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ABSTRACT

This paper presents a brief review of the present knowledge on student learning assessment in traditional face-to-face courses that use brain-based learning principles and adopt the guided-experience approach. The understanding of these principles and approach is then applied to the design of an effective student learning assessment model for a virtual learning course.

Keywords: virtual learning assessment, guided-experience approach

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Virtual learning is the migration of conventional face-to-face education (such as teachers, classes, classrooms, colleagues, homework, visits to museums, and tests) to distance learning via the web, using all the available tools for content management, synchronous or asynchronous interaction between students and instructors, and—in some cases—integration with the conventional classroom (referred to as *blended learning*).

The method of virtual learning is popular, and continues to proliferate at almost the same speed as new social media, games, smartphones, and tablets. As well as following (and building on) the new media habits of the increasingly wired society, virtual learning has proven to be very attractive to students. The advantages of an online learning environment, including the ability to work from the comfort of home, the time and peace gained by not having to commute to attend classes, and freedom from rigid time schedules, have contributed to the growing popularity of virtual learning. Students engaged in virtual learning conditions have also been shown to perform more successfully than those receiving traditional face-to-face instruction; and this result was further improved when virtual learning was blended with some elements of traditional face-to-face instruction (Means et al., 2009).

With the growing demand for virtual learning from students and the need for schools and universities to respond to this demand (Christensen, Horn, & Johnson, 2008; Julian, 2009), instructors have learned, during the last decade, how to design effective virtual and blended courses based on the approach and content of traditional face-to-face teaching, by using all the newest web tools, including social media, wikis, and virtual worlds (Behar, 2011; Dabbagh, 2005; Dickenson, Burgoyne, & Pedler, 2010; Ellis & Goodyear, 2009; Erenli & Ortner, 2011; Ferrão, Galván, & Rodrigues 2009; Hauser, 2010; Longhi, Behar, & Berchi, 2012; Macpherson, Homan, & Wilkinson, 2005; Mentis, 2008; Rapanotti & Hall, 2011; Robbins & Butler, 2009; Rourke & Coleman, 2011; Stavredes, 2011; Wu & Hwang, 2010).

On the other hand, instructors have discovered that although traditional forms of assessment of student learning (such as tests and quizzes) have been used effectively for face-to-face courses, these do not work as well in the virtual learning environment. Traditional assessment methods had no answer to the recent concerns about academic honesty that were raised in the context of virtual learning (Palloff & Pratt, 2009): namely, ensuring that the students who are enrolled in the virtual learning class are the ones who are participating in the assessment; finding ways for instructors to know if the students really understands and can apply the material that they are teaching; overcoming the inability of instructors to ensure that students won't cheat on tests or other assessments in virtual learning courses; and concerns of plagiarism in the use online contexts.

Contemporary instructors have a wide knowledgebase on the best practices for assessing students learning in traditional face-to-face courses (Serban & Friedlander, Eds., 2004; Banta, Jones, & Black, 2009; Suskie, 2009), whereas a similar knowledgebase for assessing students in virtual learning courses is still under development (Palloff & Pratt, 2009). For this reason, this paper briefly reviews the present knowledge on effective student learning assessment criteria based on the brain learning principles, and examines the extension of these criteria for virtual student learning assessment.

Student Learning Assessment

Student assessment is an integral part of any course design, and this includes traditional face-to-face, virtual, and blended courses. A course design consists of the course *objectives* (which defines what the students should learn), *competencies* (the knowledge and skills that the student should acquire during the course), *outcomes* (which describes what the students will be able to know or do), and the *grading rubric* (which specifies the standards of performance used for the assessment of students learning during and at the end of the course).

An effective course design aligns the course objectives and the competencies that students should acquire with the desired course outcome. This, coupled with assessment based on grading rubrics that are also in alignment with the course outcomes, leads to a higher level of

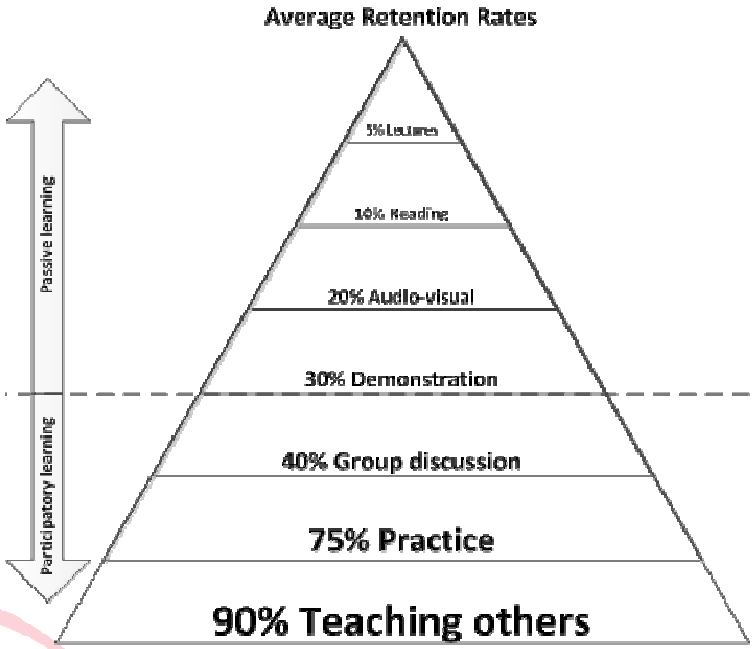
student performance and satisfaction with the learning process, regardless of the delivery mechanism of the course (Buzzetto-More & Alade, 2006). These alignments are fundamental for the best practice in student learning assessment (Palloff & Pratt, 2009).

In designing a course, it is also important to take into consideration how the brain learns and the activities that contribute to the retention (memorization) by the students of the course content. The unfortunate fact for instructors is that students forget, very quickly, most of what they have been taught in traditional face-to-face classes. Hermann Ebbinghaus (1913) became famous for uncovering that students forget 90% of what they learn in face-to-face classes within 30 days. He further showed that the majority of the forgetting occurs within the first few hours after class. This has been confirmed in modern times through extensive studies (see Medina, 2008).

Learning Pyramid

The learning pyramid (Figure 1), developed by National Training Laboratories (NTL) in the U. S. in the early 1960s, is an image that maps a range of teaching methods and learning activities onto a triangular image in proportion to their effectiveness in promoting student retention of the material taught (Palloff & Pratt, 2009). The research base for the average retention rates displayed in the pyramid is difficult to establish conclusively. Although there remains a level of discomfort around the use of an instrument with such a questionable research base, it can be used as an indicator of the effectiveness of the different teaching methods and effectiveness in promoting student retention (Magennis & Farrell, 2005). This is particularly noteworthy, considering that modern brain-based learning reaches similar conclusions as to the relationship between passive and participatory learning (Degen, 2011).

Figure 1: The learning Pyramid



Source: Adapted from Palloff & Pratt, 2009

Guided-Experience Approach

The most effective approach to teaching, according to Caine, Caine, McClintic, & Klimek (2009) is the method of guiding students to live an experience, with the appropriate learning challenges to encourage them to reach flow, in a richly stimulating teaching environment: they term this the *guided-experience approach*. This approach motivates students to make sense of the experience using *actor-centered adaptive decision-making* (Goldberg, 2001) and to thereby develop knowledge and skills. This emphasis on actor-centered adaptive decision-making aims to develop the student's executive functions by capitalizing on the innate need to know or acquire skills. Understanding, knowledge, and skills grow out of answers to questions the students ask themselves, which are driven by their own purpose, interest, and need to search for meaning (Caine & Caine, 1991). The questions students raise, and their answers to these questions, have to be an integral part of the assessment of the students learning.

The guided-experiences must be real-world projects with an embedded academic curriculum, driven by the student's choices and interests. The purpose is to go beyond normal academic standards through ongoing

questioning, investigation, and documentation. The approach is determined by the students, based on their understanding of experts in the chosen field. However, this approach will only work only if the teacher acts as a leader and the students establish an authentic partnership (or team) with shared procedures and expectations. The teacher must have—based on the course objectives and expected outcome—a clear sense of the essential knowledge and skills (competencies) that the students will need to master to succeed, and thus be able to coach the students to reach these goals (Caine et al., 2009; Degen, 2011).

Using the guided-experiences approach, learning does not occur via the traditional method of direct transmission from the person who knows (the teacher) to the one that doesn't (student). Learning is, instead, embedded and consolidated by the student's processing of the experiences. Knowledge and skills are developed by the student's search for meaning and answers to his or her own questions (Caine et al., 2009; Degen, 2011).

The use of the participatory learning methods illustrated in the learning pyramid (Figure 1), induces students to acquire knowledge (that is, to learn) by processing experience (Dewey, 1998). Thus, living an experience (digesting, thinking about, reflecting on, and making sense of experience) is the best way for students to acquire knowledge or to consolidate and internalize information in a way that is both meaningful and conceptual coherent for them (Caine & Caine, 1991).

Reaching Flow

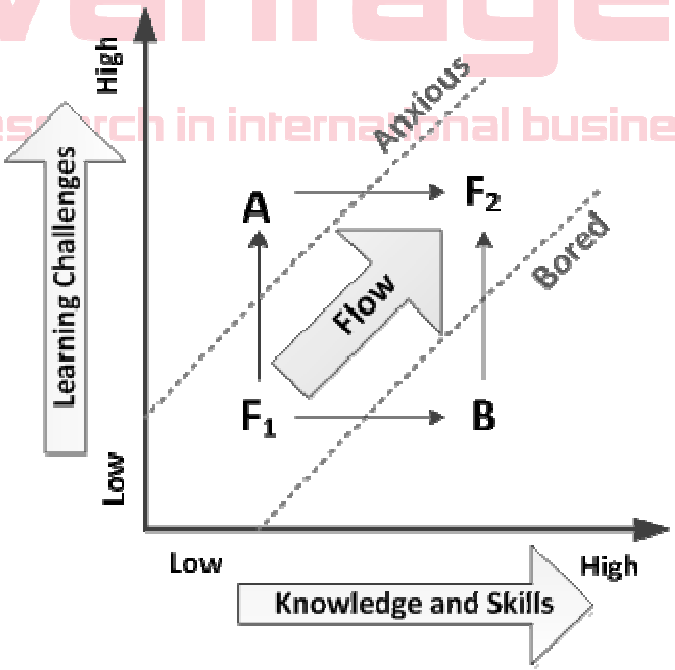
Csikszentmihalyi (1991) described a state of consciousness he called *flow*, which is the primary criterion for optimal learning. It is impossible to merely will this uninterrupted state of concentration into existence; rather, flow occurs when students "lose themselves" in a learning activity. When students are in flow, all self-consciousness and awareness of time fades, and what is left is the pure pleasure of absorbing the learning experience (Degen, 2011).

Csikszentmihalyi (1991, 1996, and 1997) suggested that individuals or groups can reach flow if a meaningful goal emerges spontaneously as the result of pleasurable activity and interaction in which attention, challenges,

and skills are aligned (rather than being imposed). Learning occurs in an accelerated fashion when students are encouraged to enjoy themselves by defining and redefining their own learning challenges as they progress. This enjoyable combination of learning and overcoming self-imposed challenges allows students to reach and stay in flow during the whole learning experience (Degen, 2011).

This process of self-imposed challenge allows students to adjust their learning experience to suit their individual intellectual capabilities, to adapt challenges to their individual knowledge and skill level, and to take responsibility for their learning in a relaxed state of alertness (Caine & Caine, 1991; Caine, et al., 2009). One problem is that it is very difficult to for students to reach flow in a conventional classroom. The flow approach works better for individual students or teams in a virtual or blended learning environment where they can adjust the learning experience to their particular learning capabilities and motivations.

Figure 2: The instructors have to coach students to live an optimal experience and stay in flow



Source: Adapted from Csikszentmihalyi, 1991, p. 74.

The instructors have to coach students to live an optimal experience and stay in flow. They need to continuously motivate students to define and redefine new challenges in accordance with the objectives of the course. They have to help students in acquiring the knowledge and skills that are needed to meet these progressively more demanding challenges. Each time the students develop the required knowledge and skills to meet the challenge (student moves from F1 to B in Figure 2) and become bored, the instructor has to motivate them to grow the challenge in order for them to return to flow (student moves from B to F2 in Figure 2). If the challenge is too difficult for the student's capabilities, and they are unable to develop the required knowledge and skills, they become anxious, frustrated, and stressed (student moves from F1 to A in Figure 2), and will (in most cases) abandon the optimal experience. To avoid students becoming anxious and frustrated, the instructor has to assist them in the acquisition of the required knowledge and skills to return to flow (student moves from A to F2 in Figure 2).

It is important that instructors are supportive yet challenging, in order to create for the students the best emotional climate for learning (with few threats and many challenges). This keeps them in flow in what is the optimal emotional state for learning: Caine and Caine (1991) have named this state *relaxed alertness*. In relaxed alertness students feel confident, interested, and intrinsically motivated by the experience.

Relaxed alertness is important, because students facing the challenges of traditional face-to-face, virtual, or blended learning courses in form of tests, exams, papers, and projects naturally become stressed. The stress can be positive stress (*eustress*) or negative stress (*distress*). Positive stress occurs when students are moderately challenged and feel a sense of resolution to overcome the challenges: they reach flow and are intrinsically motivated to learn by the challenges. Negative stress occurs when students are over-challenged and feel helpless and threatened by the challenges.

When a student feels threatened by the challenges, their brain responds to the threat with an approach that Hart (1983) termed *downshifting*. When this occurs, the brain goes into a defensive mode, which is appropriate to survival but not for learning. The brain loses its

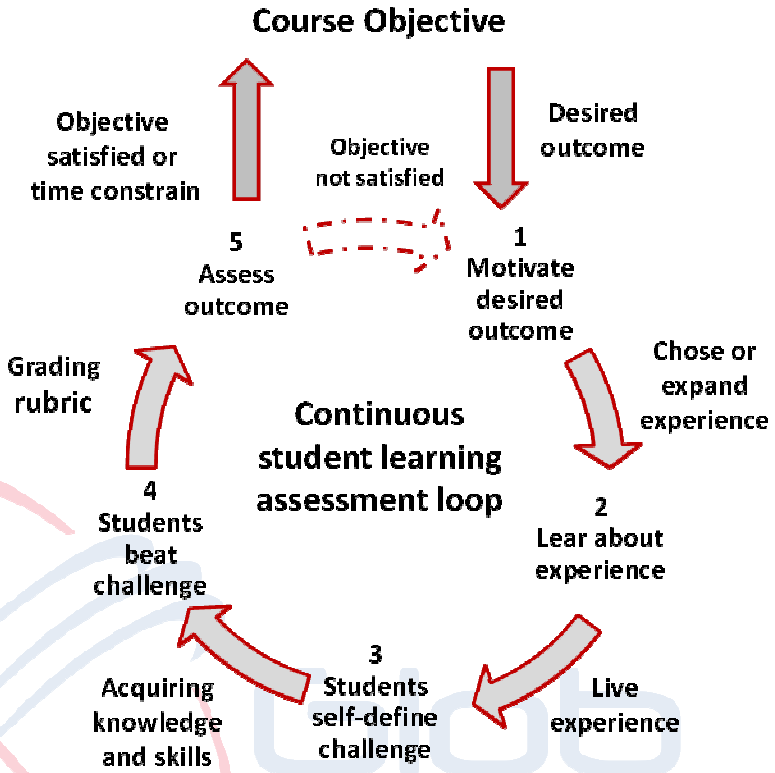
ability to correctly interpret subtle clues from the environment; reverts to familiar, tried-and-true behavior; loses some of its ability to index, store, and access information; becomes more automatic and limited in its responses; is less able to use higher-order thinking skills; and loses some long-term memory capacity (Caine & Caine, 1991; Jensen, 2008).

Learning Assessment

A typical course using the guided-experience approach starts with the instructor motivating students to live an experience that is aligned with the objectives and desired outcomes of the course (Figure 3). The instructor then motivates the students to self-define a challenge within the experience. When students overcome the challenge, the instructor assesses the outcome based on the specific grading rubric, and compares this with the desired outcome of the course. If the desired outcome is satisfied, the students have successfully completed the course; if the outcome does not meet the desired outcome, the instructor motivates the students to self-define a new challenge to close the learning gap measured by the grading rubric. The students will then be reoriented and motivated to continue living the experience until they meet the desired outcome of the course, or (due to time constraints) have to finish the experience. At the end of the course the instructor then has all the necessary information on the student's performance to assess their learning based on the grading rubric, and so is able to give the students the correct grade for their academic work within the experience.

The learning assessment by the instructor of students living an optimal experience becomes an integrated part of the whole process and can be directly evaluated by the student´s responses to the self-defied challenges (the outcomes of the experience) and the knowledge and skills required to meet these challenges. Petkow and Petkova (2006) recommended this type of course-embedded assessment as having the advantage of ease of implementation, low cost, timelines, and widespread student acceptance. They noted that performance appraisal that is supported by grading rubrics is particularly effective when assessing problem solving, communication, and team-work skills.

Figure 3: Students will be motivated to continue living the experience until they meet the desired outcome of the course, or (due to time constraints) have to finish the experience



Student Virtual Learning Assessment

An approach to course design and student learning assessment that is based on brain learning principles and used for face-to-face learning courses can also be effectively applied to virtual or blended learning, although with the following recommendations (Gaytan, 2005; Pallow & Pratt, 2009): students should be empowered, both during the learning and in the assessment process; the grading rubric should include the assessment of student's contributions to discussions and their collaboration with others; students should be given guidelines and encouraged to develop the skills for good feedback to fellow students, based on clearly stated expectations; and the learning assessment should incorporate students' input into how it is conducted.

The empowerment of students throughout the learning and assessment processes is particularly important for virtual learning courses,

because students are responsible for most of the virtual learning activities (such as discussions, participation in collaborative activities, and self-reflection on the learning experience). The involvement of the students in the development of the assessment of the learning experience helps to move them from the role of simple learners to that of reflective self-motivated practitioners. For this reason, the grading rubric should include the assessment of the student's contributions to virtual discussions, to collaboration with fellow students, to the improvement of the learning experience, and to the learning assessment of the experience.

Due to the importance of virtual collaboration between students toward an expected outcome (in forms such as projects, papers, wikis, and blogs) and the public posting of progress with comments from student to student, the instructor must provide guidelines and encourage the development of skills for useful feedback to fellow students based on clearly stated expectations. The interaction and feedback from other students assists students in the development and application of their ideas, helping them achieve a deeper level of knowledge and more skills through collaboration, and at the same time strengthen the virtual learning community.

Cheating and Plagiarism

One of the concerns of virtual learning assessment is the potential for cheating and plagiarism. To prevent cheating, many online courses adopt the practice of proctored exams. Generally, these are set up by requiring students at a distance to travel to a proctored site or to the campus to take the exam. However, this approach is cumbersome and inconvenient for both students and instructors, and the use of proctors is not completely safe against cheating.

Other approaches to circumvent cheating include the randomization of exam questions (so that each student receives an individual exam) and the use of take-home or open-book exams. In particular, open-book exams are much closer to the circumstances that students will face in professional life, where they will not need to answer questions from memory without using references; rather they will have to produce results using all possible sources of information (Pallow & Pratt, 2009).

Plagiarism occurs in both in face-to-face and virtual learning courses. Common practices to avoid plagiarism include asking students to submit a portion of the required final course paper (such a topic list, outlines, annotated reference list, and early drafts) during the course, and the assignation of topics that directly related to a student's particular experience. Requiring students to submit parts of the final paper during the course avoids what McNett (2002) described as the "deadline-driven desperation" that is a common and significant motivation for students to cheat and plagiarize. Pallow and Pratt (2009) explained that when students are asked to submit components of a paper throughout the course, they are better able to manage their time for the final paper, and this also allows the instructor to become more familiar with the student's writing style. In this context, any sudden changes to style become a red flag for potential plagiarism, allowing the instructor to intervene.

Additionally, because plagiarism can be accidental (due to a lack of knowledge about how source material is properly cited), a common practice is to have students run their own work through plagiarism detection software. Rather than using the software punitively against the students, having the student use this serves as a teaching tool that helps them to learn about paraphrasing and proper use of references (Pallow & Pratt, 2009).

The teaching approach that most effectively reduces the possibility of cheating and plagiarism (in both virtual learning and traditional face-to-face learning) is the guided-experience approach described in this paper. When the written assignments are directly related to the particular experience that the student is living, it is difficult for the student to cheat or plagiarize. Also, requiring the students to submit intermediary results during the course (self-defined challenges and the solutions) reduces their motivation to cheat or plagiarize.

Effective Student Assessment in Virtual Learning

The design of an effective student assessment system in virtual learning starts with a good course design that is based on a guided-experience approach. This approach aligns the course objectives and the competencies that the students should acquire with the desired course

outcome. The grading rubric should be embedded in the challenges of the guided-experience and should measure the student's progress in processing these challenges and in acquiring the necessary knowledge and skills (competencies) to overcome.

This form of accounting for students' learning is based on how they live their experiences, overcome challenges in pursuit of their objectives, and how they interact with colleagues and instructors. This is arguably as richer and more meaningful way of assessing students' learning than conventional grading using standardized testing (Syverson, 2006).

Example of Student Assessment in Virtual Learning

An example of a course for writing a business plan is outlined below, to illustrate how to design an effective student assessment system in a virtual learning context that is based on the guided-experience approach. The objective of the virtual course in this example is to teach students how to write an effective business plan: this includes fostering an understanding what a business plan is, who should prepare it, who reads it, and how it is evaluated. The competencies that students should acquire are: an understanding of scope; the value of the business plan to investors, lenders, employees, suppliers, and customers; how the process of persuasion plays a key role in business plans and in the success of new ventures; how to identify the information needs and the sources for business planning; why the executive summary is an important part of any business plan; the major sections of a business plan and the type of information they should include; and the things that should be avoided in an effective business plan. The desired outcome of the course is for students to be able to write effective business plans that are conducive to successful ventures.

The guided-experience approach to teaching students how to write a business plan requires students to write an actual business plan on a venture of their personal interest and encourages them to form small teams with other students (with two to four students in each team) who have

similar interests. This approach also requires the instructor to guide the teams through the process of making a business plan.

As this is a virtual course, students are required to post the type of ventures they are interested in on the course bulletin board and search for colleagues with similar interests in order to form their virtual teams. Each team then works on their business plan using a wiki. Students of other teams are encouraged to view the progress of other teams and make contributions or constructive critics.

At the start of the virtual course the instructor presents and discusses with the students (over the courses bulletin board) the grading rubric that will assess their learning progress, and how they can receive support from the instructor and access to the course material to guide them in developing their business plans. The instructor also clarifies doubts and accepts suggestions to ameliorate the grading rubric.

The final grading rubric assesses each basic component of the business plan (executive summary, industry analysis, description of the venture, production plan, marketing plan, organization plan, assessment of risk, and financial plan) elaborated by the teams in terms of the capacity of persuasion of investors, lenders, employees, suppliers and customers, and the quality and completeness of information (see Figure 4).

At the end of the course, as the final challenge, students are asked to present and defend their business plan to potential investors over a videoconference. There is additional evaluation in the grading rubric for quality and power of persuasion of this virtual presentation.

Figure 4: Grading rubric for team and individual work assessment

Grading Rubric for How to Write a Business Plan

Team Assessment	Persuasion	Quality and completeness
Industrial Analysis		
Description of Venture		
Production Plan		
Marketing Plan		
Organization Plan		
Assessment of Risk		
Executive Summary		
Presentation		
Total		

Individual Assessment	Quality of Contributions	Participation
Contribution to Team		
Contribution to Others		
Total		

Assessment: Not Sufficient (0-3), Basic (4-6), Proficient (7-8), and Distinguished (9-10)

The grading rubric also contains the assessment of the individual contributions of each student to its team business plan, as measured by their individual input to the plan (as it is written, modified, and rewritten on the wiki) and the their individual contribution (with suggestions, information, and constructive criticisms) to the business plans being developed by other teams of students.

The instructor remains available via the bulletin board, throughout the course, to respond to students' questions and provide orientation. The instructor also asks students to write the business plan in the sequence of its components (industry analysis, description of the venture, production plan, marketing plan, organization plan, assessment of risk, financial plan, and executive summary) so that ongoing feedback for improvement is provided as the plan is written. The instructor periodically reviews the progress of the students (as they write the business plans on the wikis),

assesses student contributions, and provides feedback on progress to the teams and individuals.

The team assessment section of the grading rubric is made public to all the students who participate in the course. Each team can see the other team's business plan being written on the wiki, can identify how the instructor is evaluating them, and is aware of recommendations for improvement. This encourages learning from other teams and may contribute further ideas. The individual assessment is not made public and the instructor's evaluation and recommendations are only available to the individual student.

The assessment of the teams and individual students is updated periodically by the instructor, and is accompanied by recommendations, so that the students can see their progress as the course progresses.

Conclusion

The need to develop a wider knowledgebase on the best practices for assessing student in virtual learning courses is a direct consequence of the recent advances in neuroscience and brain-based learning, and the extraordinary growth of these courses over recent years. In 2010, over 6.1 million students were taking at least one online course in the United States, representing 31% of all higher education students. This number is a ten percent growth rate for enrollments in virtual learning courses over 2009 and far exceeds the less than 1% growth of the overall higher education student population in the United States (Allen & Seaman, 2011).

The reason for this growth is that students today live in a wired society and virtual learning is therefore a natural process for them. Virtual learning also allows students flexibility to learn their own way (because each brain learns differently), liberated from the rigidity of the traditional face-to-face classroom. This familiarity and flexibility in learning, and the facility to work from the comfort of home have proven to very attractive to many students.

To take advantage of this trend in education, institutions and instructors have had to redesign the traditional face-to-face curses to virtual or blended courses to satisfy students' demands and at the same time use

the new newest brain-based learning principles and the guided-experience approach to improve and enrich their learning experiences. In recent years significant improvements have been made in designing these courses by incorporating the use of these principles and of emerging web tools.

Unfortunately, student assessment in virtual learning courses has not progressed at the same pace, and the knowledgebase of best practices remains relatively modest (Palloff & Pratt, 2009). This paper has made a contribution by presenting ways that brain-based learning principles and the guided-experience approach can be used to design an effective student assessment model for virtual learning courses.

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