CHAPTER 1

EMPOWERING LEARNERS IN THE VIRTUAL UNIVERSITY

An Introduction to the IQ FORM Project and its Theoretical Framework
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The Virtual University as a Learning Space

The Virtual University means a space in which university studies are provided to students using the newest communication and information technology. Studies can be organised entirely in technology-based environments (for example, through computers and digital TV) or they may include a combination of contact hours and various distance learning methods. The capacity and speed of technical environments make it easy to combine different technological tools with different sources of information, such as texts, pictures, simulations and voices. Steve Ryan and his co-writers (2000, 2) define a Virtual University to include the following two types:

“Virtual Education Institution may be defined as:

A. an institution which is involved as a direct provider of learning opportunities to students and is using information and communication technologies to deliver its programmes and courses and provide tuition support. Such institutions are also likely to use information and communication technologies for other core activities such as:

• administration (e.g., marketing, registration, student records, and fee payments);
• materials development, production, and distribution;
• delivery and tuition; and
• career counselling, advising, prior learning assessment, and examinations.

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B. an organisation that has been created through alliances/partnerships to facilitate teaching and learning to occur without itself being involved as a direct provider of instruction. Examples of such organisations would be the Open Learning Agency of Australia, the emerging Western Governors University in the United States, and the National Technological University (in Canada - the author's addition).”

This article is a description of the theoretical basis for an adaptive and interactive assessment and tutoring system, the IQ FORM, in the Finnish Virtual University. The Consortium of the Finnish Virtual University (FVU) was established at the end of the year 2000. The Consortium has some aspects of both types of virtual education institution as defined above by Ryan et al. The Finnish Virtual University is an alliance of all the universities in Finland that will create channels to deliver courses and other study options in different universities. The portal of the FVU combines and makes available the supply of the partner universities to students, who may select individual courses or larger combinations. They may also connect conventional campus-based studies and FVU studies with each other. The FVU does not serve as a direct provider of courses. However, it has certain meta-level tutoring services, of which the IQ FORM project focuses on increasing students' awareness of themselves as learners and improving their management of the learning process.

The IQ FORM – A Technology-based, Interactive Assessment and Tutoring Tool

The IQ FORM is a co-operative project with researchers in education, psychology, computer science, information and communication sciences, and media culture. The project was started in late 2000. The aim of the project is to create a technology-based, interactive assessment and tutoring tool, which helps students to become active learners in virtual learning environments. The name “IQ FORM” refers to the technological solution of an “Intelligent Questionnaire platFORM.” This is an intelligent system of computing which allows interactive relationships on-line between a user and a technological environment. The IQ FORM questionnaires work as a databank which provides users with interactive information about themselves as learners. The tutoring set, which is based on the same theoretical frameworks as the questionnaires, guides students towards self-regulation and collaboration, encouraging them to reflect on their own
learning and offering information about how to acquire effective learning skills.

The main goals of the project are:

- to identify different learners' needs in virtual learning environments,
- to create a flexible tool for data collection from large numbers of students,
- to use a Bayesian technique to model data about different students' learning profiles and needs in open learning contexts,
- to develop new tutoring methods and support to learners to become more empowered through self-awareness, self-regulation and collaboration in virtual environments, and
- to use the new data collection techniques to develop learning materials for virtual learning environments.

In the initial stage of the project, interactive questionnaires have been constructed for identification of learners' strengths, weaknesses and motivational strategies. The theoretical basis of the interactive questionnaires is H. Gardner's multiple intelligence (MI) and P.R. Pintrich's motivational theories. The IQ research group (2001a; 2001b) has created a psychometric MI test for students' self evaluation. The test is based on P. Ruohotie's APL (abilities for professional growth) questionnaire (2000a) that has been widely applied to the research work measuring polytechnics students' self-regulation. The data is gathered by the computerized questionnaires (Figure 1).
Figure 1. The IQ FORM Questionnaire Screen.

Students' individual profiles, as well as group profiles are displayed visually and as statistical parameters (Figure 2).

Figure 2. The IQ FORM Visualization Screen.
The first version of the IQ FORM consists of three sub-tools:

1. A test bank with four question sets for students' self-evaluation
   - Students strengths profiles
   - Motivational components: forethought, cognitive strategies, and learning skills
2. Tutoring sets with hypertext structure for each sub component of the tests
   - Tutoring sets for students
   - Additional guidelines for teachers
3. A learning diary for learners' self-reflection about their experiences and storage of their own and the learning group's earlier test profiles.

After completing the questionnaires, the students receive their personal profiles on line. They are also provided with statistics about the results of the group in the same virtual course. The tutor has access to the group profiles and to an individual student’s profile, but only if this access is granted by the student. Test results, illustrated with graphics, offer optional links to relevant tutoring sites where students can get information on how to develop their abilities. Virtual university teachers are given guidelines on how to support their students to become self-regulated and active learners. Students have the opportunity to identify their own qualities, as well as to compare their own profiles with those of other learners. The goal is to increase students’ self-awareness and to show them how to increase their own motivation and learning strategies and skills. Tutoring packages, which guide students and teachers in the use of information about students' aptitudes and motivational qualities, are constructed on the same theoretical basis as the questionnaires (Figure 3).
The virtual environments allow flexible options for learning. Students need to have a good self-awareness and effective self-management strategies. They should have the technological management skills to make choices and even to construct their own learning environments with, for example, different hypertext materials, figures and voices. This information is also important to tutors and teachers working on the Net.

Table 1. The main principles in the construction of the IQ FORM.

<table>
<thead>
<tr>
<th>Flexibility</th>
<th>Interactivity</th>
<th>Supportivity</th>
<th>Tutoring</th>
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<tbody>
<tr>
<td>a databank is a combination of various scales and used for different purposes</td>
<td>allows a dialogue between learners and tutors</td>
<td>gives information to learners about their own learning and how to direct it effectively</td>
<td>gives supervision to learners to find options which help them to learn more effectively</td>
</tr>
<tr>
<td>the data is qualitative and quantitative</td>
<td>allows interaction between users and technological environments</td>
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Figure 3. The IQ FORM Tutoring Screen.
Towards Empowerment of Learners - Meta-Theories of the IQ FORM Project

The theoretical framework of the project is multidisciplinary. Conceptually, the project has hierarchical levels, including meta-theories that guide the high-level objectives of the project as a comprehensive mission. The other theoretical selections, which are intended to be in line with the meta-theories, have guided the design of practical tool sets. (Figure 4.)

The psychological and educational theoretical perspectives are based on the assumption that a learner is an active contributor in the learning process, but s/he needs support and facilitation to find his/her capacity and power. The fundamental purpose of the project is empowerment of learners. The overall theoretical framework is based on empowerment and other theoretical conceptual frames which serve the aims of empowerment. Theories of mediated learning (Feuerstein, 2000; Kozulin & Rand, 2000), distributed cognition (Salomon, 1993), and individual differences in learning (Gardner, 1993; Snow, Corno & Jackson, 1994) influenced the approach taken to empowerment of learners in the IQ FORM project.
Empowerment in the IQ FORM Project

Empowerment in the IQ FORM project means the enablement of learners. Siitonen and Antola Robinson (1998, 168) have provided a thorough review of the history and development of the empowerment concept. Referring to Sears and Marshall, they differentiate between two kinds of empowerment: empowerment-by-authorisation and empowerment-as-enablement. When they intend empowerment-by-authorisation, people work within a limited framework, imparting specific knowledge, skill, and certification to those who are being “empowered” with the underlying assumption that “the power” in empowerment derives from and ultimately rests with those who do the empowering. Empowerment-as-enablement is an ongoing process, not to be bestowed on one person by another but a “deeply personal process of meaning-making within particular historical, cultural, and economical contexts” (p.17). Empowerment-as-enablement means that the power is created and realized by individuals themselves, not given or handed down by someone else.

Hannah-Moffat (2000, 7) also describes the history of the empowerment concept. She points out that empowerment is a common term nowadays, but it was originally associated with social movements in the 1960s and 1970s that sought radical political changes in social relations. More recently, the concept of empowering individuals (whether they be the poor, workers, patients, immigrants, students, citizens or prisoners) has become a common tenet of several diverse political strategies and policy initiatives. The widespread use of the term empowerment in everyday language has gradually depoliticised and deradicalised the language of empowerment.

Although it has become a common concept, “empowerment” still means that a person or a group has an improved ability or power to manage personal capacities. As Worell & Remer (1992) define it, empowerment means finding one’s own personal power, developing increased self-esteem and valuing one’s self, but in addition to this power to manage personal capacities, the empowerment concept implies that a person also manages her/his circumstances and has the ability to participate in and to influence a social community. Fetterman (2001) has introduced the concept “Empowerment Evaluation,” through which people may grow as human beings,
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Empowerment evaluation is necessarily a collaborative activity, not an individual pursuit. An evaluator does not and cannot empower anyone; people empower themselves, often with assistance and coaching. Empowerment evaluation can create an environment that is conducive to empowerment and self-determination. This process is fundamentally democratic in the sense that it invites (if not demands) participation, examining issues of concern to the entire community in an open forum.” The essential feature in empowerment evaluation is its collaborative function. Empowerment is to be found in relationship with others (Fetterman, 2001).

According to the classical definition by Israel, Checkoway, Schulz & Zimmerman (1994) empowerment is “The ability of people to gain understanding and control over personal, social, economical, and political forces in order to take action to improve their life situations.”

Empowerment-as-enablement has always had a value component. It has democratic purposes, creating the potential for better life situations, supporting people to find their voices and make their needs visible in social communities. Learning processes are an important means to make people more empowered, but these processes should be supported by teaching and tutoring arrangements. Teachers, learning materials and learning environments have an important mediative role in empowerment. They facilitate learning processes towards self regulation and active contribution in social contexts.

At the beginning of the project, two general theoretical visions provided the guidelines for platform construction. One was Feuerstein’s mediated learning theory and the other was Salomon’s distributed cognition concept. Although these two theories have their own specific emphases, they both share the Hegelian philosophical idea of mediated activity. According to Hegel, the very existence of a human type of activity depends on the transition from the immediate, animal type of satisfaction of needs, which coincides with the ability of the individual animal, to the human satisfaction of needs dependent on the activity of others. Hegel linked the emergence of human consciousness and self-consciousness to the process of mediated activity, which is work. The work presupposes material tools and these tools have a reciprocal influence on the individual because they change his or her type of activity and cognition. Work always has social and psychological characteristics, and work is impossible
without symbolic representation. These symbols and the means of their transmission become additional mediative agents. Vygotsky has continued this tradition. He presupposes three major classes of mediators: material tools, psychological tools, and other human beings. Material tools do not exist as individual implements; they presuppose collective use, interpersonal communication and symbolic representation. (Kozulin & Presseisen, 1995; Vygotsky & Luria, 1993; Vygotsky 1978). The reciprocal relationship between a human being and cultural artefacts is the foundation for development. Development is not a straight path of quantitative gains and accumulations, but a series of qualitative, dialectic transformations, a complex process of integration and disintegration (Gindis, 1995; Vygotsky, 1978). Social perspective theories emphasise the role of social and cultural contexts in cognition. They highlight the effects of the social framework on our beliefs, concepts and construction of knowledge. Learning is embedded within a social context and framework.

In Feuerstein’s view, cognitive growth results both from incidental learning in interaction with the environment and from mediated learning; that is, learning that is assisted by a teacher or other mediator who focuses, sharpens, elaborates, emphasises, provides cues, and corrects to get learners to understand and solve the problem (Gage-Berliner, 1988, 104). Feuerstein's theory states that human cognitive structures are modifiable, but human support is needed for this structuring. Feuerstein emphasises a dynamic approach to human learning. Teachers and tutors are needed to increase students' understanding and the self-self-criticism that leads to successful results. The goal is to get students to monitor and regulate their own learning. Human interaction is fundamental to this process. In virtual environments, mediated learning can be promoted by providing students with tools which help them to find their own capacities. It means, for example, that, students in higher education are provided with teaching and tutoring, which is designed to enable them as learners, and in a larger sense as human beings. They need tools which make them more aware of themselves and increase their self control as learners. The other ways to promote mediated learning is to create an encouraging social infrastructure in virtual spaces. Interaction between a learner and a tutor, as well as between a learner and other students in collaborative courses, is an important component of learning processes. The IQ FORM provides a platform for human interaction, using technological solutions which allow multilevel interaction between a learner, a learning group, teachers, and course designers. How the project has succeeded in promoting mediated
learning experiences will be analysed and assessed in the research of Raija Latva-Karjanmaa. In this book, she suggests the main criteria through which the IQ FORM will be evaluated in the near future.

Distributed cognition means that we acknowledge individual differences between human beings and their own constructions created by their mind, but we see that these constructions always have cultural and social roots and frameworks. Each individual has potential, but how this potential is developed and activated depends on cultural symbol systems. Salomon has described how such a joint system interacts in learning (Pyysalo, 2000): “The different (individuals and distributed) components of a joint system are thought to interact with one another in a spiral-like fashion whereby individual’s inputs, through their collaborative activities, affect the nature of the joint, distributed system, which in turn affects their cognitions such that their subsequent participation is altered, resulting in subsequent altered joint performances and products” (Salomon, 1993, 122). In virtual learning contexts, distributed cognition offers a real challenge to students' minds and to culturally constructed virtual artefacts (e.g., knowledge, sounds, visual images, human communication) in reciprocal and interactive relationships. In this book, Riikka Pyysalo's article “Using multiple representations to scaffold distributed learning in virtual university” focuses on these themes at a theoretical level.

The IQ FORM project has applied the assumptions of mediated learning and distributed cognition and modified the classical definition of empowerment of Israel, Checkoway, Schulz, & Zimmerman in the following complementary way:

*Empowerment in virtual learning spaces means mediative and reciprocal relationships between learners and between learners and technology-based environments that is intended to increase the learners' ability to gain understanding and control over personal, social and learning environmental force, in order to take action to improve their individual and collaborative learning opportunities.*

The definition includes personal qualities, social aspects of learning and environmental factors. It also has a cultural message. Virtual learning environments should enrich distributed cognition and provide mediated learning experiences. Cultural artefacts, including human interdependence in knowledge creation, may create a learning culture in which students' potential will be supported. The empowerment concept covers more than the individual, however. In
virtual learning spaces, students need strategies to monitor themselves, but they must also utilise other opportunities which are available in open learning contexts. In addition to self monitoring, they must create social learning communities which promote collaboration and knowledge creation in partnership.

Table 2. Empowerment-as-enabling in the IQ FORM.

<table>
<thead>
<tr>
<th>Understanding and management</th>
<th>Social community</th>
<th>Technological environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self</td>
<td>Collaboration and mediation</td>
<td>Reciprocal relationship with different symbol systems</td>
</tr>
<tr>
<td>Self-awareness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-regulation</td>
<td>Participatory knowledge creation</td>
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Towards Self-Regulation and Self-Reflection in Empowerment Processes

The important psychological processes which lead towards empowerment are self-regulation, self-determination and self-efficacy (Fetterman, 2001, 12). These concepts are based on the social cognitive view of motivation and cognition. Zimmerman (2000, 16) claims that, from a social cognitive perspective, self-regulatory processes and accompanying beliefs fall into three cyclical phases: Forethought, Performance or volitional control, and Self-reflection. (Figure 5.)

Figure 5. Cyclical Phases of Self-regulation (Zimmerman, 2000, 16).
Forethought refers to inferential processes that precede action and set the stage for it. Performance or volitional control involves processes that occur in action and affect attention and persistence. Self-reflection involves processes that occur after action and influence a person’s response to that experience (Zimmerman, 2000, 16).

In the 1980s the concept of self-regulated learning emerged as a promising tool for human learning behaviour. Self-regulation means an individual’s control of his or her own learning processes. There is evidence that self-regulated learning includes the same sub-processes as Zimmerman has presented (Pintrich, 2000). Forethought in learning consists of cognitive and motivational orientations through which students set goals for their learning, activate prior content knowledge and metacognitive knowledge, make efficacy judgements, and activate their interest and task values. During the learning task, students monitor and control their learning through cognitive, metacognitive and resource management strategies. The cognitive activities includes strategies related to the students' learning or encoding of material as well as strategies to facilitate retrieval of information. The metacognitive processes involve strategies related to planning, regulating, monitoring, and modifying cognitive processes. In self-regulated learning, students also use resource management strategies. These concern students' control of resources (e.g., time, effort, outside support) that influence the quality and quantity of their involvement in the task (Pintrich & McKeachie, 2000, 40).

Self-regulation research provides evidence that at least some self-regulatory processes may be learned and transferred to new situations. Wolters (1998, 224) summarises, based on a large body of earlier research (Schunk & Zimmerman, 1994; Pintrich & Garcia, 1991; Winne, 1996), that self-regulated learners are generally characterised as active learners who efficiently manage their own learning experiences in many different ways. Self-regulated learners have a large repertoire of cognitive and metacognitive strategies that they readily deploy, when necessary, to accomplish academic tasks. Also, self-regulated learners have adaptive learning goals and are persistent in their efforts to reach these goals (Schunk & Zimmerman, 1994). Finally, self-regulated learners are proficient at monitoring and, if necessary, modifying their strategy use in response to shifting task demands. Self-regulated learners are motivated, independent and metacognitively active participants in their own learning (Pintrich & Ruohotie, 2000b).
Research on metacognition since the 1980s (e.g., Flavell, 1979; Biggs, 1988; Stewart & Landine, 1995; Pintrich, 1995; Winne, 1996; Borkowski, 1996; El-Hindi, 1997; Corkill, 1996) underlines the importance of metacognition in self-regulated learning. It is usually assumed to consist of two broad components:

1. knowledge about one’s cognitive states and processes, and
2. the ability to control or modify these states.

At a general level, we may define the concept of metacognition as Pekka Ruohotie does (1994, 33; 2000b, 18): “The term metacognition is often used to mean the conscious selection and assessment of strategies in learning. Metacognition can be subdivided into knowledge and skills. The knowledge component is an individual's understanding and his/her own schemes, strategies and processes as well as his own understanding of him/herself as a learner. Metacognitive knowledge (executive control) directs choice of the strategy to be applied in any given situation. Selection of a strategy presupposes that it will be accurately interpreted and skilfully applied.” Metacognition researchers emphasise that metacognitive knowledge and skills are interactive.

The IQ FORM project has applied Zimmerman's and Pintrich's theories and research work in constructing tools to promote students' self-regulated learning strategies. The self-assessments of self-regulation focus on motivational components of forethought, and students' cognitive and metacognitive strategies. Other self-assessments activate students to reflect their strengths and weaknesses as measured through the MI test.

Self-reflection has a central role in achieving self-regulation in learning. A learner assesses his/her own acts and achievements and makes decisions how to continue learning process. Zimmerman (2000, 22-23) divides self-reflection into two components: self-judgement and self-reaction (Table 3). Self-judgement involves the self-evaluation of one's performance and attributing causal significance to the results. Self-reactions include self-satisfaction with one's performance and adaptive-defensive inferences as conclusions about how one needs to alter his or her self-regulatory approach during subsequent efforts to learn or perform.

The IQ questionnaires provide information about learners' self reflections; for evaluating of self-judgements and self-reactions. Students may evaluate their own strengths and motivational qualities. They have the opportunity to save their test profiles in their learning
diary, and to make their own remarks on their learning processes. Learning group profiles are also available to students. Furthermore, they may share their reflections with their peers and teachers on learning in a virtual community.

**Table 3.** Sub processes of self-regulation (Zimmerman, 2000, 16).

<table>
<thead>
<tr>
<th>Forethought</th>
<th>Performance/volitional control</th>
<th>Self-reflection control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task analysis</td>
<td>Self-control</td>
<td>Self-judgement</td>
</tr>
<tr>
<td>- Goal setting</td>
<td>- Self-Instruction</td>
<td>- Self-evaluation</td>
</tr>
<tr>
<td>- Strategic planning</td>
<td>- Imagery</td>
<td>- Causal attribution</td>
</tr>
<tr>
<td></td>
<td>- Attention focusing</td>
<td></td>
</tr>
<tr>
<td>Self-motivation beliefs</td>
<td>- Task strategies</td>
<td>Self-reaction</td>
</tr>
<tr>
<td>- Self-efficacy</td>
<td></td>
<td>- Self-satisfaction/affect</td>
</tr>
<tr>
<td>- Outcome expectations</td>
<td>Self-observation</td>
<td>- Adaptive-defensive</td>
</tr>
<tr>
<td>- Intrinsic interest/value</td>
<td>- Self-recording</td>
<td></td>
</tr>
<tr>
<td>- Goal orientation</td>
<td>- Self-experimentation</td>
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In the IQ FORM students may also reflect on their self-reaction. In the tutoring package there are several items or tasks which help students to increase their learning capacity. The tutoring sets of the IQ FORM mediate students’ search for meaningful adaptive self-reactions. The theory of mediated learning has made an important contribution to create supportive tutoring sets for different learners. The idea of distributed cognition has also been implemented in producing multidimensional and multilevel structures for tutoring packages.

**The IQ Data Bank - Managing Own Learning as a Part of Empowerment**

The IQ FORM Project has applied Pintrich's and Ruohotie's research and earlier test batteries (Ruohotie, 2000a) in developing motivational tests for virtual university students.

In the initial stage of the project, four tests are available (IQ-Research group, 2001a; 2001b).
Table 4. The tests of the IQ FORM for higher education students' self evaluation

A. MULTIPLE INTELLIGENCES -WHO AM I AS A LEARNER?

- Students' self-assessment of their strengths and weakness using a questionnaire based on Gardner's differentiation of human intelligences. A Multiple Intelligence test consists of seven dimensions based on Gardner's theory.

B. FORETHOUGHT OF LEARNING- HOW DO I TRUST MY CAPACITIES?

- A test for efficacy of learning measured on four dimensions: (1) expectations of success, (2) performance anxiety, (3) inner reward of one's own studies and concept of usefulness of studies, and (4) self-efficacy and self-confidence.

C. STRATEGIES IN LEARNING?

- A test for time management, self-management in learning, persistent in learning tasks and help seeking strategies.

D. HOW CAN I EXPAND MY LEARNING SKILLS?

- A test of basic learning skills in higher education with the following learning operations: rehearsal, critical thinking, finding essential points, connecting newer and older knowledge, using keywords and advance organizers, applications of theories, self-assessment skills of learning.

Multiple Intelligences Test for Self Evaluation

The IQ FORM research group has developed a psychometric Multiple Intelligences Test (IQ-Research group, 2001a; Pyysalo, 2001) based
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on the following intelligences in Howard Gardner's theory (Gardner, 1993).

*Linguistic Intelligence*

- sensitivity to phonology, to the sounds of words and their musical interactions upon one another
- sensitivity to the shades of meanings of words, semantics
- allows an individual to choose exactly the correct word from many alternatives to capture and express some emotion, atmosphere, image, vision or other and to use language to give a consistent picture of something
- mastery of syntax (grammatical rules governing the use of language)
- allow an individual to understand the uses to which language can be put and its different functions
- to use language to convince other individuals of a course of
- the ability to deal with numerical information, to find and recognise analogies and patterns, and similarities and differences between phenomena
- the ability to manipulate numerous variables in one’s mind
- sensitivity to and understanding of the relations between propositions and the implications of one proposition (or law) for another
- the ability to follow and skilfully handle long chains of reasoning
- the ability to deal with abstraction, to recognise significant problems and then also solve them with the help of the heuristics of problem-solving.

*Spatial Intelligence*

- good visual or spatial imagery and visual-spatial memory: the abilities to create a mental image and to remember several complex mental images
- the ability to perceive the visual world accurately
- the ability to perform transformations and modifications upon one’s initial perceptions
- the ability to recreate aspects of one’s visual experience, even in the absence of relevant physical stimuli
• the ability to discern similarities across diverse domains, conjure up mental imagery and to transform that imagery
• the ability to produce a graphic likeness of spatial information belonging to this intelligence.

Musical Intelligence
• the ability to discern meaning and importance in sets of pitches rhythmically arranged
• the ability to produce such metrically arranged pitch sequences as a means of communicating with other individuals (Gardner, 1993a, 98).

Bodily-kinesthetic Intelligence
• the ability to use one’s body in highly differentiated ways for expressive as well as goal-directed purposes
• the ability to control one’s bodily motions and the capacity to handle objects skilfully.

Interpersonal Intelligence
• the ability to notice and make distinctions between other individuals, and, in particular, between their moods, temperaments, motivations, and intentions
• the ability to read intentions and desires – even when these have been hidden and, potentially, to act upon this knowledge.

Intrapersonal Intelligence
• the ability to access one’s own feeling of life and the capacity instantly to effect discriminations among these feelings, and, eventually, to label them, to enmesh them in symbolic codes
• the ability to draw upon them as a means of understanding and guiding one’s behaviour
• the ability to detect and to symbolise complex and highly differentiated sets of feelings.

Gardner claims that there are symbol systems in our cultural environment, with which an individual must come into (regular) contact in order for his or her (potential) intelligences to be realised (Gardner, 1993a, 104; Pyysalo, 2001). Virtual environments are multirepresentational. This context provides challenges to multiple intelligences, and the students’ intelligences may adapt and develop these virtual symbol systems. Virtual spaces provide several
opportunities to create a reciprocal relationship between learner and learning environments, if students and their teachers recognise different symbol systems. A necessary condition for achieving a fruitful relationship between learners and a learning environment is that students know who they are and what kind of symbol system is useful for them. They need a self-awareness of their personal qualities and aptitudes. Learners are different and they have different strengths and weaknesses, but they all have many opportunities to grow as learners. The IQ FORM project provides students with the MI test, which makes student more aware of their aptitudes.

**Tests of Forethought, Cognitive Strategies and Learning Skills**

Motivational components are measured through three test sets, including the motivational components of Forethought, Cognitive strategies and Learning Skills. Earlier, Pintrich's studies, as well as Ruohotie's research results, gave evidence that motivational components correlate with the use of cognitive and metacognitive strategies. In Ruohotie's studies, tests for cognitive and metacognitive strategies and skills have been developed for students in polytechnics. The IQ FORM Project has applied Pintrich's and Ruohotie's research and earlier test batteries in developing motivational tests for virtual university students.

**Sub components of forethought.** Forethought in learning is measured along four dimensions: expectations of success, performance anxiety, inner reward of one's studies and perception of usefulness of studies, self–efficacy and self-confidence.

Pintrich (2000), emphasises the importance of three general types of motivational beliefs: (1) self-efficacy beliefs, or judgements of one's capabilities to do the academic task; (2) task value beliefs about the importance, interest, and value of the task; and (3) goal orientations, including a focus on mastery and learning of the task, extrinsic orientation, or performance orientation (which refers to a concern with comparing one's ability or performance to others). He recommends that self-regulated learning be promoted by facilitating adaptive efficacy beliefs, encouraging interest and value beliefs, and fostering the adoption of mastery goals. Students' expectation of success, performance anxiety, task value and self efficacy include the learners’ own beliefs about their ability to perform a task, their beliefs of self-efficacy and control, and their expectancy for success. They are related to the students’ self regulation and metacognitive control. Learners who believe in their ability to perform a task, are more likely
to evaluate their progress; and in conflicting situations they may apply various cognitive strategies. Performance anxiety refers to learners' emotional reactions and disturbances, which may decrease their cognitive capacity. Highly anxious students do not use appropriate learning strategies, even if they study and try as hard as others (Ruohotie, 2000b, 17).

**Strategies in learning** refer to different resource management strategies. In the IQ FORM test, four components are assessed: time management, self-management in learning, persistence in learning tasks and help-seeking strategies. These strategies assist learners in managing the environment and the resources available (e.g., time, own efforts and other people). Successful learners manage themselves. Pintrich and McKeachie consider it to be the most important learning strategy and a nexus between motivation and interaction (Ruohotie, 2000b, 20; Pintrich & McKeachie, 2000).

**Learning skills** may also be termed cognitive and metacognitive strategies. In the IQ FORM tests, these components were modified to be relevant to university students. The following learning operations are assessed: rehearsal, critical thinking, finding essential points, connecting newer and older knowledge, using keywords and advance organisers, applications of theories, and self-assessment skills of learning. The dimensions are relatively broad and functionally complex processes of deep learning. This means that learners utilise these strategies in the acquisition, storage, retrieval and use of information. In the IQ test battery, the strategies have been labelled as skills, because the aim is for the learners to become skilful in using these different strategies; and they could even learn new skills to manage their learning (Ruohotie & Nokelainen, 2000, 155-175).

The project has collected data with four IQ FORM tests, at the beginning of 2001, from 300 students in different disciplines at three universities. Tests have been modified for the higher education context. The data has been analysed for test validation. The dimensions of each test have been accepted, following a careful explorative and confirmatory factor analysis (Nevgi, 2001; Tirri & Komulainen 2001). The validation process of the test is explained in two articles in this book. Kirsi Tirri and Erkki Komulainen write about the psychometric construction and validation of Gardner's Multiple Intelligence theory. Anne Nevgi presents the validation process for motivational components. Their components and Cronbach's alpha scores are presented in Table 5.
Table 5. Factors in the validation process for tests in the IQ FORM.

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<th>Cronbach’s alpha</th>
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<td>Self-assessment</td>
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The IQ FORM is designed with the Bayesian modelling methodology in mind, which allows for the modelling of very large data collections. Pilot courses in the virtual university environments, 2001-2002, will give new data for the further development of the tool. The project is in the pilot stage in 2001, using the preliminary version of IQ FORM. The initial stage of the project databank focuses on the component of self-awareness and self-regulation. The next step will be to develop modeling methods for social navigation. The initial testing of the usability of the tool was carried out in August 2001, and individual users were interviewed in August and September 2001.

Collaboration and Social Community as a Part of Empowerment

Social perspective theories emphasise the role of social and cultural contexts in cognition. They highlight the effects of the social framework on our beliefs, concepts and construction of knowledge. Learning has increasingly been seen as embedded within a social context and framework. Social perspective theories have been variously called social constructivism, sociocultural perspective, socio-historical theory, and socio-cultural-historical psychology. Although social perspective theorists' views are diverse, each theorist posits that learning occurs through the mediation of social interaction. Rather than use the terms acquisition and representation, social perspective theorists view knowledge as construed by, and distributed among, individuals and groups as they interact with one another and with cultural artefacts, such as pictures, texts, discourse and gestures. Knowledge is not an individual possession, but is socially shared and emerges from participation in social activities (Reynolds, et al., 1996, 98; Cole, 1991).

Empowering a learner in virtual environments also requires collaboration and human interaction. In a virtual environment, a comprehensive and direct human interaction is missing, but we have many ways to enrich the learning process through interactive systems, which also provide a real humanistic component in technology-based environments. Concepts of mediated learning suggest how to help learners to support each other to find intentionality, reciprocity, transfer and the meaning of their learning (Feuerstein, 2000; Niemi & Latva-Karjannea, 2001). Mediation means that the IQ FORM, with its databank and tutoring sets, creates a supportive environment for learners and helps them to grow towards empowerment in their learning.
Social atmosphere and the importance of collaborative culture has emerged in research projects about help-seeking behaviours when a learner is experiencing difficulties (e.g., Butler, 1998; Newman, 1998; Ryan et al., 1998). They have revealed that many learners do not actively seek help with their academic task when it is needed. Learners with low self-efficacy are more likely to believe that others will think that their need for help indicates that they lack ability, and, therefore they are less likely to seek help. In contrast, when students who have high self-efficacy encounter failure or difficulty they do not worry that others will attribute it to their lack of ability. The learners who do not feel capable of doing their work are the ones most likely to avoid asking for help. It is a question of culture in learning settings. Learning and working environments that are characterised as caring, supportive and friendly, are likely to make learners feel more comfortable interacting with tutors and trainers and other learners. Positive relationships that encompass both academic and social concerns are likely to support learners’ efforts to seek help when it is needed.

Japanese researcher Ikujiro Nonaka asks what the fundamental conditions are for knowledge creation. Where is knowledge creation located? To address these questions, he (Nonaka & Konno, 1998) introduces the Japanese concept of “ba,” which roughly translates into the English word “place.” Ba can be thought of as a shared space for emerging relationships. This space can be physical (e.g., an office, dispersed business space), virtual (e.g., e-mail, teleconference), mental (e.g., shared experiences, ideas, ideals), or any combination. What distinguishes ba from ordinary human interaction is the concept of knowledge creation. Ba provides a platform for advancing individual and/or collective knowledge. Ba is a shared space that serves as a foundation for knowledge creation. Common, shared space for knowledge creation is also a forum in which tacit, silent knowledge may be transformed in a visible and concrete way. The virtual learning environments may create spaces which unlock human potential for the learners’ own richness and for richness in their learning communities.

Students’ participatory skills are essential in virtual university environments. European scenarios stress the social nature of learning through approaches such as co-operative learning, collaborative problem-solving, sharing and promotive interaction (Dillenbourg, 1999). Social perspective theories give importance to developing organisational cultures towards more co-operative knowledge creations. The demands of learning in the future emphasise teamwork
and networking as important tools for bringing people closer together. In addition to its cognitive and emotional nature, learning is also social.

An encouraging and participatory learning culture is also needed in virtual communication. Knowledge creation is a social project and students need social readiness. They need participatory skills for cooperation and sharing. The IQ FORM includes tutoring sets that encourage students to help each other. The important tool is “social navigation”—modelling that helps learners to see if there is somebody who is in danger of dropping out of the collaboration.

**Mastering Learning Environments as a Part of Empowerment - Towards “Intelligent Systems”**

The IQ FORM is intended to promote self-regulation in personal learning processes and mediation in collaborative interaction. It also aims to give learners control over learning environments. This is a very important goal in virtual environments. Managing technical environments means that students have information about different options in virtual learning spaces, and they learn to use facilities to construct meaningful learning tasks for themselves by using open learning services and supply. They also need information, for example, on the following issues:

- management of basic technical skills to use computers in virtual spaces such as the Internet;
- how to establish different forums for discussion and interaction, give and receive feedback, and further knowledge;
- how to create and effectively utilise links and inter-textual material to create individual learning space; and
- how to create multiple symbol systems (visual, linguistic, musical etc) and to use them in learning.

Technical learning skills can be achieved fairly easily, but reciprocal interaction between learners and their technological environments requires a high capacity on the part of the learner as well as a sophisticated technical infrastructure. Both actors should have adaptive and interactive qualities.

The IQ FORM opens doors to adaptive, interactive systems. In its initial stage, it acts as a flexible tool for data collection from a large number of students. This requires that the software architecture
design consider the scaling issues right from the early stages of its development. This is a quite standard web technology with only some minor differences from the usual server solutions (e.g., highly distributed storing of the profiles). However, more interesting issues arise when considering the IQ FORM tool as a profiler; that is, modelling the students learning profile and making adaptive use of this profile. In the IQ FORM, this modelling is based on building probabilistic models in the Bayesian framework (Howson & Urbach, 1993). Although some recent work has addressed user modelling, based on for example Bayesian networks (a particular class of Bayesian models that can be represented in graphical form), the IQ FORM technology is unique in its application of these techniques in the open learning environment domain. It is well known that recent developments in Bayesian modelling provide significant advantages over more traditional statistical approaches (Nokelainen, Kurhila, Miettinen, Silander & Tirri, 2002).

Bayesian probabilistic models used for student profiles are an interesting and well-founded new approach for adaptive learning environments. The models built from earlier student data sets can be used to classify new users of the tool into categories (profiles) that describe various learning styles and skills (Nokelainen, Kurhila, Miettinen & Tirri, 2002). The use of such profiles is twofold. First, it gives feedback to the student as a learner, and consequently helps her/him in orientating towards the learning process. More importantly, this profile can be used to personalise the learning material to better suit the student’s needs. This, of course, also requires co-ordination with the course producer, and for this purpose the IQ FORM introduces a simple mark-up language for tagging the online learning material. The IQ FORM is not restricted to any specific virtual learning environment, and it is intended to be used with different course materials.

The Spirit of Empowerment - “Only heaven as a limit for learning”

The idea of reciprocal symbol systems (Salomon, 1993; 1998; Salomon & Perkins, 1996; Pyysalo, 2001) is the basis for the interactive databank and tutorial set. Symbol systems of learners’ own capacity, virtual learning environments, self-assessment tools, and tutoring systems have been constructed to interact in an intelligent and reciprocal way. Computing science and technological solutions are also modified with these adaptive and interactive principles.
A summary covering important teaching and learning concepts used in creating the empowering spirit was given earlier in Figure 4.

Table 6. Teaching and learning concepts in the IQ FORM.

<table>
<thead>
<tr>
<th>The learning concept</th>
<th>The teaching and tutoring concept</th>
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<tbody>
<tr>
<td>Accepting individual differences</td>
<td>Supporting learners for self-regulation</td>
</tr>
<tr>
<td>Metacognitive and motivational strategies</td>
<td>Providing strategic learning skills (cognitive, affective and concrete)</td>
</tr>
<tr>
<td>Collaborative knowledge creation</td>
<td>Providing resource management skills</td>
</tr>
<tr>
<td>Interaction with external symbol systems (distributed cognition)</td>
<td>Creating a collaborative learning space</td>
</tr>
<tr>
<td>Active and intentional processes</td>
<td>Serving as moderators in mediated learning</td>
</tr>
</tbody>
</table>

The spirit of empowerment comes from the theoretical frameworks and how the concepts have been applied in a practical solution. One aspect of these applications is graphics in the tool. The graphics used in the tool (metaphors) are intended to provide a strong image of empowerment through learning. Information technology, with semiotic perspectives, has been applied to create an encouraging learning atmosphere. After completing the tests, a student will have profiles which describe his/her own and his/her group’s qualities. The test profiles use the following visual metaphors:

**Rising balloons** for seven intelligences, giving an image that we all may grow and develop. A student may click on a balloon to get more information about each intelligence area and how s/he may develop this quality. There is also a short animation for each intelligence by which a learner may test her/himself in each ability area.

**Shining suns** for self-efficacy qualities emphasise the importance of self-confidence and the will to win in learning tasks. By clicking on the graphical symbols (sun) in one’s self-efficacy profile, students receive tutoring support; for example, how to perform and overcome performance and test anxiety.

**Flying planets** for learning strategies make visible the power of learning strategies. The four planets profile tell a learner how strong her/his own strategies are. By clicking on a planet, a learner receives information and practical guidance; for example, how to improve time management in virtual courses and how to use help-seeking strategies in learning groups.

**Shining stars** in the dark sky symbolise learning skills and reflect an image of our learning, opening for us the richness of the universe.
An empowering learning environments is a holistic one which is intended to enable learners. It involves supporting self-management skills, social and collaborative communities, interactive technological solution and all the small details and images which are included in the databank or tutoring sets. The spirit which the IQ FORM project seeks may be summarised by the following principles.

In virtual learning we need a learning culture:

1. We need to move towards encouragement and sharing—a culture which allows risk-taking and open collaborative problem solving and challenge without fear.

2. A growing experience of mastering something is required—learning as a process that supports self respect—which means learning for competence, not for control.

3. A sense of giving something to others is needed—sharing something and having a feeling that my part is important and valued.

4. Positive tension should exist—the drive to make an effort, to do something that a person considers as valuable, overcoming difficulties. Students are not seeking an easy life; they are seeking meanings.

Educational Implications of the IQ FORM

This article has introduced a research project concerned with developing a supportive virtual learning environment for higher education. The project creates tools through which students can learn about themselves as learners and learn skills to become more effective learners in virtual courses. The main tool is called the IQ FORM (Intelligent Questionnaires PlatFORM), which is an interactive databank of information about learner's qualities; for example, learners' strength profiles and motivational structures as well as social navigation during their virtual studies. Another essential feature of the tool is tutoring sets that help students to become more self-regulated and collaborative learners through self-reflection. The theoretical framework is based on theories of Feuerstein's mediated learning and Salomon's distributed cognition. They provide the meta-level theoretical background for the project. Students' learning qualities are measured using tests based on H. Gardner's multiple intelligence theory and P.R. Pintrich's motivational theory. The questionnaires work as a databank, from which students may select
different combinations to become more conscious of their strengths and motivational strategies, and changes in these qualities during the course. Their profiles also direct them to sources within the software and encourage them to seek support from their teachers and peers. The tool also encourages learners to use new kinds of learning material or routes to find more effective learning strategies.

Universities throughout Europe have changed from small elite communities to large institutions. Large numbers of higher education students have become the international norm at the end of the 20th century. In most parts of the world, higher education was limited in size and scope until the 1960s. Sociologist Martin Trow, writing in the early 1970s, divided the world’s academic systems in terms of elite (below 5 percent of the relevant age group participating in post-secondary education), mass (between 20 and 30 percent), or universal (above 30 percent) access, and argued that higher education was inevitably moving toward universal access.

Establishing virtual universities is in line with these common trends. Virtual university means that students have more opportunities to take courses, modules or whole programmes using university services in information and communication technology environments. The Internet allows learning spaces to cross old boundaries. New technological environments give access to large numbers of students and courses can be delivered without limitations of time and distances, but raise new questions about the quality of learning in these new contexts of higher education.

Achieving high quality learning in higher education is more demanding than ever. Universities face enormous pressure to generate new knowledge. European scenarios emphasise that the success of people, firms, localities and regions depends upon their “capability to learn” and to constantly create new knowledge. This trend has led to a growing interest in the promotion of a learning society and learning organisations. The life cycle of specific skills and competencies is getting shorter and this poses significant challenges, both for the formal education system and for informal education.

How to support higher education students with high quality learning in new virtual learning spaces is a key issue in developing virtual universities. Flexible course delivery in itself is not a guarantee of quality. The necessary conditions for high quality learning are as follows:

- Students need high quality learning skills, which consists of metacognitive and metamotivational learning strategies, as
well as the technological skills to use opportunities in virtual learning spaces.

- Students need high quality course providers who take the students’ differences seriously and offer different options for high quality learning.
- Students need high quality teachers and tutors who have the time and capacity to support learners to become more effective and self-regulated.
- Individual students need peer groups and learning partners who together create learning communities for knowledge creation.
- Students need well-functioning infrastructures in order to add their knowledge. This means good computers and fast Internet connections, as well as libraries and books and other information sources which should also be available in an electronic environment.

All these conditions should have the same common goal: to support the students' own capacity to manage their learning. The role of a university, even virtual universities, is to educate people who have a high competence in learning skills and who are actively in touch with life. The purpose of studies is to educate highly skilled people who are capable of taking responsibility for their own learning and of developing initiative-taking professionals, of managing innovations, of activating new scenarios, of mastering transformations and not only following ready-made outlines. During their university studies they should establish and practice these qualities. This means that higher education should provide them with authentic, meaningful learning and growth processes through which they will become committed learners throughout their life.

The learning process should be an active one in which the learner has ownership and initiates. However, there is a mutual interaction between how learning environments, for example organisations and working places, support learners to learn and to become effective learners. Adults’ learning skills are often seen as self-evident capacities. Very often we overestimate their self-regulatory skills (Mandl, 1997). However, there is much evidence that many adults have problems in managing their learning, and even in higher education, we find that students need support in developing learning skills (Boud, 1995; Niemi, 2000; Richardson, 2000; Simpson, 2000).
The needs and challenges of our rapidly changing societies are so great that higher education institutions are under enormous pressure. Virtual universities need to seek methods to add quality of learning to higher education. The IQ FORM gives tools for assessment and tutoring. It aims to empower learners. The learners’ own ability to learn is an important asset which contributes to empowerment. The IQ FORM includes an interactive databank and tutoring sets, which have been designed to promote self-reflection and learning skills. The concept of mediation combines teaching and learning and gives guidelines for constructing human environment in virtual spaces. The concept of distributed cognition indicates the need for reciprocal relationships between a learner and a learning environment.

The IQ FORM has been created for learners and their teachers, but it also has broader applications. The information which is produced through the IQ FORM can also be used by the course developer. The manuscript writer must have a concept of different learning routes and difficulties. The need for adaptive and enriched learning environments in virtual space is clear.

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