement for both the instructors and the students in order to obtain an adequate transmission of knowledge, and subsequently to reduce the difficulties in teaching such abstract yet important subjects. From this prospective, many similar projects have been launched by groups of professors of applied mathematics at many universities (Yerion and Rinehart 1995) and (Hic and Pokorny 2005).

As mentioned earlier, at the Faculty of Information Technology at AAU, we are trying to be innovative through introducing new teaching methods to replace the traditional old methods in teaching Mathematical oriented courses for non-mathematicians, by adopting new e-related activities and applying them to the syllabus, i.e. reducing the abstraction and rigid concepts typically associated with mathematical concepts, and making them easier to understand and closer to be comprehended and more interesting to students. This is achieved through the blended e-learning model where we are converting our traditional mathematics
courses to incorporate Computer Algebra Systems, such as Maple and become e-mathematics courses in nature. The new approach is based on developing e-content and blending the program with the usage of applications such as, Maple, in teaching mathematics. This is a novel area of applications especially in teaching mathematics subjects for non-mathematicians in domains such as Information Technology and Engineering, as far as we know, none of the Jordanian Universities, has taken such approach; it is still novel and we are pioneering this area.

Maple (Maple 2016) is a powerful Computer Algebra System to handle symbolic algebra, numerical calculation and plotting of graphs. Using this application software allows students to spend more time on modeling and interpreting results rather than just memorizing the theory. Maple also has a text editor, which enables students to explain their results in writing and take notes and remarks as needed.

(Scherger 2009) presented a classroom activity where students doing mathematics are given tasks to enhance their understanding of the Numerical Integration through the Maple technology. Using this technology in such activity, it is noted that students can see for themselves that not every function has an anti-derivative with an elementary formula and that some numerical methods, like the Simpson’s rule, are dramatically more effective than previously learned numerical techniques. Closed formulae for the forward, backward and symmetric solutions of an ARMA-representation were presented, and how they were implemented in the symbolic computational language Maple (Scherger 2009), providing supporting evidence of the suitability and effectiveness of such system in abstract math courses.

Early Maple work sheets were technology-focused, that is based on using the mouse and click buttons, write statements, use commands ...etc. (Rosen 2015) and (Maple 2016). As an example, how to express and solve by Maple to perform three tests of the function say

\[ f(n) = \{\{0, 0\}, \{1, 1\}, ..., \{n, n\} \}. \]

We can use Maple to define the sequence function \( f \) as follows:

\[ f := n \Rightarrow \text{seq}([k, k], k=0.. n); \]

If technology is going to be used to support the learning of Discrete Mathematics, learning basics and how to use this technology must be done first. In a new experiment especially when changing approach is needed, straightforward and simple questions are usually raised by students: Why do we need this extra work? Another question is raised: Why don’t we use the textbook only? The answer to those questions and similar ones is simply resulted the new blended e-learning environment and associated teaching methodologies. We need to be aligned by using a platform technology such as Maple, and to enhance the self-paced learning capabilities and teach yourself approach in math courses in our IT majors’ curricula.

In this case, from our experience as academics been into this business for a while, we simply found that the classical textbook used in the conventional way of teaching along with Maple sometimes did not fit and couldn’t be used to convey the understanding of basic abstract concepts. There are a number of reasons attributed to this fact; such as, it may be related to the time needed to get acquainted
with the application and have a feel for how to use Maple as planned for, a need to integrate Maple in the syllabus and restructuring the course to reflect this by adding an e-lab to the course.

Moreover, our roles as instructors are to enhance students skills to explore different routes and to explore alternative solutions rather than just memorizing one specific solution as “dictated by instructor”, so they learn the abstract theoretical concepts and discover solutions themselves. It is a methodology and pedagogy to lead the students into thinking, so the objective of building a student-centric approach is enforced. Maple and the Introducing Maple in teaching math courses, and restructuring the associated courses help in achieving this target. For the new generations, whose involvement with technology are very close, as it is known, smart devices are part of the lives for almost all young generation, so education, learning and teaching must be in line and methodologies must change accordingly. The gap between textbooks and current students is increasing, and it is noticed that they try to be always away from using textbooks, by introducing e-labs, and new pedagogy, concepts can be absorbed and understood much easily and the rigid math courses become easier, this could be a good approach to come closer to students acceptance of the new approach.

Some interesting examples were presented in (Shi 2009) and (Mauch and Shi 2005), those examples can be used even in teaching mathematics classes students. A few interesting ways to apply this sequence of points in teaching Math related Information technology students courses such as Linear Algebra, Numerical Methods in Computing, and Discrete Mathematics were discussed (Krampetakis and Pugh 2003). Studies like these are likely to promote students’ interests and get students to be more involved in the learning process, therefore make the learning process more effective, accepted and interesting.

Maple was also used in electrical engineering field where many students have difficulty in learning technical subjects because they lack sufficient competencies in mathematical modeling and in Algebra (Yaseen and Aljibboury 2010), it was also shown in (Royeyik 2002), that the design of Maple documents is suitable for EE teaching. A computer algebra program for verifying soliton solutions of ultra-discrete equations in which both dependent and independent variables take discrete values was presented; Maple was used to implement the solution (Shi 2007). An integral approach is presented to strengthen the teaching and learning processes in the environment of the undergraduate course Numerical Analysis for Engineering (Gao and Masaaki 2009), they examined the advantages of combining the symbolic and numeric paradigms. In particular, the methodology is illustrated with the iterative methods: Gauss–Seidel and Conjugated Gradient, for the numeric solution of Linear Systems. The computer tools MATLAB and MAPLE are used in a pedagogic model that requires the explicit definition of Prospective Learning and Activities of Learning (Gao and Masaaki 2009).

Abstract concepts are very hard to be completely comprehended by students especially at the junior level. Discrete Mathematics is used to be taught to IT students as pure mathematics approach; this made it extremely difficult to understand and master the basic concepts by the students. In addition, the difficulty faced in appreciating the course value for their major and how it impacts certain aspects of
structures and/or concepts in some IT related courses cannot be usually seen by students. Issues and questions such as: Why Math courses are needed for IT students? and, How Math courses should be utilized? What matters more is comprehend the rigid abstract theoretical and difficult mathematical concepts. Such approach was faced in similar situations with abstract concepts in areas such as Numerical Analysis, Programming and Cryptography courses. The use of Maple worksheets was explored in a course on modern cryptography for undergraduate sophomores and juniors (Cariaga and Nualart 2002). The worksheets allow students to explore deep topics without requiring many prerequisites. The conclusion was in favor of using Computer Algebra Systems in teaching Cryptography (May and Mike 2009).

At Faculty of Information Technology at Al-Ahliyya Amman University; we are taking this endeavor to demonstrate the success and suitability of applying such paradigm to abstract concepts in pure mathematical courses in order to increase the interest of students attract their attention and raise appreciations and understanding of those abstract theoretical courses.

**e-Lessons in Mathematics Computer Science Courses**

Discrete Mathematics is a basic core course in the curriculum for computer science major; this has been the case since launching the program at faculty of information technology at AAU. In general, it is a fundamental course for Information Technology (IT) students as it lays the foundation for dealing with structures, the first lesson involving the structure is about sets; such topics are among the most important and valuable for IT majors’ students. So far it has been taught in the conventional typical theoretical method of teaching that can be found anywhere in a higher education institution in Jordan or anywhere else.

Usually in this course, we try to provide students with opportunities to develop and demonstrate practical examples of how the concepts being treated and used in developing information; in addition to the way of thinking properly, we decided to enhance the perception and appreciation of this course by introducing the use of Maple application as a practical and application part of the material covered in this course, restructure the course and require an e-lab, and have the student practice their exercises and examples in the lessons of this subject in the labs as practical sessions and as part of the requirements that students should fulfill in the course.

At the beginning our aim was simple, instead of writing a lot of details, theorems, definitions in classical way as we do in the conventional way of teaching pure mathematics and as many mathematicians still do, we prepared Maple worksheets on sets and operations on the sets considering many different examples to introduce the concepts. During our long academic life experience, we discovered that the pure math teaching approach (the conventional way) is neither good nor suitable way to teach computer science students and other related Majors’ students especially at their early stages. Our objective initially was not set to compare the learning outcomes of the classical and conventional way of teaching with this new e-content (blended e-learning) approach, but rather to verify whether our students
are capable of using a new independent form of study, and then decide how suitable it is to develop a whole e-content for discrete math course using Maple.

We gave students a list of all sets’ rules which they already knew as a worksheet, also the instructions and commands to use Maple. Maple has a few built-in set theory commands; our initial goal was set to apply them to some simple problems modified from the text, and measure the effect on students. In the following section, we will give example of the lab sessions given to the students to work on under the supervision and mentoring of the instructor.

**Lab Sessions analysis and Discussion**

In the following we are going to give an example of a practical lab session, where students are given this activity; then we will explore students’ behavior, reaction and attitude in dealing with this experiment using various sets’ operations. The students were not exposed to Maple before, our objective is to have the students learn and get acquainted with the system by example and by solving problems from a course that is part of their requirements.

The details of the activity is detailed below, our observations to students’ behavior is reported too. Total number of students in this lab session was 32, each student has his own computer, and they are connected and monitored via a special classroom management system called Teacher, instructors can monitor and control students’ screens from their own monitor, thus allowing instructors to take over, correct, guide or show students anything they want, while sitting on their computer. This software is a tool provided in the e-learning environment.

**Activity Example:**

Given the universal set \( U=\{-2,2,3,-3,4,5,6,7,8,9,10,11,12,13,14,15\} \); # small universe.

And the subsets: \( A=\{3,5,7,9\}; \ B=\{2,3,5,6,7\}; \ C=\{2,4,6,8\}; \)

a) Find the following set operations by direct Maple commands:

\[ A \cup B; \]  
\[ B \cap C; \]  
\[ B \setminus A; \]  
\[ A \setminus B; \]  
\[ \text{complement}(A); \]  
\[ \text{complement}(B); \]

b) Find the sets of all even, odd, and prime numbers of the given set \( U \)

c) Generate random subsets \( A, B, \) and \( C \) of size 3, 5, and 7, respectively and find the above set operations in items (a) and (b).

d) Write a maple program which will compute the intersection of any finite number of sets.

e) Write a Maple procedure, \( \text{Union()} \), to compute arbitrary unions. Be sure to check it works correctly.

f) Write a Maple procedure which accepts as input of any finite number of finite sets and returns: \( \text{True} \), if they are pair wise disjoint and returns \( \text{False} \) otherwise.

The 32 students immediately logged in and started the tasks in the activity sheet, they all appeared on instructor’s screen and his assistant where they moni-
tored their work and interact with students by answering questions or addressing students with questions to help them out of their problems whenever they stuck or face any problem, through the Teacher software. The reaction was smooth at the beginning, then when the patterns became harder to spot for many students, the students’ reaction and attitude towards the work began to change, some of them gave up and were turned away from the computers, they wanted to switch the machine off, lost interest and wanted to do the tasks at home; of course we know this will not be done it’s just an excuse to leave out of frustration. Other reactions were more impressive to us and attracted our attention directing us towards some critical conclusions regarding this exercise; students are then grouped together to compare their answers and discuss what they were doing, trying to use many commands, from Maple to test and amend their results, this good learning behavior was not available in the typical conventional theoretical classes that we used to teach.

This attitude signifies a new learning behavior, which was not seen in the typical classical theoretical teaching and learning behavior. Students are now the focus of the teaching process and it is not the instructor anymore, we are moving towards the essence of Student-Centric Model. In this exercise, we, as instructors, were just facilitators, mentors and learning aid. This exercise triggered the utilization of computer software and special purpose applications in teaching such abstract and pure math subjects, to make it more apprehended, and to enable students to master tough and hard abstract concepts.

From this experiment, we can conclude that computers can motivate students and help them to initiate discussions among themselves; they can generate new knowledge and create new learning patterns. Even with the existence of a group of students who were not motivated and didn’t take part and gave up quickly, we thought that this is normal and always, there will be a group who will not participate regardless of the adopted methodology.

Computers can also introduce another dimension related to the students’ solving problems, for example generating answers that students cannot understand. A typical question always raised by students is: How can Maple do that? In this example, it's evident to us that there are difficulties in the original basic concepts related to sets and programming associated difficulties at this early stage in the major for the students. By giving them the tools (such as Maple), they now have the chance to go back, review the material, understand and analyze the structures one more time, and even try to write their own programs challenging Maple, so they can test the behavior of the system and comparing it to their solutions. It’s a mechanism to creativity and understanding.

Based on this initial exercise and the success achieved, we directed our attention to create the e-Discrete Math Course, restructure it and modify the curriculum to incorporate Maple along with a scheduled e-lab as requirement for the course. We concluded that using systems such as Maple in abstract theoretical courses such as Discrete Mathematics could be of great benefit to students and of great interest to Math instructors. We also concluded that understanding, appreciation and mastering of abstract theoretical concepts become easier, interesting, more affordable and reachable to most students.
Comments on Using e-Environment with Discrete Mathematics

Here in Jordan there is not much research on the behavior of the professors and students, toward teaching mathematical courses by Computer Algebra Systems, but from our own experience over a period of time, we observed the following:

1. Through our experience with Math Instructors, they tend to use software in mathematics only when it comes to answer specific questions that are already present in their minds. In many cases they are interested in the final result only without going through the detailed steps of generating the answer and that’s the only reason that they tend to use Maple for example, or any other application.

2. Abstract theoretical concepts, in general, are very hard to be completely comprehended, appreciated and understood by IT majors’ students; especially to students with weak background in Math, when taught following the conventional pure mathematics approach.

3. Difficulties in abstract theoretical concepts not only affect the low level of understanding the concepts but also in appreciating the related courses and their relevance to their major.

4. For Information Technology Majors’ students, Discrete Mathematics course is just another extra tough and boring course, and it is irrelevant to them when taught as just another pure mathematics course; i.e. the concepts in the course are not connected nor related to any computer science concepts. This will give students the conclusion that the course has no benefit to them, it is just another extra tough and boring course, and it is irrelevant to them.

5. Using applications such as Maple, allows students in computer science and other IT related majors to bridge the gap between Math subjects and IT subjects, by applying the abstract mathematical concepts in a computer lab with a computer application; realizing the difference and the importance of the specific IT subject and the Math subjects in general.

6. Maple worksheets allow students to explore deep topics without requiring many prerequisites. The conclusions from the students’ performance statistically found that they were in favor of the using Computer Algebra Systems in teaching Discrete Mathematics, and subsequently other math courses.

e-Discrete Mathematics Students Satisfaction

To measure the satisfaction of our students and collect their feedback about courses in general and instructors in particular, as any other institution, we do course evaluation. The following demonstrate our findings related to this experiment and show the degree of satisfaction and appreciation of students and their reaction, in addition to demonstrating the process and associated mechanisms.
a. FIT conducts students evaluations of every course during every semester, the evaluation process is done online through *Horani e-Learning Centre*; the student must log to a secure system and may submit only one evaluation per FIT course in which they are enrolled, no identifying information about the student is associated with the evaluation, the evaluation consists of 20 multiple choice questions and sections for comments, the multiple choices allow the students to rate various aspects of the course and the instructor of the course, the ratings are scaled from (low) 1 to 5 (high). The course related questions covers: course objective, difficulties, textbook, assignments, labs…,

b. The results of these evaluations indicate that students who took the e-Discrete Mathematics are more satisfied with the new methodology (i.e. blending the course with Maple application) than the other students attending same course but taught in the traditional conventional method, the results for course-related questions show that the course evaluation scores above the average.

c. The e-Discrete Mathematics course’ students are increasingly happy and more satisfied with the course and attributed this to the changes introduced in the course especially the e-lab and the Maple application utilization in the lab.

d. Final examinations analysis for the academic year 2012/2011, which is the year we started this experiment, indicated that students scored higher than previous years in same course but taught in the old conventional way. Table (1), shows statistics related to scores for first term, while Table (2) represents statistics of second term of the same academic year. Variation is measured to be around 6% comparing scores of students in the new e-Discrete Course using Maple and introducing e-lab for the course, and the old traditional course.

<table>
<thead>
<tr>
<th>Total No. of Students in the class</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>60</td>
</tr>
<tr>
<td>Median</td>
<td>61</td>
</tr>
<tr>
<td>Lowest Marks</td>
<td>28</td>
</tr>
<tr>
<td>Higher Marks</td>
<td>76</td>
</tr>
<tr>
<td>Absents</td>
<td>2</td>
</tr>
<tr>
<td>Withdrawn students</td>
<td>1</td>
</tr>
<tr>
<td>Suspended Students</td>
<td>0</td>
</tr>
</tbody>
</table>

Table (1)
Feedback collected from students indicates that they can learn independently by themselves with little assistance of the instructor, we can conclude that the “learning objective” is fulfilled and satisfied. This experiment encourages self-learning pattern, where students can go through the examples embedded in the Maple lab session and learn it by themselves, when they encounter difficulties in understanding some concept or topic in the course. The students’ learning curve increased and their dependence on instructors decreased.

The usefulness, ease of use and self-efficacy related to the pilot implementation of changes done to the Discrete Math course are summarized and concluded from surveys done at the end of the term, Table (3) demonstrates the conclusion and responses of students regarding preference of new platform.

<table>
<thead>
<tr>
<th>Students Preference</th>
<th>Percentage</th>
<th>Average class marks</th>
<th>Average class absence</th>
</tr>
</thead>
<tbody>
<tr>
<td>I do prefer New Platform</td>
<td>13%</td>
<td>71</td>
<td>1%</td>
</tr>
<tr>
<td>Prefer a class with entirely on line New Platform</td>
<td>70%</td>
<td>68</td>
<td>3%</td>
</tr>
<tr>
<td>Prefer a class with limited New Platform</td>
<td>9%</td>
<td>64</td>
<td>33%</td>
</tr>
<tr>
<td>I do not prefer New Platform</td>
<td>3%</td>
<td>69</td>
<td>4%</td>
</tr>
<tr>
<td>It does not matter</td>
<td>6%</td>
<td>55</td>
<td>11%</td>
</tr>
</tbody>
</table>

Table (3)

Students were asked to choose one of the statements listed under “Students Preference”, it was intended to measure their feedback regarding usage of new
platforms in teaching Discrete Mathematics, i.e. Introducing Maple as an integral part of the course that follows the implementation the e-content, in the Blended e-Learning Model and as a new platform. So we can conclude students’ acceptance, effectiveness and ease of use of the new platform. Responses were captured during the final exam so each response is linked with the specific student because we wanted to study the effect of their performance and overall grade they scored in the course (This is tallied under the column “Average Class Marks”), and their attendance average to reflect their presence in attending the lectures in the course.

Going through the analysis of the survey shows that 92% of students Accept the new Maple platform; while just 3% specifically rejected the new platform, and the rest (6%) responded by it doesn’t matter; this last group scored the lowest marks and their attendance was not significant in class. This is a strong indicator about the preference of students and their enthusiasm about this experiment.

More interestingly, is the group of students (83%) of the class who scored high in the course were for online platform utilizing information technology and specialized applications (e.g. Maple) in the course, and consequently in similar courses and probably in all courses of similar nature in their curriculum. This is a strong indicator about the Effectiveness, Ease of Use and Self-Efficacy of the platform and dependence on e-lab as central component of the course. It also represents good basis and guideline for Instructors to start applying the concept in other courses of similar nature; moreover, it enhances and strengthen the Students Centric Approach introduced in the e-learning blended model thus going toward more independence between instructor and student, focusing on the Learning vs. Teaching.

**Limitations**

Given the fact that students level of competency in math is generally weak, and the amount of information in math courses involve lots of new concepts, theories, proofs, …etc., which make it very hard to understand, comprehend and appreciate the benefits in their majors. On the other side, it is well known that math instructors are strong believers in transmitting large amounts of theoretical information in their courses. They believe that using computers and software systems will hinder the delivery and coverage of all topics in their courses. This was a major limitation that we faced. After conducting the pilot project, and by following the blended e-learning approach, it was proven that this misconception is not valid and that students could master the hard abstract concepts much easier than they did before, and that instructors had the time to cover difficult concepts more deeply and their role changed from lecturing to mentoring. The limitations still there in acceptance from all and the change management process needed to be undertaken to enforce the change.

Another dimension for rejection of this new approach by instructors and their resistance to change is their lack of expertise using computers and e-learning environment. This is another limitation, and could be an inhibiting condition to utilizing computers and Computer Algebra Systems in Math courses in IT majors’ curricula. This limitation is handled by giving extensive training to instructors on the
environment and methodology of teaching in an e-learning environment, and through providing assistance from technicians and technical staff support at Horani e-Learning Center to help and guide instructors and be with them at the beginning in the lecture itself to take the burden of them and to save them from lake of knowledge embarrassment if something (usually technical) went wrong during the lecture.

Those can be seen as major limitations we faced in adopting this concept. Other general limitations are attributed to time, effort and costing/budgets typically associated with e-learning projects. Those dimensions were handled in the overall project, and specifically in our pilot project.

**Implications of study**

Maple is a Computer Algebra System appeared in 1985, we introduced Maple as an integral part of the Discrete Math course and as a platform used in the e-lab associated with the course taught at all IT majors in Al Ahlyya Amman University in Jordan. From this pilot project we concluded that using Maple in Mathematics courses proven to be of great benefits to students, made it interesting and effective in the learning process. Throughout the e-Discrete course, by using Maple students were able to discover rules, deeply understand difficult abstract concept, realize the implication and the link between math course and IT majors in general. They were also exposed to testing and exploring relation between representations of functions, structures and abstractions (especially in Structured Data Types used heavily in computer related courses) and mathematical objects using computational approaches. As a result of the impact realized from this pilot project can be seen from students’ performance. Students became empowered with the tools and their understanding and appreciation of the whole course is deeper and demonstrated more comprehension of the concepts and why they were introduced.

Moreover, the main outcome of the experiment was establishing the link of abstract “difficult” mathematical concepts introduced in courses such as Discrete Mathematics to courses and concepts in the IT majors’ curricula and justify the reason behind the link. This is very important, since the old traditional way of teaching math courses was always theoretical, with no evidence of direct benefits or links to students in their majors. Now, students can see why they were taught math in principle and how it formulates the basis of majors such as Computer Science, which has so many theories built on mathematical concepts.

This experiment has also impacted our directions in teaching all math courses for IT majors in general following this approach. All Math courses such as, Linear Algebra, Statistics, Numerical Analysis,…etc. now have e-labs, with utilities and systems been introduced as appropriate as the courses require. Yet, we need to evaluate and analyze the outcomes of those courses, initial outcomes are encouraging but we still need to collect more statistics, this will be reported in a coming report.

As another dimension, at AAU; the Faculty of Engineering are following the same in their Math course, since almost all of those course are taught by same
group of Math instructors at our Faculty of Information Technology. The outcomes are encouraging and there is acceptance and satisfaction from both students and faculty members in the different engineering majors. We are planning to give reports in local gathering so other universities in Jordan can benefit from the experience, and we will share structure and approach followed in teaching Math courses for non-mathematicians in general with colleagues from other universities.

Conclusions

To match what the new model of learning that is adopted by university, and in order to prepare our students to attain critical thinking skills and have them capable of self-learning, through this project, we planned to utilize Computer Algebra Systems, in core basic math courses included in the IT majors curricula. Thus we introduced using Maple software application in Discrete Math course as an example. The outcomes of this pilot project proved that utilizing mathematical/algebraic software in demonstrating and clarifying abstract concepts and ideas is successful. The results are excellent and encouraging, we succeeded in achieving our objectives and we demonstrated that this is a suitable approach for teaching math courses to application side majors like information technology majors, and to be followed by introducing Maple or other systems (as deemed suitable) in all Math courses taught in general in IT majors’ curricula. This would also apply on math courses in engineering majors.

Our main efforts were to make e-Discrete Mathematics and other related courses converging the way of thinking of the students hence we provided students with opportunities to develop and demonstrate practical examples of how the concepts being treated in computer science and this will help to become part of their lifelong ability to formulate and solve problems. Supported by results from the survey conducted at the end of the course, we can conclude that the survey reveals that students are very satisfied with the quality and the effectiveness of their e-lab work embedded with the theory in the class secession and then applying what they learned through using Maple application program. Effectiveness, Ease of Use and Self-Efficacy of the platform and dependence on e-lab as central component of the course are concluded as outcomes from this pilot project.

References


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A survey to identify strategies to enhance the public health role of community pharmacists

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Jane Portlock
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Abstract

This survey seeks the opinion of community pharmacists to identify strategies to enhance the public health role of community pharmacists in the UK. This study took the form of a descriptive, cross-sectional survey that generated mostly quantitative data. Questionnaires were mailed to 524 randomly selected community pharmacists from Barnet, London, and its surrounding areas, and Bedfordshire, Cardiff and Edinburgh. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS 19.0). This study revealed that a majority of the respondents would want pharmacists to work closely with other healthcare providers (91.8%); to enhance their skills in the management of polypharmacy and long-term conditions (88.4%); to develop good adherence strategies for patients (88.3%); to be remunerated directly for providing public health services (87.1%); for themselves and pharmacy students to be provided with advanced experience in public health (86.3%; 86.4% respectively); and, to enhance patients’ self-management capacities (88.4%). Those respondents that qualified between 2000 and 2014 were more likely than other respondents to support the idea of pharmacists being remunerated directly for providing public health services ($p = .043$; $\eta^2 = .078$). Respondents from Cardiff were more likely than other respondents to be participating in local authority-run schemes ($p < .001$; $\eta^2 = .180$). To enable UK community pharmacists to enhance their role in public health, it seems necessary to improve, among several other things, the undergraduate as well as the postgraduate training and skills of pharmacists in public health; to remunerate pharmacists directly for providing public health services; and, to provide students and pharmacists with advanced experience in public health. In addition, pharmacists would need to work more closely with other healthcare practitioners, for example, general practitioners and nurses.

Keywords: strategies, public health, community pharmacy, polypharmacy
Introduction

In a recent white paper, the 'Five Year Forward View', the government presented its plan to make greater use of pharmacists through its 'Multispecialty Community Providers' (MCPs), which would become the focal point for a far wider range of care needed by their registered patients (NHS, 2014). However, the recent observation that the present Master of Pharmacy (MPharm) degree offered by the British universities fails to prepare pharmacists with the skills needed to deliver the care and services expected of them in the future, problematises the situation (Anon, 2015). According to the General Pharmaceutical Council, there is now a need to produce pharmacists who are competent in delivering patient-centred care and, at the same time, have people skills and are able to work in a multi-disciplinary team (Anon, 2015). This becomes even more relevant when we also consider the results of a recent IPSOS/Mori poll that revealed that although the public trusts the advice given by a community pharmacist, the degree of trust is lower than that afforded to other health professionals (IPSOS/Mori, 2014). Employing the survey method, this study aimed to identify strategies to enhance the public health role of community pharmacists in the UK.

Methods

This study was approved by the programme approval panel (PAP) and research ethics sub-committee (RESC) of the University. The study took the form of a descriptive, cross-sectional survey that generated mostly quantitative data. Items were selected and included in the questionnaire based mainly on the identified themes in the review of literature and information (Agomo and Ogunleye, 2014), with assistance from J.O. and J.P. (content or face validity) (Oparah and Arigbe-Osula, 2002). The questionnaire was designed to take approximately 30 minutes to complete, with confidentiality of responses assured. The questionnaire was pilot tested for content, clarity and format of the questions on a group of 150 randomly selected community pharmacists in the Bedfordshire area, England, as listed on the NHS Choices website (eligible population, 517) (NHS Choices, 2015). Each questionnaire was assigned with an identifiable coded letter and a serial number. The prefix letter ‘P’ represented pilot study questionnaires; ‘C’ represented questionnaires from ‘Cardiff’; ‘E’ represented questionnaires from ‘Edinburgh’; and the prefix letter ‘B’ represented questionnaires from ‘Barnet’ and the surrounding areas. The response rate for the pilot study was 39% (59/150), after two reminders (three weeks apart). Based on the 56 items tested on the pilot questionnaire, the SPSS reliability test indicated that the Cronbach's alpha was 0.787. As this was greater than 0.7, there was no need to alter the questionnaire (Nunnaly, 1978).

The questionnaire was designed to collect demographic characteristics of respondents, such as gender, age, years of post-qualification experience (Oparah and Okojie, 2005). Respondents were also requested to describe their involvement in public health services, hence, were asked to tick ‘Yes’ or ‘No’ to some questions, such as: offering over-the-counter advice; participating in a local authority run scheme (e.g., immunisation) for pharmacists; and collaborating with a local prac-
Pharmacists characteristics

Both men (73 [50%]) and women (73) responded to the survey (C.I. ±8.09). Their age-range distribution (Figure 1) indicated that the youngest as well as the highest number of respondents were aged between 20 to 29 years (26.5%, C.I. ±7.12), while the oldest as well as the fewest number of respondents were aged between 70 to 79 years (2.0%, C.I. ±2.26). A majority of respondents (51.7%, C.I. ±8.12) qualified between 2000 and 2014. The role distribution of respondents (Figure 2), indicated that the majority of our respondents were working as employed community pharmacists (76.9%, C.I. ±6.8). The results presented in this paper, is an extract from much larger results.

Involvement of community pharmacists in public health services

The survey responses indicated that most of the respondents (98.6%, C.I. ±1.9) were offering over-the-counter (OTC) advice, 78% of respondents (C.I. ±6.77) participated in local authority run scheme, while 33% of respondents (C.I. ±7.85) collaborated with a local practice in a shared care kind of scheme.

Funding for public health services from community pharmacies

In terms of funding, the majority of respondents (79.1%, C.I. ±7) indicated that the public health programme they were involved in was fully funded by the local authority. For those that said 'No', it seems that these services were funded
through other sources. Five respondents indicated that the services were privately funded, notably:

The patients through private payments – weight loss – ineligible for NHS (and) Flu jab. [RC 196]

Self-funded [P 11].

In the case of another six respondents, they were receiving some financial support from various health authorities:

- Beds Clinical Commissioning Group (CCG) [P 49]
- Health Promotion, Wales [RC 210]
- NHS Board [E347]
- National contract [E443]
- Local Pharmaceutical Committee (LPC) [P81].
- Also CAN, plus smoking cessation clinic, plus CCGs [PR28].

For three other respondents, the companies they were working for funded the costs of providing these services:

- Company [C168].
- Sainsbury’s [P39; P143]

**Strategies to enhance the public health role of community pharmacists**

Regarding strategies to enhance the public health role of community pharmacists in the UK, 69% of respondents (C.I. ±7.48) indicated that there was a need to increase the public health content of the undergraduate curriculum (Table 1). Five per cent of respondents rejected the idea. A majority of respondents (77.9%, C.I. ±6.74) indicated that they would want pharmacy students training closely with other healthcare students, while 92% of respondents (C.I. ±4.44) would prefer pharmacy graduates working closely with other healthcare providers, for example, general practitioners (GPs) and nurses.

As it concerns communication skills, 83% of respondents (C.I. ±6.09) indicated that they would want content-specific or advanced communication techniques to be taught to UK undergraduate pharmacy students and pharmacists. In terms of other strategies needed to enhance the public health role of community pharmacists, 88% of respondents (C.I. ±5.2) felt that there was a need to develop good adherence strategies for patients; 83% of respondents (C.I. ±6.06) would like community pharmacists to enhance their role in preventing the spread of infections as well as managing anti-microbial resistance; 88% of respondents (C.I. ±5.17) would like community pharmacists to enhance patients’ self-management capacities; while 78% of respondents (C.I. ±6.65) indicated that they would like pharmacists to enhance safe medication disposal methods.

Furthermore, a majority of the respondents also indicated that they would like community pharmacists to enhance their skills in the management of polypharmacy and long-term conditions (88.4%, C.I. ±5.18); to manage the medication needs
of athletes (65.1%, C.I. ± 7.72); and to enhance their involvement in smoking cessation (81.6%, C.I. ±6.25). As well as these, a majority of respondents would want pharmacy students provided with advanced experience in public health (86.3%, C.I. ±5.57); pharmacists provided with advanced experience in public health (86.4%, C.I. ±5.53); and, pharmacists remunerated directly for providing public health services (87.1%, C.I. ±5.41). However, when it comes to UK universities offering dual MPharm (or even PharmD) / MPH degrees and community pharmacists adopting the use of new technologies and the social media in practice, only 41% (C.I. ±7.93) and 44% (C.I. ±8.03) of respondents, respectively, were in support of these initiatives.

The survey questionnaire also provided an option for respondents to contribute free text comments about what they considered necessary for enhancing the public health role of community pharmacists in the UK. Two of the respondents argued that there was a need to address issues of funding:

Any services should be paid properly, taking into account time. [P124]

Create a minimum amount a pharmacist can be paid – this will enhance respect for the profession. [P103]

In the case of another respondent, the solution lay with removing commercial interests in pharmacy practice:
Stop New Medicines Service (NMS) and Medicines Use Reviews (MURs) being target-driven so that pharmacists can start worrying about their actual jobs and not figures; and cap the number of pharmacists. [P103]

Yet, role expansion and skill development were also cited by a number of respondents as some of the strategies needed to enhance the role of community pharmacists in public health:
Expansion of minor ailments service – local arrangement. Provision of vaccinations including Flu, travel, etc. [E390]

Make prescriber courses an optional extra during the pre-registration training. [P133]

Consultation skills (and) business skills. [B37]

Regarding the question that asked about how essential it was that patients get public health services from community pharmacies, 50% of respondents (C.I. ±8.15) indicated that this was ‘very essential’; 26% said ‘essential’ (C.I. ±7.18); 15% indicated ‘quite essential’ (C.I. ±5.76); 8% said, ‘sometimes’ (C.I. ±4.5), while one respondent (0.7%, C.I. ±1.62) disagreed.

In relation to the positive aspects or successes of the present public health services provided from the community pharmacy and how these could be strengthened, more than 50 respondents highlighted the accessibility advantage of community pharmacy. Other comments noted that the public health services offered from
community pharmacies provided savings to the NHS; remained a source of role-extension (14 respondents), provided recognition and status enhancement for community pharmacists; and, at the same time, enabled teamwork and collaboration between pharmacists and other healthcare professionals to be developed. However, to boost outcomes, it seems that more funding as well as training will be needed.

**Various strategies**

Ease of access – no appointment necessary; more integration into healthcare team; reduce stress on the National Health Service (NHS), e.g., Accident and Emergency (A&E), etc. Already handle medicines. [P11]

Accessible, infrastructure and logistical support to deliver these services. Need to reduce pressure on A&E and GPs, by utilising pharmacists’ skills. Acceptance on the part of all stakeholders that this is cost effective to do. [E390]

**Training**

More appropriate training. [P17]

**Savings**

Cost-effective number of available sites. [PR43]

**Role extension**

Emergency Hormonal Contraception (EHC), Nicotine Replacement Therapy (NRT), health check, drug and alcohol services. [P112]

Methadone, smoking cessation, EHC, MUR, NMS, flu vaccination, travel vaccination, minor illness (ailment), greater time given to patients by pharmacists. [PR91]

**Recognition**

By recognition from government of the role played by pharmacists, by keeping people healthy in many ways. [B123]

**Status**

Strengthens the standing of the profession with patients and other healthcare professionals. [C157]
Less waiting time for patients, improving the image of pharmacists. [C272]

**Teamwork/collaboration**
Get the whole pharmacy team – counter assistants, dispensers and technicians involved in providing the services. Healthy living pharmacies/champions. [Respondent B121]

Relieve pressure on GPs. [Develop] professional working relationship with other health practitioners. [C255]

**Funding**
When funded by NHS, all pharmacies are involved, for example. NRT, so funding is essential for universal service. [E444]

**Accessibility**
Convenience, sometimes no need for an appointment. [PR19]

Being physically available all the time. [PR29]

With regard to how the community pharmacy-based public health services could be developed in the future (Table 2), a minority of community pharmacists (36.5%, C.I. ±7.96) would like pharmacies to employ their own public health advisers. Twelve per cent of respondents (C.I. ±5.45) would like community pharmacies to devolve all such work to non-pharmacy based public health practitioners. A majority of respondents (66.9%, C.I. ±7.81) rejected the suggestion. However, a majority of respondents (60%, C.I. ±8.1) would want community pharmacists to reach out to the community and run public health programmes in libraries or other community meeting places; community pharmacies to develop into Healthy Living Pharmacies (76.8%, C.I. ±7.03); and, pharmacists to develop their own expertise in public health (90%, C.I. ±4.98).

Provision in the questionnaire for other comments, revealed other suggestions as well:

**Opportunity**
One library in one local area, but many pharmacies in one local area. Up-take is great, far more than channelling the services to other places. [RB144]

**Autonomy**
The recent Scottish white paper on pharmacy practice should be imple-
mented in the rest of the UK, where pharmacists will have autonomy on their patients independent of their employers. [P9].

Difficult to deliver due to responsible pharmacist presence in a location. [PR100]

Referral
Lots of services undertaken by nurses could be done by us, for example, flu jabs, asthma checks, blood pressure (BP) checks, diabetic checks, etc. [P33]

GPs and clinicians actively referring patients to pharmacists for intervention. [E390]

Tests for significance and correlation of variables

Notably, tests for significance of variables indicated that the male respondents (median = 4.0) were more likely than the female respondents (median = 3.0) to agree that UK Pharmacy Schools should offer dual MPharm (or even PharmD) / MPH degrees (p = .029; Eta squared, $\chi^2 = .033$) [ANOVA, Significance level = p < 0.05]. Yet, those respondents that qualified between 2000 and 2014 (median = 5.0) were more likely than other respondents to support pharmacists being remunerated directly for providing public health services (Total mean = 4.0; p = .043; $\chi^2 = .078$).

Based on the locality of practice, respondents from Cardiff were more likely than other respondents to be participating in local authority run schemes (p < .001; $\chi^2 = .180$). However, respondents from Cardiff (median = 3.0) were less likely than other respondents to support community pharmacies developing into healthy living pharmacies (p < .001; $\chi^2 = .147$; Total median = 4.0). In addition, respondents from Cardiff (median = 3.0) were less likely than other respondents to agree that the public health content of the UK undergraduate curriculum should be increased (p = .035; $\chi^2 = .059$; Total median = 4.0).

On the other hand, respondents from Edinburgh (median = 5.0) were more likely than other respondents to agree that pharmacists should enhance their role in the management of polypharmacy (p = .043; $\chi^2 = .057$; Total median = 4.0). Those respondents aged between 60 and 69 (median = 5.0) were more likely than other respondents to agree that UK community pharmacies should develop into healthy living pharmacies (p = .028; $\chi^2 = .090$; Total mean = 4.0).

For the correlation of variables [significant level of p < .05 (Spearman's rho, $\hat{n}$)], the ‘age of respondents’ was negatively correlated with respondents agreeing that: pharmacy students should train with other healthcare students [$\hat{n} = -.241; p = .004$], pharmacists should work closely with healthcare practitioners [$\hat{n} = -.198; p = .016$], and that pharmacists should be remunerated directly for public health services [$\hat{n} = -.198; p = .016$].
Discussion

The generalisability of the study may have been limited due to the low response rate. A majority of respondents supported most of the strategies identified in the review of knowledge and information (Agomo and Ogunleye, 2014). This support was, however, lower on issues such as offering dual MPharm (or even PharmD) / MPH degrees (40.9%) and community pharmacists adopting new technologies and the social media in their practice (43.8%). Dual degrees are known to be popular in the United States of America (US), where some universities now run the dual PharmD/MPH (DiPietro et al, 2011), MD/MPH, MD/PhD, MD/MBA degrees (Flynn, 2010). However, the significant difference found in this study between male and female respondents regarding UK Pharmacy Schools offering dual MPharm (or even PharmD) / MPH degrees, needs further investigation. Regarding the use of social media in the practice, it has been argued that social networks can be great tools to obtain professional knowledge and disseminate information globally (Safdar, 2015). As it has, however, been noted that the number of pharmacists using the social media is minimal (Safdar, 2015), this therefore raises the concern that pharmacy practice in general is not taking up the opportunity offered by social media. Further study might also be needed to determine why UK pharmacists continue to be less interested in the use of new technologies and social media in their practice, and possibly how this impacts on their role in public health.

Eighty-eight per cent of our respondents indicated that they would want UK community pharmacists to develop good adherence strategies for patients. Poor adherence by patients could be associated with poor monitoring and reporting of serious adverse drug events (ADEs) by pharmacists (Gavaza, 2011). However, the magnitude of the problem is also dependent on the condition being treated (Sukkar, 2014). Still, the issue of non-adherence costs is not just about the costs of wasted drugs but also includes the increased health costs to payers if a patient’s condition worsens (Sukkar, 2014). Also, based on recent evidence that suggests one would need to have 12 or 13 different drugs to mimic all the effects of exercise, it has been argued that good adherence should no longer be focused on patients just taking their medicines correctly, but should soon shift to patients also adhering correctly to their exercise prescription regimes (Dolgin, 2015). Several studies have identified the role of community pharmacists in smoking cessation (Anderson, 1998; Anderson and Blenkinsopp, 2003; Agomo et al, 2006; Agomo, 2012). This study revealed that some 82% of the respondents would want community pharmacists to enhance their involvement in smoking cessation. During the review of knowledge and information (Agomo and Ogunleye, 2014), a gap in the evidence base was identified on the willingness of retail pharmacies to stop the sale of tobacco products. This point was further highlighted in the free text comment by a respondent:

Companies that own pharmacies should not be involved in activities which show conflict of interest, e.g. selling cigarettes. [B123]

A number of studies have also noted that there is a need for healthcare practitioners to improve their communication techniques (Emmerton et al, 2010;
This study further confirmed this need, with the majority of the respondents indicating that they would want content-specific and advanced communication techniques to be taught to UK undergraduate pharmacy students and pharmacists. It has, however, been noted that in practice, little attempt is made by healthcare professionals to assess patients' understanding of any health advice given (Schwartzberg et al, 2007). This is even more concerning when we also consider the findings of a recent study that found that while only 7% of asthma patients used their metered dose inhaler (MDI) properly, in the case of patients using an epinephrine auto-injector device, the success rate was only 16% (Bonds et al, 2015). This, therefore, calls for better patient training, including practical demonstrations in the use of their devices (Bonds et al, 2015).

Sixty-nine per cent of the respondents supported the need to increase the public health content of the UK undergraduate pharmacy curriculum. On the other hand, 86% of the respondents were in favour of students receiving an advanced pharmacy practice experience in public health. This desire to broaden and enhance the public health (including clinical pharmacy) training of undergraduate students and pharmacists supports the recent move in the UK to employ pharmacists in GP practices (Robinson, 2015). Hopefully, pharmacists working in GP practices will help to enhance the professional image of pharmacists.

Regarding the promotion of interdisciplinary initiatives in pharmacy education and then practice, these were widely supported by our survey respondents. Interestingly, this support is often not well reflected in practice, as only 33% of the respondents indicated that they were collaborating with a local practice in a shared care kind of scheme. In terms of the benefits, integrated learning and practice are likely to facilitate easy transfer of knowledge between practitioners, can help minimise wastage of resources and duplication of efforts in some institutions, facilitate patients’ care services, and enhance the profile of pharmacists.

Sadly, antibiotic resistance continues to be a global problem (WHO, 2015). In the UK, the National Institute for Health and Care Excellence (NICE) recommends that everyone engaged in providing healthcare should understand the standard principles of infection control (NICE, 2012). In both the service focused study (Agomo, 2012) and the review of knowledge and information (Agomo and Ogunleye, 2014), the role of community pharmacists in infection control were identified. Other studies such as, Bruce and Scott (1998) and Watson et al (2003) have also highlighted the role of community pharmacists in infection control. This study supports this unique role, with the majority of our respondents indicating that they would like community pharmacists to improve their role in preventing the spread of infections as well as managing anti-microbial resistance.

At the same time, promoting self-management capacities is likely to empower patients, and ensure better health outcomes and savings to the NHS (Taylor and Bury, 2007). This study revealed that some 88% of the respondents would want community pharmacists to enhance patients' self-management capacities. Regarding the strengthening of patients’ education on safe medication disposal methods, there are indications that inappropriate medication disposal is still a problem, not just in the US (Abrons et al, 2010), but also in the UK (Fradgley and Smith, 2012). This study supports safe medication disposal methods.
A majority of the respondents would want community pharmacists to improve their skills in the management of polypharmacy and long-term conditions. In a US study (Munger, 2010), it has been argued that the risks associated with polypharmacy and the potential for inappropriate therapy needed to be considered and balanced against the possible benefits of multiple drug therapies. Encouragingly, the Scottish government supports this initiative as it has identified the need for pharmacists’ greater contribution in polypharmacy (NHS Scotland and The Scottish Government, 2012). It is therefore possible that the Scottish government’s position on polypharmacy contributes to the reason that respondents from Edinburgh were more likely than other respondents to agree that pharmacists should enhance their role in polypharmacy.

Nonetheless, a number of studies have also identified the role of pharmacists in drug addiction, substance abuse and misuse (Lee et al, 2009; Ambrose, 2011; Chaar et al, 2011). In this study, the majority of the respondents indicated that they would like community pharmacists to manage the medication needs of athletes, to prevent them from the accidental use of a banned substance. There seems to be, however, a lack of information that pharmacists are being made aware of the educational opportunities and pharmacists’ responsibilities in anti-doping activities (Ambrose, 2011).

According to a Scottish government document, remunerating pharmacists directly for providing public health services can help enhance their role in public health (Scottish Government, 2013). The majority of the survey respondents would like pharmacists remunerated directly for providing public health services. This becomes even more important moving forward when we also consider that those respondents that qualified between 2000 and 2014 (younger pharmacists), were more likely than other respondents to support pharmacists being remunerated directly for providing public health services.

Yet, alcohol consumption is known to be associated with crime, violence, domestic abuse, child sex abuse and road traffic accidents (Kaczmarek, 2015), with drink-driving being the second biggest killer on European Union (EU) roads (European Commission, 2014). In this survey, a number of respondents highlighted in a free text comment the role of community pharmacists in alcohol misuse. While, there seems to be a potential for alcohol screening and brief intervention (SBI) services in community pharmacy (Horsfield et al, 2011), still, there exists little empirical evidence of the effectiveness of community pharmacy-based services for alcohol misuse (Dhital, 2004; Fitzgerald and Stewart, 2006; Watson and Blenkinsopp, 2009).

Similarly, regarding travel medicines, a UK study (Hind et al, 2008) has noted that community pharmacists provide limited services in this area. Yet, this service could be enhanced by community pharmacists offering the travelling public general advice on various issues such as bite prevention, provision of immunisations and malaria prophylaxis, with the public in many cases also willing to pay for some of the services (Hind et al, 2008). According to a recent study from Australia (Tudball et al, 2015), there is more to travel medicine, which might also include community pharmacists managing patients’ medicines properly before they embark on any journey. Sadly, prior to travelling, patients seldom asked for advice regard-
ing their regular medicines from healthcare professionals (Tudball et al, 2015). Nevertheless, community pharmacists and other health professionals are well positioned to advise and assist patients with complex drug regimens who are planning to travel, and at the same time, provide general awareness regarding the need for maximum care with multiple medicines (Tudball et al, 2015).

This study also revealed that the majority of the respondents would like UK community pharmacies to develop into healthy living pharmacies (HLPs). Supporting the role of HLPs is also mentioned in the recent announcement by Public Health England as an aim to “accelerate the role of HLPs”, by ensuring that they grew from “around 1,000” to “more than 2,000 over the next three to five years” (Kennedy, 2015). This can further be accelerated and strengthened by enabling Independent Pharmacist Practitioners (IPPs), without the burden associated with dispensing and workload, to establish HLPs in local communities. It might also be helpful to verify why respondents from Cardiff were less likely than other respondents to support community pharmacies developing into HLPs.

Yet, according to the free text comments, it is apparent that tackling inadequate funding, minimising commercial pressures, and empowering pharmacists through professional autonomy could help enhance the role of community pharmacists in public health.

Limitations of study

A major contributing factor for the low response rate in this survey might have been the length of the survey questionnaire, which listed 63 items (including free text options). Also, the fact that we did not have multiple contacts with respondents or offer any financial incentives might have negatively affected the survey response rate (Dillman, 2000). Yet, the poor response rate recorded in this study could also be a reflection of how disengaged UK community pharmacists are with the profession. This has often been reflected in past RPS elections (Madlom, 2013; Cartwright, 2015).

Implications for policy makers

This survey identified strategies which could enhance the public health role of community pharmacists in the UK. The survey revealed that the majority of our respondents were less enthusiastic about UK Schools of Pharmacy offering dual MPharm (or even PharmD)/MPH degrees and also community pharmacies adopting new technologies and social media in practice. Further research in these areas might be needed, to identify how these could help enhance the public health role of community pharmacists in the UK. These findings could also be made more illuminating by exploring the perspectives of healthcare users.

Conclusion

To enable UK community pharmacists to enhance their role in public health, it seems necessary to improve among several things, the undergraduate as well as the post-graduate public health training and skills of pharmacists; enhance the ca-
reer structure of community pharmacists; provide students and pharmacists with advanced experience in public health; enable pharmacists to manage polypharmacy and develop good adherence strategies for patients; and teach students and practitioners advanced communication techniques.

In addition, there might also be a need to enable the development of a mixed market in community pharmacy practice by the government and the profession doing the following: encouraging pharmacists to be employed in other untraditional sectors, such as GP practices, accident and emergency departments and social care; contracting public health services directly to individual or group pharmacists; and, encouraging pharmacists to use new technologies and the social media in practice. In addition, the profession should enable inter-professional learning and practice in order to develop further.

References


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Appendix

Figure 1: Age of participants – Agomo et al, 2016

Figure 2: Respondent's role in pharmacy – Agomo et al, 2016.
<table>
<thead>
<tr>
<th>Questions</th>
<th>Disagree (%)</th>
<th>Strongly disagree (%)</th>
<th>Neither agree nor disagree (%)</th>
<th>Agree (%)</th>
<th>Strongly agree (%)</th>
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<tbody>
<tr>
<td>Increase PH content of undergraduate curriculum? (n = 147)</td>
<td>3.4</td>
<td>1.4</td>
<td>26.5</td>
<td>50.3</td>
<td>18.4</td>
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<tr>
<td>Offer dual MPharm (or even PharmD)/MPH degrees? (n = 147)</td>
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<td>8.2</td>
<td>38.8</td>
<td>32.7</td>
<td>8.2</td>
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<tr>
<td>Pharmacy students training with other HC students? (n = 145)</td>
<td>4.8</td>
<td>4.1</td>
<td>13.1</td>
<td>58.6</td>
<td>19.3</td>
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<tr>
<td>Pharmacists working closely with HC practitioners? (n = 146)</td>
<td>1.4</td>
<td>2.1</td>
<td>4.8</td>
<td>54.8</td>
<td>37.0</td>
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<tr>
<td>Teach advanced communication techniques? (n = 146)</td>
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<td>1.4</td>
<td>15.1</td>
<td>55.5</td>
<td>27.4</td>
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<tr>
<td>Adopt new technologies and the social media? (n = 146)</td>
<td>13.7</td>
<td>11.0</td>
<td>31.5</td>
<td>34.2</td>
<td>9.6</td>
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<td>Develop good adherence strategies for patients? (n = 146)</td>
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<td>1.4</td>
<td>10.3</td>
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<td>9.5</td>
<td>54.4</td>
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<td>Enhance safe medication disposal methods? (n = 147)</td>
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<td>1.4</td>
<td>16.3</td>
<td>53.1</td>
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<td>Enhance the management of polypharmacy? (n = 146)</td>
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<td>8.9</td>
<td>47.3</td>
<td>41.1</td>
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<td>Managing the medication needs of athletes? (n = 146)</td>
<td>1.4</td>
<td>2.7</td>
<td>30.8</td>
<td>41.1</td>
<td>24.0</td>
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<td>Enhancing involvement in smoking cessation? (n = 147)</td>
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<td>1.4</td>
<td>14.3</td>
<td>44.2</td>
<td>37.4</td>
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<td>Providing students with advanced experience in PH? (n = 146)</td>
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<td>10.3</td>
<td>58.9</td>
<td>27.4</td>
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<td>7.5</td>
<td>38.1</td>
<td>49.0</td>
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Table 1: Possible ways the public health role of community pharmacists could be enhanced – Agomo et al, 2016.
Table 2: Suggestions on how the community pharmacy-based public health services could be developed in the future – Agomo et al, 2016.

<table>
<thead>
<tr>
<th>Survey questions</th>
<th>Disagree (%)</th>
<th>Strongly disagree (%)</th>
<th>Neither agree nor disagree (%)</th>
<th>Agree (%)</th>
<th>Strongly agree (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmacies employing their own PH ad-</td>
<td>22.9</td>
<td>10.0</td>
<td>30.7</td>
<td>27.9</td>
<td>8.6</td>
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<td>Devolve all work to PH practitioners? (n = 38)</td>
<td>38.8</td>
<td>28.1</td>
<td>20.9</td>
<td>6.5</td>
<td>5.8</td>
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<tr>
<td>Pharmacists reaching out to public plac-</td>
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<td>7.9</td>
<td>19.3</td>
<td>45.7</td>
<td>14.3</td>
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<td>Community pharmacies developing into</td>
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<td>3.6</td>
<td>17.4</td>
<td>44.2</td>
<td>32.6</td>
</tr>
<tr>
<td>Pharmacists developing their own exper-</td>
<td>1.4</td>
<td>1.4</td>
<td>7.2</td>
<td>54.0</td>
<td>36.0</td>
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</tbody>
</table>
Why is Ethics of Management so Necessary?

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Abstract

Post-war development of society is focused on the dynamics of technology at the expense of humanities. The consequence was observed mainly in the fields of economics and management where quantitative values that allow the use of the results of successful technology are favoured. This brought the lack of ethics in human behaviour. Overcoming this situation is a long process, which main tool is education. This paper examines why the issue of ethics is necessary management of corporate organisations. It highlights management ethic and its subsystems—morality, competence and its application. The paper draws a number of conclusions—one is that quantitative traits of business phenomena that are presented by corporate indicators are necessary to monitor the impact of their qualitative values.

Keywords: ethics, morality, management, responsibility, education, leadership

Introduction

Post-war business climate is influenced by inflation of legislative standards and frequent amendments. It is the result of post-war boom of technology, dynamic development management disregarded. Due to stagnation management philosophy has not respected the law of unity of quality and quantity. Ethical values of management were developed but management is fully focused on the monitoring of measurable values of economic, social and political phenomena. It established the quantitative management, which creates prerequisites for the development of consumer values.

We still have no idea about the final consequences of consume management on the company's future development. Changes in management that still assert, have more political significance, since they are not enforced systematically as a comprehensive and continuous process of innovation. This enables the discussion whether implemented changes in legislation respect ethical values when there is the well-known slogan: “what is not prohibited is permitted”.
Ethics in management

Lack of awareness and belief in the importance of ethics in management creates space for ethical thinking in companies. Deepening ethical methods, based on respecting the unity of quantity and quality, in the decision-making process increased the responsibility for the strategic development of the management of economic and social life. It is the responsibility of management which is liable not only for economic activities, but also for the methods which have been used to achieve the results which are transparent prosperity, economic development and socially prosperous company.

Reaching responsible company management and ethical management of the economy is a difficult path, because non-essential consumption is for someone appealing. For strategic management of economic development it is not enough just to maximize the measurable economic phenomena, as it is enabled by the quantitative management. Yet it needs to be respected for their qualitative value. We get a transparent efficiency achievements and increase accountability. Management of the object should be considered as management innovation process of a system whose internal structure seeks a relatively balanced development.

Managerial ethics is based on three subsystems that represent it as a system. They are interdependent and complementary. Therefore their benefit is evident only in their comprehensive application. The management prevails routine and the realization of innovations which are mainly oriented towards the use of technology management is only partial. This orientation significantly contributed to the acceleration of communication and analysis of information on the basis of the development of measurable results. Monitoring and evaluation of measurable properties of the economic and social phenomena through indicators, however, does not reflect their actual contribution, that is the ethics of methods that have been achieved (Dvořáková, 2010).

If we evaluate the economic results of operations, based on the unity of qualitative and quantitative characteristics of individual activities, then we get a comprehensive factual information about the success or failure of management. Otherwise we risk unethical development and unstable development of managed objects.

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Predicative ability</th>
<th>Output of decision making</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morality</td>
<td>ethics of character</td>
<td>ethical disposition of manager</td>
</tr>
<tr>
<td>Competence</td>
<td>ethics of qualification</td>
<td>disposition of professionalism</td>
</tr>
<tr>
<td>Application</td>
<td>professional ethics</td>
<td>effective management - leadership</td>
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</tbody>
</table>
Managerial Ethics

Subsystems:

Morality
- Principles of cultural values of Western society
- Responsibility for the compliance of legislation and moral values
- The application of morals in life of daily work
- Morality is a part of all people - is dependent on the function

Competence
- Theoretical and practical knowledge and experience
- Responsibility for their qualification growth (lifelong learning)
- Creative thinking - an ambitious innovation - Strategy and
- Application complexity and synergy in management

Implementation
- Respecting the unity of quantity and quality management
- Creative, ambitioned and ethical decision
- Decision making understood as a creation of the innovation process
- Promoting ethics in internal and external communication
- Balanced relationship between work stimulation and motivation
- Responsibility for decisions and their consequences

The contents of ethics is often hampered by morality. This reduces the importance of managerial ethics as a management superstructure. Innovation management is considered as systematic application of managerial ethics in theory and practice. Absence of ethics in management by consumer management which is considered a negative innovation management, because it allows the formation of recession, which produces various types of crises Dytrt, Z. (2011).

Consumer management can be corrected by use of ethical and social legislation. We do not have a complete picture of the consequences of consumer thinking on the development of society. Deepening ethical methods in the context of decision making and delegating responsibility contribute to strategic management in the private and social life. The application of innovation in management should focus on two seemingly separate areas:

* Innovation content management philosophy and
* Complexity of the system and creative strategy, theory and practice.

Existing management philosophy longer fits the needs and interests of the achieved level of society, since it has lasted for nearly two centuries. The existing discrepancy between the needs of the company and management philosophies raises consumer thinking and deepens consumer society.

Application of managerial ethics is desirable for all entities that use a control process. Not only in business and public administration, but also in the management of our private lives (Dytrt, Gajdušková, & Zadražilová, 2014). Managerial ethics is based on the unity of quantitative and qualitative values.
Conclusion

The desirable development of the theory and practice of management would help communication and cooperation between research centres of scientific development and economic entities that are converging their strategic development as a prerequisite for a systematic and effective development of the company. To significantly benefit to the effectiveness of the superstructure management (so called leadership) the following points has to be taken into consideration:

- Systems management is manifested leadership-driven organization which leads to sustainable development.

- Leadership should be considered superstructure management. In particular, to focus on promoting growth and stabilization of loyal workers and stimulating their creative and ethical thinking.

- As a basis for decision-making responsible management complexity, timeliness and accuracy of information for decision making is required. Besides quantitative traits of business phenomena that are presented by corporate indicators, it is necessary to monitor the impact of their qualitative values.

- The turning point of superfluous consumption to desirable consumption adjusts the degree of managerial ethics in decision-making process. The requirement to apply ethical philosophy applies to creative innovation in the management of production units, as well as public administration.

- Related requirement to upgrade the educational system where graduates of all levels of the educational system would be acquainted with the importance of ethics and would be theoretically ready to apply ethics in their education and later in the development of business, political and administrative sphere.

- Managerial activity manifests decisions and consists of overcoming adverse imbalances which occur during the functioning of living or inanimate system. Managerial Ethics is not associated with job function and applies to all who control even if it is just a human being themselves.

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Big Data Science Education and the PIPAE Methodology for Big Data Analytics

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Abstract

The objectives of this paper are to identify the issues (ethical and pragmatic), particularly those related to education, and opportunities that big data science brings. It defines the converging factors which have led to the Big Data Science phenomenon; Cloud Computing, the Internet of Things, and the increasing digitization of society and the generation of (big) data worldwide. Ethical issues are those of privacy and security, whilst pragmatic issues relate to people (skills), processes (algorithms) and technologies (systems) requirements. The paper looks at the “people issues” and reports on a review of (big) data science teaching, surveying courses and programmes in the UK and Ireland, and suggesting an ideal curriculum for a Master in Data Science. Several technological and business cases for big data science are discussed; examples include Care.data and DNA storage. Finally, the main points are summarised and conclusions drawn, leading to the proposal of PIPAE; a four stage generic systems development methodology for big data analytics.

Keywords: big data, analytics, cloud computing, Internet of Things (IoT), data science education, PIPAE

Introduction

The emergence of the Big Data Science phenomenon has been the due to a number of converging factors, such as Cloud Computing, the Internet of Things (IoT), and the digitization of society and the resulting massive increase in (big) data generation. The information pool that is generated worldwide is said to double every twenty months (Heger, 2014). The big data phenomenon has led to an increase in demand for people with appropriate skill sets. This paper begins by introducing terms and defining the converging factors which have led to the Big Data Science phenomenon. The issues, particularly in relation to education, and opportunities that big data science brings are then identified. The paper reports on a review of (big) data science teaching and a survey of courses and programmes in the UK and Ireland, suggesting an ideal curriculum for an MSc in Data Science. The main points are summarised and conclusions drawn on the requirements and the future of big data science and big data science education. Finally, a four stage generic systems development methodology; PIPAE (Problem Identification, Preparation, Analytics, Evaluation) is proposed for big data analytics.
**Big Data**

Big data are massive heterogeneous data (unstructured, semi-structured and structured) sets, not solvable (manageable data analysis) using conventional data models, such as relational databases. Graham (2015) summarised here, describes big data and established models of knowledge. There are several definitions of big data, all of which refer to very large data sets, with some combination of five characteristics: Volume, Variety, Velocity, Value and Veracity. Volume is where the amount of data to be stored and analysed is sufficiently large to require special consideration. Variety refers to the data being of multiple types and from multiple sources. Data sources can be structured data held in tables or objects for which metadata is well defined, for example, semi-structured data in documents where the metadata is contained internally (XML documents), or unstructured data such as photographs, video, or any other form of binary data. Velocity refers to the data being produced at high rates and operating on “stale” data is not valuable. Value is where the data has perceived or quantifiable benefit to the enterprise or organisation using it. Finally, Veracity is where the correctness of the data can be assessed. Big data can exploit data held in the cloud, and cloud storage; adding public cloud data to private cloud data (Gordon, 2013).

McKinsey Global Institute (Neaga and Hao, 2013) suggested models for big data characteristics based on the source, with the main key characteristics being those of volume, velocity, variety and value. Here, an additional characteristic is Veracity.

Attributes for each modelled characteristic (Neaga and Hao, 2013, p. 36):

- **Volume: Data at Rest** – Terabytes to exabytes of existing data to process.
- **Velocity: Data in Motion** – Streaming data, milliseconds to seconds to respond.
- **Variety: Data in Many Forms** – Structured, unstructured, text, multimedia.
- **Veracity: Data in Doubt** – Uncertainty due to data inconsistency and incompleteness, ambiguities, latency, deception, model approximation”.

Characteristics of Variability and Complexity have also been added (SAS, 2012). Variability describes the variability of the data flow, in addition to its speed. Complexity refers to the data “relationships, such as complex hierarchies and data linkages, among all data” (SAS, 2012, p.3).

These characteristics, particularly Value, have an implicit temporal element (data at rest, for example), and through associations with definitions of data, information and knowledge, and relationships with established models (heuristic, causal and statistical). Graham (2014) depicted the “transformations” from data to information and then from information to knowledge, discriminating between data, information and knowledge through the dimension of time for the purpose of learning (competence achievement). Human learning appears to involve the taking in of raw data with a specific goal, organising the data so that it has meaning, and analysing this information (compare and contrast, applying elements of Bloom’s (1956) taxonomy) to a more structured form, namely knowledge. Such knowledge or expertise is the basis of knowledge-based systems and heuristic knowledge models.

In Table 1, causal, statistical, heuristic and big data models have been differentiated by their origin or mode of generation, where they are commonly “stored”/
source, their quantitative or qualitative characteristics, main “format”, whether or not they are domain specific, and their main affinity with data, information or knowledge. In addition, these models can be differentiated by their temporal association.

<table>
<thead>
<tr>
<th>Model</th>
<th>Causal</th>
<th>Statistical</th>
<th>Heuristic</th>
<th>Big Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mode of origin</strong></td>
<td>Simulation</td>
<td>Data Collection Methods</td>
<td>Knowledge Acquisition/ Elicitation</td>
<td>All/Ad hoc</td>
</tr>
<tr>
<td><strong>Common source/store</strong></td>
<td>Automatic Test Equipment</td>
<td>Data-base/ Data - warehouse</td>
<td>Knowledge-base</td>
<td>All/Any (Data-centres, Cloud, IoT, Social Networks, RFID, etc.)</td>
</tr>
<tr>
<td><strong>Characteristics</strong></td>
<td>Quantitative</td>
<td>Quantitative</td>
<td>Quantitative &amp; Qualitative</td>
<td>All</td>
</tr>
<tr>
<td><strong>Main Format</strong></td>
<td>Numeric</td>
<td>Numeric</td>
<td>Strings; Facts; Rules; Meta Rules</td>
<td>All/Any</td>
</tr>
<tr>
<td><strong>Main Affinity</strong></td>
<td>Data</td>
<td>Information</td>
<td>Knowledge</td>
<td>All</td>
</tr>
<tr>
<td><strong>Domain Specific</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes/No</td>
</tr>
<tr>
<td><strong>Temporal Association</strong></td>
<td>All (Past, Present, Future)</td>
<td>Present</td>
<td>Past &amp; Future</td>
<td>All (Past, Present, Future)</td>
</tr>
</tbody>
</table>

Table 1: Characteristics of Big Data and Established Models (Causal, Statistical, Heuristic) of Data, Information and Knowledge within in a Temporal Context. (Extended from Graham, 2015, p. 8).

Big data’s distinguishing feature is its mode of origin, often more ad hoc than by design in comparison with the established models, where most, if not all of the
knowledge embodied within is methodically sought and structured for a specific domain. Big data originates from multiple sources and is often a by-product of other things, for example; data stored in conventional databases, in public and private clouds, gleaned through social media interactions, or sensor data generated as a result of the IoT. It has no restrictive characteristics, and is of multiple formats (variety) and veracity. Big data that is outside the domain specific state space, is not data specific to a given domain, and as data, it is also (as supported by McKinsey’s model (Neaga and Hao, 2013)) temporally unspecific. Unlike information and knowledge, the value of data is absolute (it is not altered by time). The value of big data (using analytics) is obtained through converting the data into temporally constrained information or knowledge. The lack of spatial and temporal constraints, resonate with its features of volume and velocity. The term “Big data” is all encompassing as it fits anywhere and everywhere within the domain specific state space (Graham, 2015), and more importantly, outside.

Data-bases and data-warehouses hold both alphanumeric, as well as numeric data, but numeric, quantitative data is directly applied in statistical analysis (models). Qualitative (alphanumeric) data is often mapped on to numeric values or frequency counts etc., as employed in discourse analysis.

**Analytics**

Analytics has been described by its use; Descriptive, Diagnostic, Prescriptive or Predictive. Analytics has also been categorised by its data format and origin; Text analytics, Speech analytics, Video/image analytics and Combined analytics (Marr, 2015, pp. 105-149).

Analytics refers to the analysis of data (usually big) to identify patterns or anomalies, and so to provide descriptions, diagnoses, prescriptions or make predictions, using techniques such as machine learning, e.g. ANNs (Artificial Neural Networks), regression, etc.

Big data is exploited (value obtained) by the application of analytics, effectively reducing the state space, “converting” the data into information (contemporary), or knowledge (future predictive) and/or making it domain specific. Big data analytic techniques may lead to the application of established models; such as mathematical (possibly statistical) models or decision trees (which may be part of a knowledge-based model), post processing (filtering, etc).

Analytics is essentially, the application of a set of processes (algorithms) and technologies (systems), plus people (skills), to make sense of data. For example, Machine Learning (ML) algorithms, a process of learning a model of the world to predict future outcomes. The type of analytics used is based on the outcome, e.g. classification or clustering (if the outcome is discrete) for a numerical regression problem. Not all big data is stored, as it is not normally possible.

**Cloud Computing**

An immediate problem posed by these massive amounts of data is their storage. Cloud Computing both adds to, as well as provides a solution for, big data charac-
characteristics such as velocity, variety, and (particularly) volume. “The Cloud Computing Model, more commonly referred to simply as Cloud Computing or ‘The Cloud’, provides access to ‘clouds’ of shared computing resources such as storage and applications, over a network, usually the Internet” (Graham 2013, p. 7). Clouds are commonly classified into Public, Private, Hybrid and Community Clouds (Chang and Wills, 2013, pp. 233-234). Cloud offers a solution for the big data characteristic of volume by providing storage, often in the form of the Hybrid Cloud (a combination of public and private cloud, with the necessary interoperability between the two), allowing organisations flexibility, with access to variable amounts of data storage, as and when required (for analytics for example), through distributed computing. The existence of data in the Cloud of course, also adds to the total volume of data per se.

The Internet of Things

The Internet of Things has been described as “the idea that any item can be embedded with software, sensors and connectivity to exchange data with one another or a central hub” (Palmer, 2015a, p. 14). The IoT has contributed much to the increase in data as a source of big data. An example of the IoT is the smart meter such as Hive (British Gas, 2015), which permits the remote control of heating in the home via the internet. Hive employs a wireless thermostat, a hub (plugged into the customer’s broadband router so that the thermostat can connect to the internet and be controlled remotely), a receiver (so that the thermostat can “communicate” with the boiler and vice-versa) and an app (software). Embedded “things” lead to the generation and usually the recording of, significant amounts of data (much of which is from sensors) that are amenable to analytics. Curran (Sumner, 2013, p. 16) argues that “data centres will be the engine rooms driving the ‘Fourth Industrial Revolution’, which will see the internet of things and big data transform the way modern businesses operate and societies function”.

The Issues

There are several issues regarding the exploitation of big data and analytics (predictive or otherwise, although it is often prediction that raises most concern, especially in relation to privacy (Marr, 2015, pp.149-154)) which resonate between questions of “if” and “how” it should be exploited. The question of “if” is intrinsically linked with ethical concerns, and the issues of privacy and security, whilst the question of “how” revolves around the pragmatic concerns and the issues of People, Processes and Technologies. The European Commission makes reference to a Big Data Value Association Hexagon with; Skills, Legal, Technical, Applications, Business and Social components (de Lama, 2016, p. 10).

Ethical Issues

The question of “if” (ethics) the data should be exploited is not only relevant to big data, but to Cloud Computing and the Internet of Things. The “if” revolves
around maintaining privacy and therefore anonymity, which has been found to be much more difficult than anticipated. Big data analytics usually require contextual data which is likely to necessitate the use of personal data, e.g. sex, age and postcode, to enable meaningful analysis. In some cases, this contextual data could lead to the identification of individuals and so to a lack of privacy for the individuals concerned. Algorithms exist for making data anonymous through adding layers (which aim to “bury” the data’s origin), however, it is doubtful that such algorithms would work in all cases where exceptional data attributes (those resulting from genetic testing for example) all but guarantees the identification of an individual. Individuals would also be unwilling to contemplate the provision of any of their data to any party (whether or not they are authorized) if there is any security risk, for example, disclosure, data loss or damage, etc. An example of this ethical dilemma is the proposed NHS Care.data initiative (Palmer, 2015). Care.data is the controversial data harvesting of big data and analytics programme by the NHS in England. Proponents such as Tim Kelsey (Palmer, 2015) argue that it will improve patient care, whilst opponents including MPs and GPs have raised concerns over patient privacy. In order to make causational sense of the data (analytics), demographic data such as age and sex may be necessary, whilst postcodes are needed for epidemiological studies.

Chessell (2014) describes an “ethical awareness framework” developed by the UK and Ireland Technical Consultancy Group (TCG) to aid in the development of ethical policies for analytics and big data. There are nine facets to this framework, namely; Context, Consent & Choice, Reasonable, Substantiated, Owned, Fair, Considered, Access and, Accountable.

Fundamental ethical concerns of big data, analytics, the Cloud and the IoT are; the collection, storage and access to large quantities of Combined data. Plus questions such as: Who should collect, store, access (control) and extract value from the data? Hive (British Gas, 2015) for instance; smart meters may enable the benefits of remote control, but are still vulnerable to physical and logical security failures. For example, the loss of internet service in the case of the former, or an attack by Hackers, in the case of the latter. Analysis of HIVE data for domestic heating control could indicate the occupancy and sleeping periods of customers, and indirect information such as employment hours (related to occupancy), or health conditions (where room temperature is constantly high). Such technologies may not be as “innocent” as they initially appear, and combining the IoT, Cloud and big data through analytics may have serious consequences for privacy. Legislation seldom, if ever, maintains pace with technology, analytics and big data are no exceptions.

**Pragmatic Issues**

The question of “how” big data can be exploited to be of value raises more pragmatic concerns in terms of; people (skills), processes (algorithms) and technologies (systems) requirements, as shown in Figure 1. The successful application of analytics is only possible where these three areas converge.

The drive towards usability has to some extent made visible a skills gap and a shortage of people with functional expertise in several areas, particularly those of
artificial intelligence (AI). This skills gap is also in part to do with educational fashion. AI has not been fashionable for some time and most AI experts are either retired or no longer contributing to the worldwide information pool (deceased). Shah (2015) discusses the adoption of the open-source big data platform and the lack of skilled developers (in Hadoop software, for example) being unfounded. He argues that the simplicity of open-source software makes the technology easy to understand and use, and so requires lesser skills. However, a counter argument may be that knowing how to use the tools is not the problem, but knowing what tools to use and when is. There are several stages involved in data analytics, from identifying the Business Case to data cleansing, pre-processing, feature extraction, selection, construction and applying predictive models, and cross validation. These stages require several tools, many of which are open source. Determining the Business Case (Problem Identification) and knowing what to use and when, is where the expertise comes in. The PIPAE methodology (later described) attempts to inform and support the application of processes and technologies for big data analytics. The skills shortage of course also has implications for education.

Figure 1: Pragmatic Requirements for Big Data Analytics (Venn diagram): People, Processes and Technologies.
The ultimate goal of Interaction Design (also referred to as Human-Computer Interaction) is to enable people to build computer systems and products that users find efficient, effective, safe and satisfying to use. Interaction Design is a newer, more generic term referring to the building of products, not just computer systems, to understand the various factors (psychological, physical, technical etc.) that determine how well humans interact with computer systems/products. Benyon et al. (2010, p. 18) suggested that: “Products should be everyday things requiring only everyday skills to use, e.g. like a knife and fork, a pen or a wrist watch. They take time to learn, but once mastered they slip into the background of everydayness. Text messaging on mobile phones has become like this for some people”. The IoT in many ways reflects the evolution of Interaction Design.

The changes in computer users and technical advances have been accompanied by a shift in focus in computer system development and training. The shift is from functionality being key, and towards usability (human-centred) being seen to be of equal or greater importance. An example of the usability versus functionality conflict is the humble calculator. A calculator represents the usability ideal with its intuitive interface, no product expertise is required and it is fully user-task centric. Very few users actually understand the underlying mechanisms (algorithms) and formulae by which a calculator works, such as the derivation of square roots for non-integer numbers. This usability utopia is fine until the model is to be superseded and a return to functionality is required. Big data analytics have inadvertently drawn attention to these problems.

One solution to the shortage of skilled personnel is to externalize the big data analytics by employing Analytics-as-a-Service. Using Analytics-as-a-Service can have its own problems associated with outsourcing not only the analytics, but the data, and these services still require the skilled personnel.

For big data and predictive analytic processes and technologies; many “modern” examples have reverted back to “old” processes and technologies, such as batch processing (although processing has been real-time since 2012), flat files, machine learning and operational research. In addition, programming languages such as ML (Meta Language) and LISP (List Processing) are enjoying a renaissance. Improvements to permit greater interoperability remain an important requirement however.

Furthermore, other pragmatic issues exist with big data and analytics, suggested to be (Graham, 2015):
1. Noise—Data quantity, data quality and relevance (problems associated with the five characteristics). Determining what data is relevant and of value, separating this data from the “noise”. This relates to data cleansing and filtering activities.
2. Exploitation of big data analytical models for prediction as opposed to projection, the latter is comparatively established, but both required data of high quality.
3. Over filtering or analysis—Big data can be overly filtered, analysed and refined so that it will inevitably match the set hypothesis. An example would be the over training of artificial neural networks.
4. Quantum or random element—Spontaneous, unforeseen original data.

An example of this quantum or random element was the appearance of “Loom Bands” in the toy market. Past data (big or otherwise) did not predict the appearance and popularity of this toy; there was no trend to analyse. The next new toy
trend is normally based on fashion, films and market creation (existing data). Loom Bands could not be predicted because the data was not available; it did not exist. This relates to incomplete knowledge, but, in reality, this is an example of a quantum factor – the spontaneous creation of original data. In a temporal context, predictive (future) knowledge is usually based on past data and/or present information. Knowledge is gained by the extrapolation of past data to predict future trends, but prior to the appearance of Loom Bands, the trend data simply was not there.

Other pragmatic considerations include the fundamental nature of big data: volume, velocity, value, variety, veracity, variability and complexity, much of it generated by the IoT. What and how do you collect, store and manage, such huge volumes of data, at such velocities and of such variety, veracity, variability and complexity? The use of the Hybrid Cloud is only part of the solution. Quantum computing potentially offers another solution but it is still in its infancy in terms of any large scale implementation. A further possible solution for the collection, storage and management of big data may be the use of DNA storage. In an article by Jacob Aron (2015), originally appearing in print as “DNA in glass—the ultimate archive”, it is reported that “just 1 gram of DNA is theoretically capable of holding 455 exabytes—enough for all the data held by Google, Facebook and every other major tech company, with room to spare”.

Data Science Education

Recent teaching of computer science students has perhaps focussed on more design oriented (usability) topics, such as Unified Modelling Language (UML), and perhaps less on functionality; algorithms, operational research, data structures and, most significantly, logic, mathematics, artificial intelligence and machine learning. This choice originally proved to be both popular and beneficial at the time. The problem is, however, that when technology is to progress to the next level, there is a need to return to the functionality. The processes and the technologies are not possible without the people with the appropriate skills. A review of Data Science programmes in UK and Irish universities was conducted, using search terms “Disruptive Technologies, “Analytics”, “Big Data” and “Data Science”. Dozens of courses were found, however, the “overlap” between search terms made identifying the exact numbers of distinct courses/programmes difficult in some instances. There were a variety of definitions for Disruptive Technologies, therefore, few (if any) UK and Irish courses/programmes were categorically described as “Disruptive Technologies”. However, nineteen programmes were clearly listed under “Analytics” for the UK and Ireland, and all were at Master Level. Most programmes found were labelled under “Data Science”, but there was an overlap with the search terms “Big Data” and “Analytics”, the vast majority were Master level. The survey also found that whilst application and usability-based topics such as; Hadoop, Cloud Computing and HCI were included in many programmes, “harder”, functionality-based topics like machine learning and AI, were not as common. The notable exceptions were for institutions with a strong background and history in AI and machine learning. From the data, the inference is that UK and Irish educational establishments (exclusively universities) were trying to establish Data Science pro-
grammes using the expertise available. As previously mentioned, AI and ML have been out of fashion for some time so many institutions simply lack the people with these skills, so courses are often “AI/ML light”. Most courses and programmes offered were post-graduate. The fact that most Data Science programmes offered are postgraduate is probably a further reflection of the skills shortage, in this case, having the skilled personnel to teach. Data Science need not be specifically offered at postgraduate level, however, a return to “hard” Computer Science undergraduate degrees is desirable, with a strong foundation in data structures, operational research, mathematics, distributed programming, AI and, ML, etc.

MSc Data Science Programme Requirements

The following curriculum was identified, through a combination of this survey and experiential data, as required for the ideal data science programme, suggested to be at Master Level:

- data acquisition, information extraction, aggregation and representation, data analysis, knowledge extraction and explanation.
- data analysis and machine learning, data visualisation and visual analytics, high-performance, parallel and distributed computing, knowledge representation and reasoning, neural computation, signal processing, data management and information retrieval.
- use of Data Science tools and technologies such as Python, “R”, Apache Spark, JavaScript and GPU programming.
- a practical project for a real-world problem using big data, collecting and processing real data, designing and implementing Big Data methods and tools, applying and evaluating big data techniques to solve a real problem.

In addition, core modules on Data Science Principles, Machine learning, Big data, Neural Computing, and Visual analytics. Additionally, electives in Advanced Programming (Concurrency), Advanced Database Technologies, Information Retrieval, Data Visualization, Digital Signal Processing, Cloud Computing, Computer Vision, the IoT, Software Agents and MATLAB training.

The Opportunities

The opportunities for the application of big data and analytics or “Big Science” are suggested by the hype to be endless. Current applications include medical applications, such as the human genome project, with Genomics becoming increasingly important (Palmer, 2014).

There is a temptation to use big data simply because it is there. A significant proportion of big data is likely to be spurious to any specific application or domain. One domain source of big data has apparently been utilised successfully for anoth-
er unrelated domain; the use of an earthquake aftershocks mathematical prediction model applied to crime prediction in Los Angeles (MIT, 2013). This could be the identification of a natural generic pattern (akin to fractals) for seemingly disparate phenomena, or a unique feature of crime data models, a question that requires further cases and research.

**The PIPAE Systems Development Methodology for Big Data Analytics**

The PIPAE Methodology for Big Data Analytics is a four stage methodology which describes the steps commonly involved in applying analytics: Problem Identification, Preparation, Analytics, Evaluation.

![Diagram of PIPAE Methodology](image)

*Figure 2: The PIPAE (Problem Identification, Preparation, Analytics, Evaluation) Systems Development Methodology for Big Data Analytics.*

1. **Problem Identification (The Why?)**
   Establish the Business Case –
Justification for using big data and predictive analytics
(i) Establish the objective(s)
(ii) Establish the evaluation/exit criteria:
Quality Assurance (QA) element (e.g. determine the mean squared error)
Proof of Concept (POC)
Service Level Agreement (SLA)

2. Preparation (The What?)
(i) Data Collection – Structured, unstructured and semi-structured data from N sources.
(ii) Data Selection of heterogeneous data

3. Data Analytics (The How?)
Steps –
(i) Cleansing the data
(ii) Pre-Processing of the data
(iii) Feature Extraction/Selection/Construction
(iv) Use of Prediction Models
(v) Cross Validation

4. Goal Evaluation (Success?)
Interpretation, evaluation and reporting
Have the evaluation/exit criteria been met? If not, return to stage 1, 2 or 3. Great care must be taken to avoid over filtering, over analysis or over refinement here (to prevent a self fulfilling prophecy/hypothesis).

Each of the four stages describes the why, the what, the how and the success (stopping) criteria. There are several techniques for each of the stages, such as discretization or normalization for data cleansing, genetic programming or decision trees for feature construction, etc. As shown in Figure 1; People (Skills), Processes (Algorithms) and Technologies (Systems) are all necessary for big data analytics. The PIPAE methodology does not advocate specific technologies (such as Spark) or processes (ANNs for example), as these need to be selected appropriately, according to the Problem Identified. These decisions do need to be made by the skilled People, and this is acknowledged to be the resource most in demand (and currently in least supply). The lack of skilled people is presently recognized to be the greatest weakness of PIPAE (or any methodology). PIPAE provides guidance as to how to conduct big data analytics and the steps involved. Even if many of these steps are ultimately automated, the most important step of Problem Identification is always likely to require human expertise (People) and this therefore, currently represents a major limitation for PIPAE.

Big Data may become Big Knowledge as a result of the application of analytic techniques. Big Information may not truly exist, because of domain specifics combined with temporal relevance. Big data includes specific domain information and knowledge “reconstituted” as data. For example, data structured, analysed and synthesized into knowledge and information could be “reformed” as big data. Big data is everywhere and “everywhen” because everything (data, information and knowledge) begins with data and data is temporally independent.
Discussion and Conclusions

To summarise, the emergence of the Big Data Science phenomenon is due to the convergence of factors, such as Cloud Computing, the IoT, and the digitization of society and the resulting increasing generation of data worldwide. The issues affecting big data science are ethical and pragmatic. Ethical issues are those of privacy and security, whilst pragmatic issues relate to people, processes and technologies. A major pragmatic issue relates to the skills shortage and the implications for education. Many Data Science programmes appear to be more application (usability) rather than functionality-centric. The opportunities for the exploitation of big data may be unlimited; however, unless the issues are met, they are unlikely to be realised.

The challenges for big data science are to address the question of “if” (ethics), as well as solving the “how” (pragmatics); the “if” should perhaps be done on a case by case basis. The “how” leads to the current big data science requirements:

1. New, more user friendly (usable) processes and technologies need to be developed, and this is only achievable through people with the appropriate skills and training (including functionality).
2. Issues of big data collection, storage and management must also be addressed to make the analytics possible, if the potential of big data is to be realised.
3. Providing people with the necessary skill set. An ideal MSc in Data Science curriculum is suggested.
4. Providing a methodology for Big Data Analytics: the PIPAE (Problem Identification, Preparation, Analytics, Evaluation) systems development methodology is proposed.

As previously stated in Graham (2015): Big data analytics is equivalent to the question of “Life, the Universe and Everything” (Adams, 2009); you may have the answer(s) in the data (“42”), but then you need to work out what the question is (Problem Identification/Why) and if the answer(s) is/are the answer(s) you want (Evaluation/Sucess), and that may prove more difficult!

Another vital consideration is the as yet unforeseen consequences of big data analytics. A conceivable scenario is that one day in the near future, genetic data would be collected at birth and past big data analytics would enable the determination of all inherited medical conditions, intellect, and other attributes, and even the computed date of death of an individual. Such a future is not so far fetched or simple paranoia, and it would be deemed undesirable by many people. Ironically, the justifications for the collection of genetic data may be security and privacy, as a person’s dna is unique and is therefore, the ideal “password” for secure access to private information. This is the ultimate ethical dilemma for big data and the IoT not equating to Big Brother. Information is power. Once the genie is out of the bottle, however, there is no going back, you cannot “un-know” something, and the digitization of society ensures that such things are recorded in perpetuity.
Acknowledgments

Apache Spark, Facebook, Google, Hadoop, Hive, JavaScript, Loom Bands, MATLAB, Python and “R” are trade names. Interesting and informative discussions with Dr. Dominic Heger, which inspired this paper, are gratefully acknowledged.

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Entrepreneurial Intention and Efficacy of Business Graduates in Bangladesh: Do Demographic Factors Matter?

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Abstract

Entrepreneurship is thought to be an effective mechanism to reduce unemployment problem. Researchers reason that both entrepreneurial intention and self-efficacy play important role for an individual to become an entrepreneur. The aims of this study are to determine the intention and efficacy level of business graduates to become an entrepreneur, and to analyze how demographic variables relate to entrepreneurial intention and self-efficacy. This research used a self-administered questionnaire comprising of Entrepreneurial Intention Questionnaire (Liñán and Chen, 2009) and Entrepreneurial Self-efficacy Scale (Chen et al., 1998). Data were collected following a quantitative survey among a diverse group of business graduates (N=173) who are currently pursuing postgraduate degree at 10 different universities in Bangladesh. Several statistical techniques including descriptive analysis and mean comparison were performed in version 20.00 of SPSS software for MAC to analyze data. Results show that business graduates in Bangladesh are quite competent and indicate a higher-medium level of intention to become an entrepreneur. Furthermore, both entrepreneurial intention and self-efficacy significantly relate to demographic factors. Male students and those who are either unemployed or whose family members been entrepreneur exhibit higher intention and self-efficacy to become an entrepreneur. The findings of this study signify significant implications to government and its policy makers. Government can promote entrepreneurship by supporting unemployed business graduates through the financial and policy support, which in turn may positively contribute to country’s economy. his study solely sampled business graduates studying at postgraduate level, who may inherently posses higher level of self-efficacy. One major limitation of this research is believed to be the inability to include business graduates who are not interested in further study. Hence, future research may involve them to unearth their perception to be an entrepreneur.

Keywords: Bangladesh, business graduates, entrepreneur, entrepreneurship, entrepreneurial intention, entrepreneurial self-efficacy
Introduction

Current socio-technical realities like technology innovation and development; mergers and acquisitions; massive competition; decentralization and contemporary global crisis shrunk opportunities for young graduates (Gibb 1996). Entrepreneurship is one of the proven concepts, which is realized as an important device that can deal with unemployment problem and manifest possibilities for young people. It is thought to be at the central to innovation and financial progress. Entrepreneurship contributes to poverty reduction and socio-economic development in many folds (Nawaz 2012). It also enhances living standard, accelerates economic prosperity, and may lead to product and technology invention (Audretsch and Keilbach 2007). Thus the essence of entrepreneurial initiation and improvement is vital for developing countries like Bangladesh.

Study suggests that many factors such as gender and family background greatly influence entrepreneurial intention and self-efficacy (Minnitti 2009; Shin-nar 2012). Females were just found to be half as likely as males to believe them able to become an entrepreneur in the USA (Thébaud 2010), and males are seventy five percent more likely than females to become an entrepreneur in middle-income countries and forty one percent in low-income nations (Minnitti 2009). Wilson et al. (2007) argue that factors including entrepreneurial self-efficacy contribute to the inequality between women and men in entrepreneurial intentions. Women are more apparent than men to eliminate entrepreneurial venture as they lack self-confidence and required skills (Bandura 1992; Chen et al. 1998). In addition to entrepreneurial intention, self-efficacy has appeared as a vital construct that supports start-up and overall business progress, and facilitates entrepreneurial success (Chen et al. 1998; Krueger 2003).

Large number of entrepreneurship research has been carried out in Bangladesh (Akharuddin 2000; Afrin et al. 2008; Begum, 1993; Rahman et al., 2000). Many recent studies significantly highlighted women entrepreneurship though (Jahed, 2011; Nawaz, 2012; Rahmatullah and Zaman, 2014); entrepreneurial intention and efficacy of educated individuals remained under-researched. In this study, the goal is to identify the perception of business graduates to become an entrepreneur. To attain this goal, this research first assessed the level of their entrepreneurial intention and self-efficacy, and then analyzed the disparity of entrepreneurial intention and self-efficacy in relation to gender, family background and employment status. The goals of this study involve the following specific objectives: (i) to determine the level of entrepreneurial intention and entrepreneurial self-efficacy; (ii) to explore the relationship between demographic characteristics and entrepreneurial intention; and (iii) to ascertain the relationship between demographic characteristics and self-efficacy.

Literature Review

Researchers reason entrepreneurship as a process and argue that this process involves identifying and seizing opportunity, and adding value to sustainable business progress (Audretsch and Keilbach 2007). Whilst substantial debates re-
regarding entrepreneur and its type emerged in the literature, researchers often highlight personal qualities and behavioral characteristics of an entrepreneur that facilitate creating competitive advantage (Baron, 2004; Ucbasaran 2001). Entrepreneurs demonstrate unparalleled characteristics and behavior patterns that lead to different entrepreneur types, and comprise different patterns of personal traits, attributes, experience, background and disposition (Carter et al., 1996; Rotefoss and Kolvereid, 2005). Scholars identified entrepreneurial self-efficacy as one of the key personal attributes that emerges to be an essential precursor to new enterprise intentions (Boyd and Vozikis 1994; Linan and Chen, 2009; Zhao et al., 2005).

Entrepreneurial intention is considered to be an important constituent that plays vital role to navigate individuals to start new business (De Noble et al., 1999; Krueger et al. 2000; Liñán and Chen, 2006). Researchers are in different views in shaping entrepreneurial intention model, and argue that entrepreneurial intention can be influenced by many factors like beliefs, values, habits and needs (Bird, 1998; Lee and Wong, 2004). Ajzen developed a model known as theory of planned behavior (TPB) that encompasses some cognitive characteristics such as personal attitudes, perceived social norms and behavioral control (Ajzen 1991). Different studies suggest different measurement disputes to assess entrepreneurial intention. Nonetheless, Liñán and Chen developed an entrepreneurial intention questionnaire following the TPB model consisting of four constructs such as personal attributes, subjective norms, perceived behavioral control and entrepreneurial intention (Liñán and Chen, 2009).

Researchers offered a number of approaches to define entrepreneurial self-efficacy (ESE). The idea of entrepreneurial self-efficacy is originated from the theory of Self-efficacy, where self-efficacy is anticipated to deliver regulatory formula and procedure for a course of successful action (Bandura 1977). Several experts defined entrepreneurial self-efficacy as the task-oriented capability and self-confidence of an entrepreneur (Boyd and Vozikis 1994; Baum et al. 2001). Researchers like Chen et al. (1998) and Segal et al. (2002) described entrepreneurial self-efficacy as the mastery of a person to develop various cognitive and behavioral requirements necessary to negotiate with the internal and external settings.

Numerous approaches of assessing entrepreneurial self-efficacy emerged in the literature. Chen et al. (1998) designed an ESE scale based on five major entrepreneurial skills: marketing, management, innovation, risk-taking and financial control. De Noble et al. (1999) proposed a measure for ESE comprising of six core skills such as opportunity recognition and development, investor relationship management, development of innovative work environment, uncertainty management, realization of core purpose and human resource development. People with higher ESE are realized to be more competent, more likely to instill opportunities into actions and efficient in responding to uncertainties (Chen et al. 1998). Several studies revealed that both entrepreneurial intention and self-efficacy significantly relate to demographic factors like gender and entrepreneurial family background (Boyd and Vozikis 1994; Lee and Wong 2004).
Research Methodology

Sample and Procedure

A self-reported questionnaire was distributed among 250 business graduates who are currently pursuing postgraduate degree in different business disciplines at 10 different universities in Bangladesh. The researchers first purposively chose ten general universities in Dhaka that have major business schools, and then went to MBA lectures at their convenient hours; and finally in each selected university, 15-35 questionnaires were manually distributed among MBA students who attended in those particular classes. The filled-in questionnaires were collected within same hour once the responses were completed. One hundred seventy six graduates returned their complete responses of which 173 were considered usable for statistical analysis. In order to acknowledge the sample sufficiency, Keiser-Meyer-Olkin (KMO) measure of sampling adequacy was experimented that produced a score of 0.851, which suggests this sample to be fairly adequate for statistical examination.

The participants are studying at MBA (Master of Business Administration) level either in day or evening program. One hundred five filled-in questionnaires were received from male. About eighty six percent of the samples are aged between 21 and 25 years. 9% of the respondents fall under the age group 26-30, while just over 5% of them are aged between 31-35 years. One hundred twenty (69.7%) graduates are unemployed and still searching for job opportunities, whereas 38.7% of the participants reported having entrepreneurs in their respective family. Over seventy three percent of the respondents study with the major in management, while 15.6, 8.7 and 2.3 percent samples were from students having major in finance, marketing and accounting, respectively. Profile of the participants is presented in Table 1.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Category</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>105</td>
<td>39.3</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>68</td>
<td>60.7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>173</td>
<td>100</td>
</tr>
<tr>
<td>Age</td>
<td>21 - 25</td>
<td>148</td>
<td>85.6</td>
</tr>
<tr>
<td></td>
<td>26 - 30</td>
<td>16</td>
<td>9.2</td>
</tr>
<tr>
<td></td>
<td>31 - 35</td>
<td>9</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>173</td>
<td>100</td>
</tr>
<tr>
<td>Employment Status</td>
<td>Unemployed</td>
<td>120</td>
<td>69.4</td>
</tr>
<tr>
<td></td>
<td>Employed</td>
<td>53</td>
<td>30.6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>173</td>
<td>100</td>
</tr>
<tr>
<td>Family Entrepreneur</td>
<td>Yes</td>
<td>67</td>
<td>38.7</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>106</td>
<td>61.3</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>173</td>
<td>100</td>
</tr>
<tr>
<td>Study Group</td>
<td>Day MBA</td>
<td>142</td>
<td>82.0</td>
</tr>
<tr>
<td></td>
<td>Evening MBA</td>
<td>31</td>
<td>18.0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>173</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1: Profile of the respondents
Measures and Techniques

Researchers often use Entrepreneurial self-efficacy (ESE) scale as it is considered highly relevant to assess entrepreneurial behavior (Krueger 1993). In this study, we used two different scales such as Entrepreneurial Intention Questionnaire (EIQ) by Linan and Chen (2009), and Entrepreneurial Self-Efficacy (ESE) Scale by Chen et al. (1998) to assess the willingness and ability of business graduates in Bangladesh to become an entrepreneur. EIQ and ESE were believed to have some limitations from both contextual and sample perspectives. As Linan and Chen (2009) argued, all EIQ instruments were positively phrased that may have had some effect on respondents leading to acquiescence bias. Chen et al. (1998) on the other hand experimented the ESE scale using students as their study sample, and thus some constructs like innovation and risk-taking may be more appropriate for the people having real work experiences. Beyond their limitations, these scales were used in a large number of studies and found being consistent and reliable measures (Austin and Nauta 2015; Bullough et al. 2014; Kickul and D’Intino 2006).

The questionnaire consisted of two sections: one section was devised to assess entrepreneurial intention and entrepreneurial self-efficacy following EIQ and ESE scale as indicated above, and another section namely demographic section that was developed to collect general information about the respondents like age, gender, employment status, family income and family background. All items but the demographic ones were completely structured and weighted on a five-point Likert scales ranging from 1-Strongly disagree to 5-Strongly agree. Some of the questions of the original scales were rephrased so as to fit the approach of our research.

20-item EIQ includes four constructs such as personal attributes (e.g. among various options, I would rather be an entrepreneur), subjective norms (e.g. if you decided to create a firm, your close family would approve of that decision), perceived behavioral control (e.g. I am prepared to start a viable firm) and entrepreneurial intention (e.g. I have the firm intention to start a firm some day). Twenty-two item ESE scale involves five sub scales: marketing (e.g. I am able to conduct marketing analysis), innovations (e.g. I am able to develop new product and services), management (e.g. I am able to make strategic planning and develop information system), risk-taking (e.g. I can make decisions under uncertainty and risk) and financial control (e.g. I can perform financial analysis).

We processed data in SPSS (Statistical Package for Social Sciences) software version 20.00 for MAC by using a set of statistical techniques. In particular, percentile and frequency distribution were applied to demonstrate profile of the respondents. Descriptive analysis and compare means were carried out to assess the level of entrepreneurial intention and self-efficacy, and to compare the results between subgroups. Pearson correlation was estimated to investigate relationships among the variables. Besides, reliability of the measures was assessed by the Cronbach’s alpha coefficients.
Results

Analysis of Cronbach’s alpha coefficients produced decent alpha values for the study variables, which closely assimilate to the scores of original studies (Table 2). As shown in Table 2, scores of alpha coefficients of all measures fluctuate between 0.700 and 0.909, which evidenced all measures to be highly reliable for the present research. ESE yields the highest alpha value of 0.909 where risk taking represents the lowest alpha score of 0.700 among all variables. The score of overall EIQ was found to be as high as 0.890, and the four dimensions of EIQ produced alpha values ranging between 0.715 and 0.852. Marketing perceives the highest alpha score of 0.822 among all subscales of ESE.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Mean</th>
<th>S.D</th>
<th>Alpha Coefficient</th>
<th>No. of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Entrepreneurial Intention</strong></td>
<td>3.49</td>
<td>0.55</td>
<td>0.890</td>
<td>20</td>
</tr>
<tr>
<td>Personal Attitudes</td>
<td>3.85</td>
<td>0.72</td>
<td>0.794</td>
<td>5</td>
</tr>
<tr>
<td>Subjective Norms</td>
<td>3.51</td>
<td>0.70</td>
<td>0.729</td>
<td>3</td>
</tr>
<tr>
<td>Perceived Behavioral Control</td>
<td>3.13</td>
<td>0.65</td>
<td>0.715</td>
<td>6</td>
</tr>
<tr>
<td>Entrepreneurial Interest</td>
<td>3.48</td>
<td>0.81</td>
<td>0.852</td>
<td>6</td>
</tr>
<tr>
<td><strong>Entrepreneurial Self-efficacy</strong></td>
<td>3.64</td>
<td>0.50</td>
<td>0.909</td>
<td>22</td>
</tr>
<tr>
<td>Marketing</td>
<td>3.51</td>
<td>0.60</td>
<td>0.822</td>
<td>6</td>
</tr>
<tr>
<td>Innovation</td>
<td>3.65</td>
<td>0.66</td>
<td>0.766</td>
<td>4</td>
</tr>
<tr>
<td>Management</td>
<td>3.78</td>
<td>0.58</td>
<td>0.774</td>
<td>5</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>3.76</td>
<td>0.63</td>
<td>0.700</td>
<td>4</td>
</tr>
<tr>
<td>Financial Control</td>
<td>3.52</td>
<td>0.74</td>
<td>0.742</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 2: Scores of mean, standard deviation and alpha coefficient

Overall mean scores and standard deviation for Entrepreneurial Intention Questionnaire (EIQ) and Entrepreneurial Self-efficacy Scale (ESE) were computed in addition to each dimension of these measures (Table 2). Results suggest a higher-medium mean score of 3.49 for overall EIQ and 3.64 for ESE. Personal attributes were found to be the most influential factor for entrepreneurial intention (M=3.85). Subjective norms (M=3.51) and interest (M=3.48) also influence intention of an individual to become an entrepreneur. Business graduates were found having higher management skills (M=3.78) and risk taking ability (M=3.76) that are the key essentials for entrepreneurial self-efficacy. Innovation (M=3.65) was also realized to be significant where similar level of skills was reported in marketing (M=3.51) and financial control (M=3.52).

In order to determine the perception of various subgroups regarding entrepreneurial intention and self-efficacy, analysis of compare means test was experimented. Results of compare means were exhibited in Fig. 1, Fig. 2, Fig. 3 and Fig. 4. Fig. 1 unveils that male possess a higher mean score (M=3.56) on EIQ in comparison to female (M=3.38). Men also reported greater mean score (M=3.72) for ESE than women (M=3.52). People who have grown up in urban society accounted...
comparatively higher mean scores (M=3.70) for ESE than their rural counterpart (M=3.43) though, no significant difference in mean scores of entrepreneurial intention between graduates grown up in urban (M=3.44) and rural (M=3.46) community was reported.

Fig 1. Mean comparison between genders

Fig 2. Mean comparison between communities

Fig 3. Mean comparison between graduates having family entrepreneurs and no family entrepreneurs

Fig 4. Mean comparison between Employed and unemployed graduates

Fig 5. Mean comparison between major subjects
Fig. 2 signifies that those who have entrepreneur in their family possess significantly greater entrepreneurial intention (M=3.63) and self-efficacy (M=3.75) than those who do not have. Unemployed business alumni though showed a significantly higher intention (M=3.62), employed graduates reported to have slightly better self-efficacy (M=3.69) to become an entrepreneur. Mixed perceptions were derived while analysing in terms of major subjects (Fig. 5). Mean scores of four different major subjects vary between 3.44 (Management) and 3.72 (Marketing) for EIQ, and between 3.62 (Finance) and 3.78 (Accounting) for ESE.

Discussion

The goals of this study involved determination of the perception of business graduates to be an entrepreneur and identification of perceptive gaps between various subgroups. Results of descriptive analysis evidenced MBA students as fairly intended to be an entrepreneur and their level of entrepreneurial self-efficacy was also perceived to be higher. This result is consistent with earlier studies. Study of Duval-Couetil and Long (2015) advocate that many students think that having a MBA could better prepare them to be an entrepreneur. Nonetheless, the level of entrepreneurial intention and self-efficacy vary between subgroups like gender, community, entrepreneurship background, employment status and major subjects.

Researchers argue that personal attributes, subjective norms, perceived behavioral control and entrepreneurial interest greatly influence intention of a person to be an entrepreneur (Linan and Chen 2009). In this study, although business graduates showed comparatively lower control over perceived behavior, we found that their determination level is quite high and goals are clear to become an entrepreneur. Results of prior study though contradict (Paul-Majumder 2006; Rahmatullah and Zaman 2014); this study suggests that people are expecting to get support from their family and friends if they intend to create a firm. Rahmatullah and Zaman(2014) evidenced similar result that indicates women who get support from their spouse are tended to be successful entrepreneurs.

Business graduates reported comparatively greater skills and competencies in management consisting of strategic planning, goal achievement, resource allocation, uncertainty and time management. They were also stated to have higher risk-taking ability. Although educated people have higher skills and competencies to start new business, many large organizations like Grameen Bank and BRAC (Bangladesh Rural Advancement Committee) have been working since early 80s to provide training and financial support mostly to uneducated people in rural areas (Moazzem 2008). Educated people are hardly given the similar support. Many researchers argue that entrepreneurial self-efficacy can be developed through education and training, and therefore may contribute to entrepreneurial intention (Florin et al., 2007; Zhao et al., 2005).

As presented in Fig. 1, male graduates reported higher intention and greater efficacy than female to become an entrepreneur. McCracken et al. (2015) evidenced similar result and argue that educated women are more interested in social enterprise than mainstream entrepreneurship. The study also indicated women having lower skills, less self-confidence and optimism than their men counterpart.
Wilson at al. (2007) found women reporting significantly lower self-efficacy in entrepreneurship than men in MBA programs. Female entrepreneurs face immense challenges to succeed in male-dominated, complex and competitive business and economic setting in Bangladesh (Moazzem 2008). However, prior studies evidenced greater involvement of rural-based less educated women in entrepreneurship (Moazzem 2008; Nawaz 2012). Nawaz (2012) found only 12.5% women entrepreneurs having secondary education and more in her study. Educated entrepreneurs are more likely to have better skills ad competencies to deal with responsibilities (Nawaz 2012); nonetheless, high-return target and empowering experience could be reasons that make them less interested to be an entrepreneur (McCracken et al. 2015).

Although business graduates who have grown up in urban community indicated similar level of entrepreneurial intention, their self-efficacy level was found to be significantly vaster than those who have grown up in rural community. Fig. 3 suggests that those who have entrepreneurs in their family exhibit increased motivation and self-efficacy to be an entrepreneur in future. Several researchers evidenced similar results in which they reason that family background influence an individual’s intention and self-efficacy to become an entrepreneur (Dalton and Holdaway 1989; Dyer 1992; Ullah et al. 2012). Ullah et al. (2012) argue that parental occupation may contribute to increased skills that in consequence facilitate an individual to be an entrepreneur. While unemployed people showed a greater intention to become an entrepreneur, employed persons were reported to be more competent.

In addition, although some similarities between groups were indicated in Fig. 5, differences both in entrepreneurial intention and self-efficacy between these groups can still be a matter of concern. Entrepreneurial intention of students with accounting or finance major was quite higher but parallel. Graduates having marketing as their major demonstrated considerably greater intention whereas those having management major showed significantly lower intention to become an entrepreneur. Students with management, marketing or finance major on the other hand were found having similar competencies while graduates with accounting major showed comparatively higher self-efficacy to be an entrepreneur. This finding is quite unexpected and surprising as management people are predicted to have greater perceived self-efficacy. The results indicate that both entrepreneurial intention and self-efficacy significantly vary between subgroups and are affected by various socio-demographic traits like gender, occupation, community, family background and major area of study.

**Conclusion and Implications**

This study intended to identify the intention of business graduates to be an entrepreneur, and their level of competencies required to facilitate entrepreneurship. Business graduates in general showed quite higher intention and self-efficacy to become an entrepreneur though, graduate women were found to be less interested and capable in entrepreneurship. The perception of participants reflected personal attributes and subjective norms as the two most significant factors that enable
individuals to be an entrepreneur. Business graduates were also reported having higher skills in management, innovation and risk-taking than marketing and financial control.

Results also demonstrated that people who have entrepreneurs in their family exposed having comparatively higher entrepreneurial intention and self-efficacy as expected. Graduates women though indicated less intention and efficacy; this study suggests that increased skills and competencies, and providing enough capitals may motivate women to become an entrepreneur. Another key finding of this study involves indication of unemployed graduates to have greater intention to be an entrepreneur than their employed counterparts. This result bears intense implication for the government and various policy-making organizations as educated people are suffering from tremendous competition and national deficit of jobs. Recent statistics suggest that a total of 244,107 people applied against a mere 1803 vacancies available in different government offices (Bangladesh Public Service Commission 2016).

In addition, banking is one of the largest employment sectors for business graduates in Bangladesh. However, recent recruitments in banks unveil cutthroat competition among job seekers and are likely to intensify in the coming days. For instance, 23886 applicants contested for 43 vacant posts in Bangladesh Development Bank (Bangladesh Development Bank Limited, 2015). Under this scenario, entrepreneurship development is of great importance. This study suggests planned interventions to link the gap found between positive entrepreneurial intention and insufficient job opportunities. These interventions can be done in several directions, for example through financial and policy support or entrepreneurship education. Initiatives and applications of new regulation and funding policies by governmental and non-governmental agencies may benefit the unemployed graduates that in consequence contribute in one hand to reduce unemployment problem and in another hand to boom national economy.

Limitations

The present study is not without its limitations as the study only assimilated business graduates who are currently pursuing postgraduate education, and who are believed to have relatively greater self-efficacy. Therefore one key limitation of this research is supposed to be the inability to incorporate business graduates who are not interested in further study. Future study may involve them to experiment their perception and level of competency to be an entrepreneur. Sample size is considered to be another limitation. A bigger sample might more appropriately demonstrate the perception of graduate students toward entrepreneurship. A third limitation of this study is assumed to be the uneven sample distribution in terms of major subjects as almost three-fourths of the responses were emerged from students having a management major. Future researchers may also include students from other disciplines like social sciences or engineering to examine their attitudes to become an entrepreneur.
References


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