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# A Dynamic Information Generation Approach for HE: IG3 Characteristics

Jeff Barker

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## Summary

This paper proposes the integration of Information Generation 3 (IG3) principles to education systems to advance curriculum and instruction from traditional static designs to build dynamic learning communities and courses in higher education. Dynamic information should stimulate and support methodological flexibility for converging learner-centred and knowledge-centred education environments. This convergence is achieved through a complex mix of connected digital devices and pedagogical methods proven effective by any number of learning theories. Flexibility and diversity are important principles in the IG3 approach to permit the application of multiple scalable digital communication tools, teaching methods and decision-making to advance this new direction. The paper concludes with a proposed list of IG3 characteristics and a model to implement the design of Dynamic Education Systems.

## Introduction

According to THE (2008), much of our approaches to education today lag behind the economy needs, society and the global challenges of the 3<sup>rd</sup> millennium. Those approaches lack interactivity between students and their teachers, and that the education model that is presently dominant is the one that is not working for a lot of young people particularly as we are moving towards the knowledge economy paradigm. According to Siemens (2005), the education field has been *slow to recognize both the impact of new learning tools and the environmental changes in what it means to learn*. Education in general, lags behind industry and business in applying technology (Siviter and Wheeler, 2004). Education has not turned to technology with the same force, enthusiasm or degree as have industry and business (Wellburn, 1996) and, in some cases, has actually resisted its implementation (Hodas, 1993). Meanwhile, increasingly business organisations integrate information through applications such as Enterprise Systems that help integrate and coordinate business processes for more efficient management of resources and services (Laudon and Laudon, 2007). How can education catch up with business and industry in terms of the implementation of agile technology in education? To respond to this question, we begin with an example from business and information systems managers. When an

order is placed online, there is an expectation that the goods will arrive faster. When someone applies for an insurance policy or submits a claim, they expect a quicker decision and more visibility into the process. These expectations require remaking supply and distribution infrastructures. An example of increased business velocity is Dell which achieved time and cost savings through the entire ordering process from customer order, system configuration, manufacturing, testing, shipping and transferring funds from the customer's bank account. IT was used to achieve real-time information sharing and virtual integration with suppliers and strategic partners (Kraemer et al, 1999). Similar examples abound in many other sectors. Law firms have accelerated many aspects of the legal profession merely by leveraging faster delivery and immediate turnaround of documents through e-mail.

Like business and IS managers, educators and administrators in higher education must identify opportunities for improving educational results by accelerating the speed at which certain teaching and learning management processes are executed and evaluated in the institution. University programs must be redesigned for the era of dynamic information because, unfortunately, most current university programs do not adequately prepare students as global graduates for this new volatile and dynamic era the world is now moving toward. The programs were designed in and for the pre-dynamic information era. It is imperative that university programs are based on and designed for this new era of information and communication technology (Barker, 2006). The *Dynamicity* dimension is an essential component for today's education systems to cope with continuous changes in information, communication, technology, business and different types of learners (Sabry and Barker, 2009), similar to the *Living System* paradigm and the *Gardening analogy* described by Ray Paul(1993), where the ability for trimming, making alterations, and continuous maintenance are essential.

This paper presents an argument and conversation about rethinking the design of education management, learning, and instruction from the viewpoints encapsulated in IG3 and the implications for education reform in higher education. We believe that dynamic information will invigorate IT integration in higher education and related courses. The paper represents an initial effort to develop a theoretical and conceptual framework to support the argument for the use of dynamic information and connected devices to support a dynamic learning community in higher education to initially teacher-controlled or pre-designed instructional systems. What are some information generation issues that emerge in decision-making, teaching, and learning in education and especially higher education? We propose that dynamic learning communities supported by dynamic information and connected devices constitute an important alternative to specifically designed instructional systems, and that communication technologies can serve to support learning communities in their efforts to incorporate social-cultural, cognitive and communication learning theories, especially in ill-defined content or

knowledge domains where content is constantly changing. The paper lists educational IG3 principles and provides a model to highlight those principles and to close gaps between knowledge, skills, and information by allowing the learner to assimilate information into a coherent whole and to improve learning outcomes (National Research Council, 2000, p. 138).

## Background

The term 'Information Generation' (IG) described in this paper refers to the availability and general distribution of non-verbal information. We refer to IG1 as the information era from rock drawings and hieroglyphics to hand-written scrolls and manuscripts, IG2 as the era from the printing press (Static Information), IG3 (the current era) from the introduction of the WWW, and IGx the future information generations. The term 'Dynamic Information' described in this paper refers to the information that is updated instantly as soon as changes occur and is available to those who need it at the time and in the form and relevance in which it is needed. Both the IG1 and IG2 refer to the pre-dynamic information era. As we have progressed to IG3, the amount of information has become greater, access is much faster, the information has become global, the information is more accessible, different search parameters can be used, dynamic information is replacing static information and ICT increasingly provides the 'electronic nervous system' for many organizations through the increasing use of cloud computing and mobile technologies such as 'smart' phones, data-capture technologies such as Radio Frequency Identification (RFID) and internet usage.

According to some statistics, the world usage of the internet increased approx 245% between 2000 and 2007 (IWS 2007). Statistics show that the number of internet devices reached 600 million in 2006 compared with 1 million in 1992. Many of today's college majors did not exist 10 years ago (eg new media, e-business, nanotechnology, etc); 21-years-olds usually have sent/received 250,000 e-mails or text messages; more than 50% of US 21-years olds have created contents on the web and more than 70% of US 4-years-old have used a computer; computers took only 4 years to reach a market audience of 50 million compared with the TV (13 years) and Radio (38 years); the amount of technical information is doubling every 2 years and in 2010 is predicted to double every 72 hours; and 3<sup>rd</sup> generation fiber optics have recently been tested that push 10 trillion bits per second down a fiber (equal to approx 1,900 CDs or 150 million simultaneous phone calls every second), meaning that marginal cost of those improvements is effectively zero (Glumbert, 2008). Further, increasingly accessing the internet for information is on the increase (see table 1), 88% of adults who have accessed the internet in the UK have used the internet for finding information about goods and services, 85% for sending/receiving emails, 65% for services related to travel and accommodation, 35% looking for information about education, training or courses and 35% consulting the Internet with the purpose of learning (ONS, 2007).

Percentage %	Male	Female	BOTH
Finding information about goods or services	88	84	86
Sending/receiving emails	85	85	85
Using services related to travel and accommodation	65	61	63
Obtaining information from public authorities' web sites	47	43	46
Looking for information about education, training or courses	35	38	36
Playing or downloading games, images, films or music	41	29	35
Consulting the Internet with the purpose of learning	35	31	33
Other communication (use of chat sites, messenger, etc.)	29	26	28
Looking for a job or sending a job application	21	21	21
Telephoning over the Internet/video conferencing	16	8	12
Doing an online course (in any subject)	6	7	6

**Table 1** *Internet activities (adapted from ONS, 2007)*

However, currently, a large gap exists between the information available and the use of that information (Barker 2005; Barker 2007; Barker and Finnie, 2004). Most current systems (in government, law, finance, economics, business, management, manufacturing, etc) were designed in the earlier information generation (IG2) for that information generation. Most decision makers were brought up in IG2 and make decisions based on IG2, not IG3. Very few systems have been designed for IG3. This means more than just applying IG3 techniques to IG2 systems. For example, despite the fact that the GSE (General Secondary Education) has been generally designed to prepare students for HE (Higher Education), most students do not get to HE (UNESCO, 2005a). According to the EFA Global Monitoring Report 2005 UNESCO, significant numbers of primary school graduates do not make it to secondary education and more significantly, very high numbers of secondary school graduates do not make it to HE (table 2).

	<b>SECONDARY EDUCATION</b> Gross Enrolment Ratio %	<b>TERTIARY EDUCATION</b> Gross Enrolment Ratio %
<b>DEVELOPED COUNTRIES</b>	105.9	54.6
<b>DEVELOPING COUNTRIES</b>	56.6	11.3

Table 2- Gross Enrolment Ratio (Adapted from UNESCO, 2005a)

According to Research conducted under the UNESCO Program, high number of school students were poorly prepared for colleges and universities and lacked important skills to compete in the labour market (UNESCO, 2005b). The research argued that there was a lack of congruency between the 'products' of the education system and labour market needs and consequently, there was a lack of guidance given to students in terms of making decisions and choices. A clear mismatch is evident between the *supply* [outcome products of schools and universities] and the *demand* [private sector needs] (The National, 2008). Clearly, information is of paramount importance for decision making. For example, sensible decisions cannot be made without information or made with old out-of-date information. The most up-to-date information (dynamic information), typically provided by an information system, must be used. There are two perspectives for the relationship between IG3 and education: educate *for* IG3 and educate *in* IG3. Educating *for* IG3 will be required at all levels of education, from the primary level to university. This will include developing skills and literacy in digital age literacy [informational, technological, cultural, global, functional and scientific literacy], inventive thinking [adaptability, curiosity, creativity and risk taking], higher order thinking [creative problem solving and logical thinking], and effective communication [collaboration, interpersonal skills, team work, personal and social responsibility, interactive communication and high productivity] (EnGuage 2004).

On the other hand, for education *in* IG3, ICT greatly facilitate the acquisition and absorption of knowledge, offering unprecedented opportunities to enhance educational systems all over the world, reducing any sense of isolation, and opening access to knowledge in different ways (Blurton 1999). Education *in* IG3 is therefore for all (classical or modern, formal and non-formal, urban and non-urban, ethnic minorities, handicapped or disabled, girls or women, young or elderly) at any location anytime with a more flexible pedagogy. It seeks more variations of different activities, collaboration, creativity (Table 3), integration (between theory and practice & between different subjects and disciplines) and evaluative learning (towards a more diagnostic approach rather than summative & student directed rather than teacher-directed) from teacher-focused to learner focused (Thijs *et al.* 2001).

Aspect	Less (‘traditional pedagogy’)	More (‘emerging pedagogy’ for the information society)
Active	<ul style="list-style-type: none"> <li>• Activities prescribed by teacher</li> <li>• Whole class instruction</li> <li>• Little variation in activities</li> <li>• Pace determined by the programme</li> </ul>	<ul style="list-style-type: none"> <li>• Activities determined by learners</li> <li>• Small groups</li> <li>• Many different activities</li> <li>• Pace determined by learners</li> </ul>
Collaborative	<ul style="list-style-type: none"> <li>• Individual</li> <li>• Homogenous groups</li> <li>• Everyone for him/herself</li> </ul>	<ul style="list-style-type: none"> <li>• Working in teams</li> <li>• Heterogeneous groups</li> <li>• Supporting each other</li> </ul>
Creative	<ul style="list-style-type: none"> <li>• Reproductive learning</li> <li>• Apply known solutions to problems</li> </ul>	<ul style="list-style-type: none"> <li>• Productive learning</li> <li>• Find new solutions to problems</li> </ul>
Integrative	<ul style="list-style-type: none"> <li>• No link between theory and practice</li> <li>• Separate subjects</li> <li>• Discipline-based</li> <li>• Individual teachers</li> </ul>	<ul style="list-style-type: none"> <li>• Integrating theory and practice</li> <li>• Relations between subjects</li> <li>• Thematic</li> <li>• Teams of teachers</li> </ul>
Evaluative	<ul style="list-style-type: none"> <li>• Teacher-directed</li> <li>• Summative</li> </ul>	<ul style="list-style-type: none"> <li>• Student-directed</li> <li>• Diagnostic</li> </ul>

**Table 3** New Pedagogy (Source: Thijs *et al.*, 2001)

This will require some changes and improvements to education quality toward increasing learner’s motivation and involvement, facilitation of the acquisition of basic skills and enhancement of educators training (Haddad and Jurich 2002). Moving education to IG3 will require changes to:

- the role of teachers,
- education process and progress (non-median),
- customization of text books from static to dynamic,
- redefining the conduct a teaching class,
- assessment methods to include dynamic assessment and possibly “group” assessment,
- distant education.

## IG3 Dynamic Learning

Eisenberg and Berkowitz’s Big Six (Eisenberg, 2007) emerged as central ideas to consider in the attempt to create dynamic learning communities (environments or courses). Principles of cognitivism, behaviorism, instructivism, and constructivism all converge in dynamic learning environments. Research shows the Big6 problem-solving strategy is the most proven, widely-known and widely-used approach to teaching information and technology skills in the world, which consists of six main stages (Eisenberg, 2007):

- Task Definition,
- Information Seeking Strategies,
- Location and Access [sources of information],

- Use of Information [engagement],
- Synthesis [organisation and presentation],
- Evaluation [effectiveness and efficiency].

The Big6 is an information and technology literacy model and curriculum that is appropriate for K through higher education instructional design (see for example: Eisenberg, 2007; Murray, 2008; Jansen, 2007; Stewart, 2004). Although this framework has focused on skill development, the process is highly appropriate and supports learning designs that involve the use of dynamic information to foster an integrated understanding of content. For example, the process allows for social and cultural methods of learning occurring through naturalistic interaction in authentic project-based learning rather than through contrived experiences. Of course, the use of various methods belonging to different places in the design phase is highly dependent upon the particular teaching situation and especially the learners' state of orientation in a new content area. The learning landscape involves the separation of information context (ontology) from epistemology or patterns of knowledge development with the ability to dynamically modify the learning process with dynamic device interfacing. Connected digital devices enable shared support and reconfirmation that reflects the ideas of Cognitive Flexibility Theory and others (Johnson, 2002). Two cognitive science theorists, **Spiro & Jehng (1990, p. 165)** state: "By cognitive flexibility, we mean the ability to spontaneously restructure one's knowledge, in many ways, in adaptive response to radically changing situational demands".

The education process is a dynamic process in its nature. It *must act as an agent of change, in equipping teachers and students alike* (Bateman, 2006). Enactivism, a learning and knowing theory that is concerned with *knowing in action*, can be explained as, *the way a living system comes to know about the medium it is in is through interaction with that medium. This implies that the system's knowledge of its world depends not only on the medium, but also on the actions the system is capable of* (Reid, nd). This approach of learning and knowing is described by Begg (2002, p4) as a *complex, emergent process by which dynamic agents maintain fitness with one another and within dynamic contexts*.

The ecological model by Frielick (2004) reflects an ecological approach for e-learning that integrate several learning and teaching interaction principles including enactivism. The model highlights the complexity of interrelationships between different components (Figure 1). It integrates several learning and teaching theories including:

- phenomenography,
- the relational perspective of Ramsden,
- the systems / constructive alignment approach of Biggs,

- Batesonian epistemology,
- enactivism (Frielick, 2004).

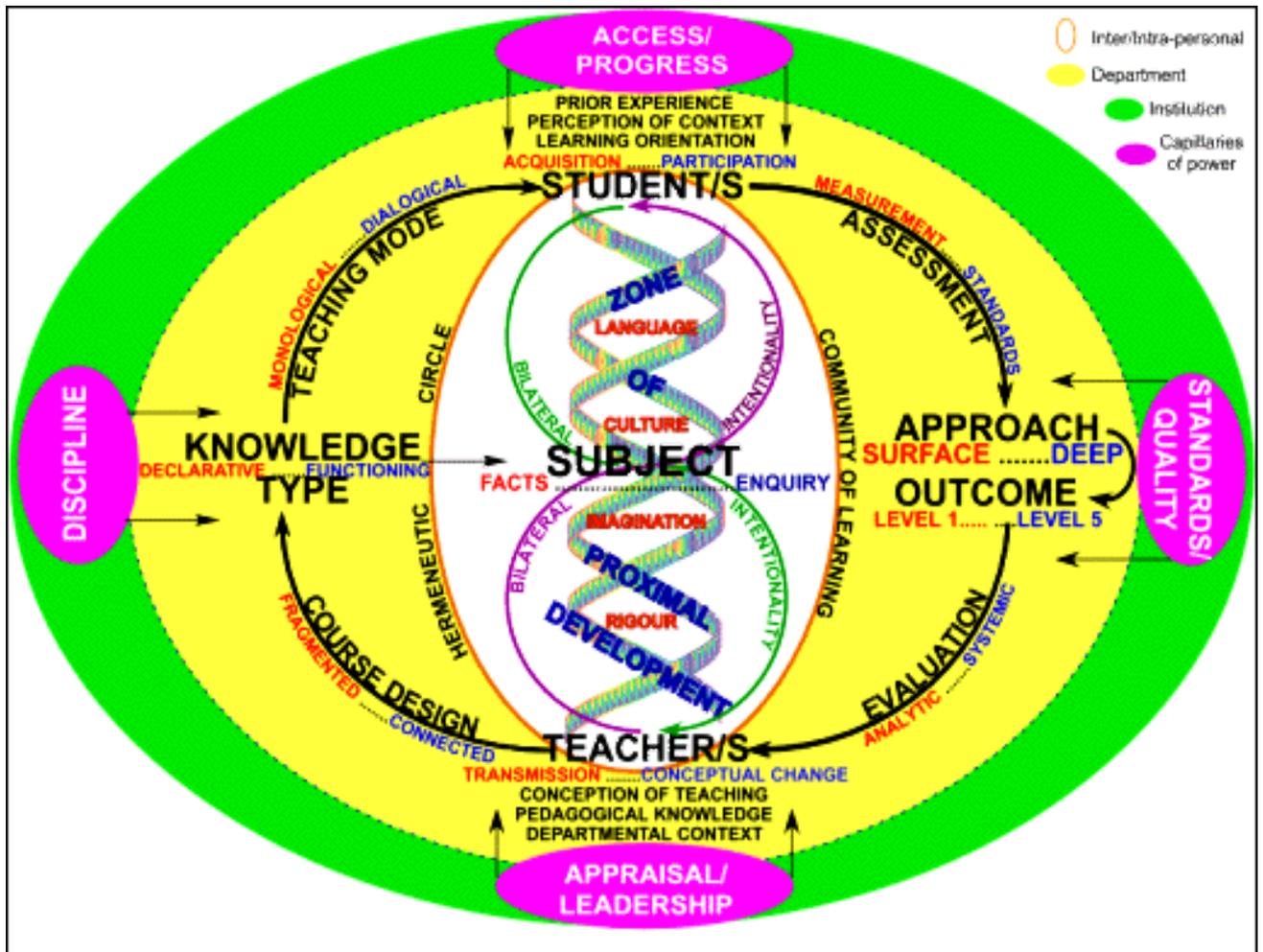


Figure 1 Ecological model of learning/teaching (Source: Frielick 2004)

McCalla (2004) argued that e-learning systems could be ecological through *continuously be adapting as the e-learning system's understanding of its external environment changes and as the external environment itself changes. The external environment includes learners, teachers, the subject matter being learned, and the technology that implements the e-learning system. The adaptation includes the possibility of modifications to the objects in the e-learning system, the possible deletion of some objects, and/or the addition of new objects. Over time, then, the e-learning system slowly evolves, fine tuning itself to its environment and keeping abreast of change in that environment.* The ecological approaches (McCalla, 2004; Frielick, 2004) described above highlighted factors related to learning

interactions, complexity, adaptability and ability to change that are relevant and supportive to dynamic learning designs that involve different learning interactions to foster an integrated understanding of content, relevance and adaptation to learners' needs.

Siemens (2005) proposed the connectivism learning theory for the digital age. The theory integrates several learning theories and is more concerned with:

- new information that is continually growing, evolving and being acquired;
- its relevance, importance and changing nature.

It is also concerned with knowledge management activities and the smoothness of Information flow within an organization. Siemens emphasise the importance of 'access' to required knowledge rather than what the learner currently knows. He argues that Connectivism presents a learning model that recognises the *tectonic shifts in society where learning is no longer an internal, individualistic activity* and that *how people work and function is altered when new tools are utilized*. Among the Connectivism principles listed by Siemens (2005) are:

- *Capacity to know more is more critical than what is currently known.*
- *Ability to see connections between fields, ideas, and concepts is a core skill.*
- *Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.*
- *Decision-making is itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality.*
- *While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.*

Siemens' Connectivism principles are concerned with some elements of dynamic learning principles as well as dynamic educational management principles. It looks at both dynamic learning as well as the decision making process, which is discussed in more detail in the next section. Sabry and Barker (2009) proposed the Dynamic Interactive Learning System model (DILS). The DILS model constitutes elements of both dynamic learning and dynamic education management. The model emphasises the *dynamic feedback and adjustment mechanism* principles that are generally ignored by most learning systems (Figure 2). The DILS also highlighted the importance of the *balancing principle through the interaction and coordination between the different components of the model based on up-to-date and dynamic information including course material, relevant technology, pedagogy and learners' actual profile in order to both accommodate students' differences and develop skills required in a relevant and balanced manner*.

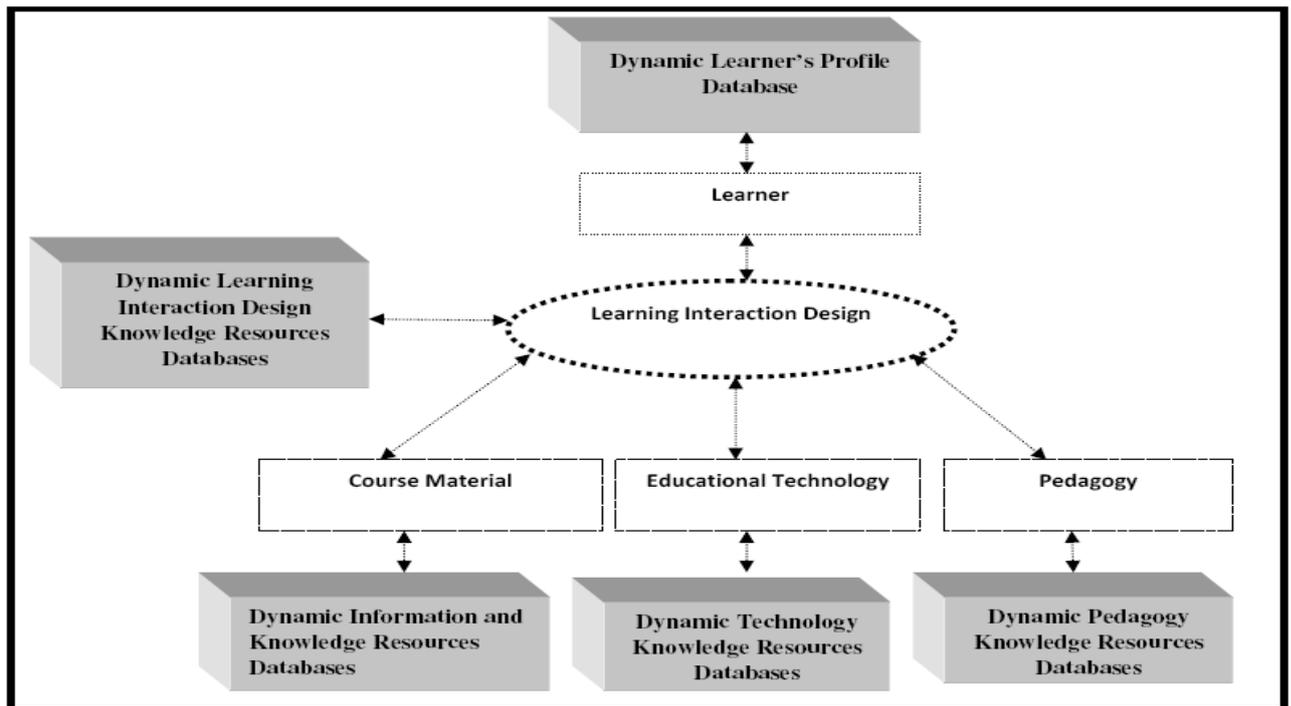


Figure 2 The DILS Model (source: Sabry and Barker, 2009)

One can ask the question: What is the purpose then of dynamic information in education? To respond to this question, we begin with listing the basic and obvious:

- informing the global learning environments (School, community, home)
- inform Instructional design,
- inform Instructional practice and assessment,
- inform education Infrastructure and
- possibly *everything* that relates to education.

As learners become more mobile, learning technologies can enable and engage dispersed groups and encourages interaction through content scaled to mobile devices (West, 2007). However, in the current educational environment, decision-making and leaning in higher education are often fragmented. Further, a large gap exists between the information available in higher education and the use of that information for critical decision-making about student learning, university operations, teacher training, teacher competence, evaluation and assessment, and community networks.

What role could dynamic information play in designing, implementing, maintaining, and sustaining dynamic learning communities and decision-making? How does learning by design using IG3 differ from or inform traditional instructional design? Is there a necessary synergy between connected digital devices, dynamic information, and instructional design to create dynamic learning environments? Consider for example the implications of a (network-based) software agent that exhibits some form of artificial intelligence that can assist the users (teachers, students, administrators, staff) and act on their behalf, in performing repetitive or educational computer-related tasks anytime/anywhere. Such example might include: Dynamic Computer-Managed Instruction and communities of learning/learners vs. Static and drill and skill software in isolated learning settings of IG1 and IG2 periods. What would other such applications (products) look like and how would they function to improve learning and decision-making in higher education?

Further, education systems should have interactivity properties, which are considered as reciprocal activities (Evans, 2004) or a three way process (Evans and Sabry, 2003) that allow users to perform different actions or tasks such as solving problems, knowledge creation, collaboration and engagement (Reeves, 1999). The model of education should be more responsive to reflect the world which we are living in, learners' changing needs, the knowledge economy, encourage and promote interactivity through establishing learning communities that in turn give a sense of belonging and develop confidence and engagement (THE, 2008). A single learning theory does not solely provide a "best theory" for designing effective learning environments, particularly for IG3. A combination of different theories are essential to accommodate different needs taking into account different agile technologies, changing work environment, and learners' different and changing needs.

## **IG3 Dynamic Education Management**

Stead et al (2000) identified three generations of information systems based projects. First-generation projects were concerned with *creating* a database and using it for multiple purposes. Second-generation projects went further towards *integration* of information from various sources together through enterprise information architecture. Third-generation projects go further towards *inter-relationship* of disparate but accessible information sources to establish associations and links to provide the appearance of integration. The third-generation projects went further than just integration to inter-relationship, by relating and linking data, information and knowledge resources external to the enterprise system to the internal data and work processes. The 3<sup>rd</sup> Generation projects hold many characteristics of IG3 in terms of integration, inter-relationship, and integration and linking of internal and external processes and data, information and knowledge.

Another categorisation was that the modern computer industry progressed through three main eras: the mainframe era (back office automation), the client/server era (departmental automation), and the current era (the network or web era). No change was more dramatic than the advent of the Internet, which itself can be viewed in three distinct phases (IBM, 2002), Access, Integration and e-business in demand.

Phase 1, Access, is defined as an initial stage of exploiting the web through some limited facilities such as getting web access to some resources for customers. Similarly, in education this might involve limited activities such as uploading lecture notes on line, academic calendar, notice board, etc.

Phase 2, the Enterprise Integration, is defined as the integration of business processes and internal systems, resulting in more business transactions and more utilisation of information and knowledge. Similarly in education, this should involve integration of internal processes, more efficient access and use of information through possible Web-based learning environments and education management systems, etc.

Phase 3, eBusiness on demand, is defined as effective and efficient adaptability to changes, a stage described as how efficiently a business can respond and adapt its structures and processes in response to changes that occur. IBM has identified four main characteristics of an on demand e-business:

- *Responsiveness*, dynamic capability of recognising and sensing changes in the environment and responding to them.
- *Variability*, flexibility and adaptability to different levels of changes.
- *Focused*, on core competencies and tasks.
- *Resilience*, work under pressure 24-hour-a-day operations, 7 days a week in a global environment, prepared for the unknown.

On demand e-business enables leaders and managers to manage their business as an *integrated whole*. However, as described by IBM (2002), the migration to e-business on demand will not occur overnight but over a reasonable period of time.

According to IBM (2002), about  $\frac{3}{4}$  of the companies in the G7 countries are already in the *Access* phase of e-business. More than a  $\frac{1}{4}$  of all large firms (comprising 1000+ employees) and over  $\frac{1}{2}$  of the world's largest companies are getting into the adoption of the *Integration* phase of e-business adoption, building seamlessly integrated end-to-end business processes that will allow a wider range of different and new interactions that will result in a *networked world*.

Similar to IBM's notion of *eBusiness on demand*, Dynamic Education Management (DEM) is at the heart of the IG3 paradigm. It refers to the integration of different education processes, both

pedagogical and administrative with key stakeholders including education suppliers (universities, colleges), knowledge resources, industry and market needs, teachers and users (learners). The evolution towards D-Education on demand may occur in roughly three stages (similar to ebusiness): Access, Enterprise Integration, and e-Business on demand. There is also a need to ensure that the outputs of different education processes appropriately fit into inputs of others and to establish a global way of thinking that is proactive in its nature rather than reactive to deal with continuous changes and volatile environments, as well as establishing systems that would consider and assist all stakeholders in making decisions that will eventually have implications on the effectiveness and efficiency of the education system as a whole including students' future, families' well being and the nation as a whole whether positively or negatively dependent on the quality of data, information, statistics, predictions and knowledge provided (Abdelhakim and Sabry, 2009).

Digital information generation is available in education and offers the potential to support dynamic learning and critical decision-making in higher education. Three things must happen for education in IG3:

1. Institutions of higher education (IHE) must redesign K-16+ education programs for IG3.
2. University programs must develop strategies to use dynamic information to make curriculum, instruction, and environmental changes to adequately prepare students as global graduates.
3. Graduates must be prepared for a new volatile and dynamic information era that is now reshaping the world's perspective on its social-cultural, and economic needs.

Further, the lack of integration between the technologies that support *E-Learning Administration* and the technologies that support *E-Learning Educational Practices* needs to be addressed (Siviter and Wheeler, 2004). Converging IG3 and **Networked-based Communication Theory** to support dynamic learning environments is grounded in socio-cognitive science and cognitive flexibility theory. Two approaches to designing learning environments are relevant in this discussion:

- Traditional Instructional Design and Dynamic Information Generation. The Traditional Instructional Design is useful to instructional design when creating programs, courses or learning communities when content is stable over time, well-defined, heavy with representation demands and valued based on the mastery of discrete knowledge.
- Dynamic Information Generation Environments on the other hand are appropriate when content is volatile, changing or new, ill-defined, best for complex problems, heavy with literacy and meta-cognitive demands and community-directed where situated support for learning is valued. Examples are Wikis, Blogs, Moodle, interactive database networks, Rapid e-learning system development methodologies, etc.

Based on different elements including: IBM’s E-business on demand and network principles (IBM, 2002), Stead’s inter-relationship principle (Stead et al, 2000), the Big6 dynamic learning communities (Eisenberg, 2007), connectivism learning theory (Siemens, 2005), ecological approaches (McCalla, 2004; Frielick, 2004), interactivity principles ( Evans, 2004) (Evans and Sabry, 2003), dynamic feedback, adjustment mechanism and balancing principles (Sabry and Barker, 2009), and integration between administrative and learning technologies (Siviter and Wheeler, 2004), the proposed list of IG3 characteristics is:

1. **Use of Internet and Agile technologies**
2. **Allow innovations and creativity.**
3. **Design with openness and scalability**
4. **Must be interactive , adaptable, adaptive & accommodating to different needs**
5. **Integrate processes and components and establish inter-relationships**
6. **Cater for workforce diversity and needs**
7. **Allow flexibility of educational methodologies**
8. **Manage Knowledge and allow real-time access & sharing**
9. **Allow easy and speedy access to diverse resources**
10. **Accommodate different types of learning and training**

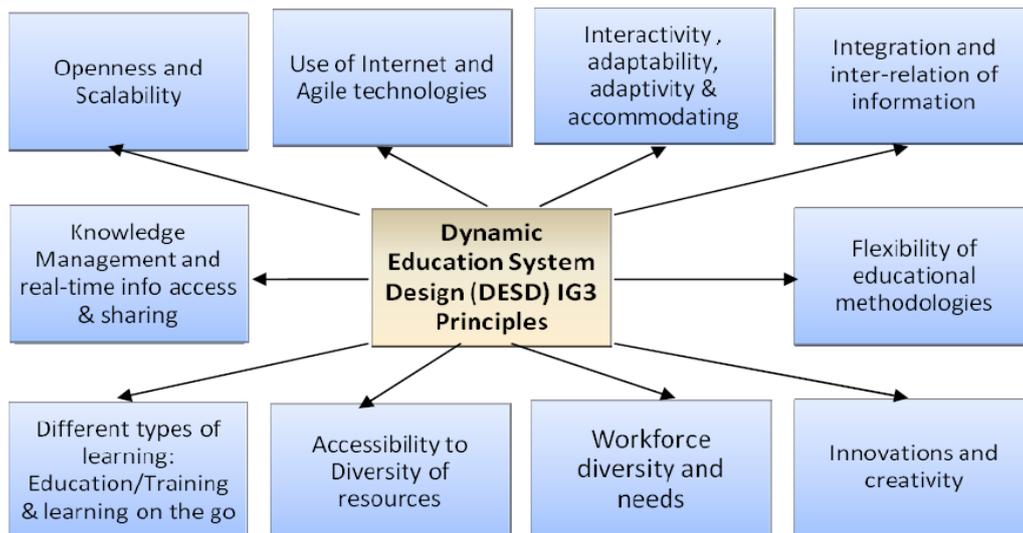


Figure 3 Dynamic Education System Design (DESD) IG3 Principles

The DESD model consists of the following 7 main components.

**Knowledge sought** is a component that represents course specific content, related and relevant knowledge.

**Learner** is a component that represents knowledge about the learner including for example learner's profile, last education level attained, learning style, etc.

**Educational Technology** is a component that represents available learning technologies suitable for different subjects, different types of learners, different teaching and learning methods, etc.

**Pedagogy & Curriculum** is a component that represents variety of teaching and learning methods suitable for different tasks, learner's needs, contexts, culture, etc.

**Work/Industry needs** is a component that represents industry and business needs including specialised and general skills, qualifications, statistics of skills required/ shortage, future predictions of work force needed, etc.

**Interested Parties/ Policy makers** is a component that represents different stakeholders and interested parties in the outcome of education strategies including students, parents, educators, business managers, government officials, etc.

**The DESD (The Maestro component)** DESD component guarantees that all components comply with the above IG3 principles including dynamicity, integration, responsiveness, interactivity, feedback, adjusting/ balancing mechanisms, connectiveness, access to real time knowledge and up-to-date research, etc.



Figure 4 Dynamic Education System Design Model (DESD)

In the case of higher education, faculty members stand to benefit as much as students from the interaction and sharing of knowledge using the DES. Most faculty members do not typically return to school for more degrees. They rely on professional interactions--including stimulus from students--as a key resource for new learning. In IG3 everyone is a learner. In practice, professors and staff can use third generation or IG3 to:

**Create a Virtual Internet Campus.**

- Make the most sought after courses available to students anywhere in the Internet world.
- Create courses in multiple languages for out of the country and ESL/Arabic students in the country.
- Accommodate different learning styles and include multimedia as necessary

**Create Content**

- Create content with their own office applications and maintain the knowledge base without programming
- Keep updating mechanism for content including the addition of new theory, practices, case studies, etc.
- Control course access and testing using Digital Signatures to authenticate students.
- Provide students with practice tests and tutorials with instant feedback to subject matter for missed questions.

**Conduct Assessment**

- Assess student progress and competency via more frequent, detailed, automatically graded testing and documented records of assignment completion.
- Import existing course content from any source.
- Easily incorporate existing multi-media content into current or new course modules.

**Generate Knowledge**

- Establishing active links to up-to-date and real time data, information, and knowledge as well as latest research and findings, and consequently creating new knowledge and building pools of knowledge repositories for speedy and easy access.
- React immediately to new instructional demands.

- Provide students with multiple modes of interaction with professor without overwhelming the professor.

### **Empower the student to select content delivery in various learning modes**

- traditional face-to-face
- content management systems (Moodle, Blackboard, etc)
- e-mail/independent study/computer learning systems
- videoconferencing/video teaching
- a combination of the above

## **Conclusion and Future work**

This paper presented a point of view regarding what characterizes the dynamic information education system to meet educators and learners expectations and to translate into an effective agile learning solution, and what educational institutions must do next to transition to an agile education model.

It is essential to establish a way of thinking that is global in nature, proactive rather than reactive, that deals with fragilities, continuous changes, demand and need, based on process integration, dynamic and interactive knowledge and information. It is essential to establish systems that would give all stakeholders more insight to make more effective decisions that are expected to eventually shape the future of education including the students, families and the nation as a whole whether positively or negatively. The paper highlighted important phenomenon for any dynamic education system. These are but not limited to Speed, Availability, On-demand, Real-time, Scalability, Flexibility, Relativity, Quality, Validity, Integration, Interrelation between different resources (internal, external, administrative, learning), Networked, Pro-activity, Interactivity and Accessibility from anywhere, at anytime to dynamic information. The paper constituted initial ideas and thoughts as an initial effort and preliminary work and preparation for a broader research in Dynamic Education Systems development. It highlighted many questions that need answers.

Shortly, cloud computing (McFedries, 2008; National Academy of Sciences, 2008), an important component of IG3, will be implemented to a realistic degree so its technical implications for educational delivery, will need to be researched as will the potential implementation of student portfolios which will follow students through all levels of their education.

Future work will also include the following framework:

Stage I. fully develop the argument/thesis in this paper we will gather more examples or case reports from the literature concerning specific learning communities, the use of dynamic information, connected devices, and social-cultural/cognitive, communication learning theories.

Stage II. Develop a small pilot to study the argument and develop case studies that can be used to gain funding and support for larger study.

Stage III. Write a grant proposal for widespread implementation, evaluation and assessment of the proposed approach to Dynamic Learning and Information Communities

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