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# All for One and One for All: Designing Web-Based Courses for Students Based Upon Individual Learning Styles

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**Abstract** - As e-learning begins to proliferate into secondary schools and is opened up to learners of all abilities, it is important that the effects different learning styles have upon how online instruction is provided are taken into consideration. In this study, students from a secondary-level business education class completed a learning styles inventory to determine their strengths in the traditional learning styles and in Gardner's intelligences. A variety of web-based instructional methods were utilized throughout the school year and the students' overall performance in the course was monitored.

## Introduction

Within the walls of a traditional classroom, teachers have become quite adapt at modifying their own instruction to assist the variety of learning styles that the students sitting in front of them possess. However, within a web-based learning environment these skills are still developing.

In the post-secondary environment, the various learning styles of students has had little impact on the design and deliver of distance education, largely due to the fact that these learners are much more motivated and independent in their approach to learning. However, as e-learning begins to proliferate into the secondary school environment and is opened up to learners of all ability-levels, it is important that the effects that different learning styles have upon how we provide online instruction are investigated/taken into consideration.

While the traditional learning styles (e.g., auditory, visual and tactile) still apply in an e-learning environment, in order to truly design and deliver web-based instruction that is directed to different learning styles, a broader measure needs to be used.

## The Study

The Centre for Distance Learning and Innovation (CDLI) began its implementation year in 2001-02 with ten courses being piloted in ten different school districts (i.e., one course per school district). The courses themselves were primarily text-based with some images. Only a select few of the courses contained any multimedia or audio components. After the pilot phase, the CDLI began to expand both its course offerings and the number of students per course. It set the student to e-teacher ratio at 1:80 and students from all over the province's ten school districts were able to access any of the courses.

The present study builds on a previous initiative that occurred during the pilot phase. One of the potential sources of skewness during that pilot phase was that many of the students enrolled in the courses had been personally selected by principals as capable of learning in an online environment. After the pilot phase, courses were offered via open enrolment and students

or all ability levels could select a particular course as long as they met the prerequisite for that course.

In this study students from one business education course during the 2002-03 school year completed a learning styles inventory to determine their strengths in the various learning styles theories. At the end of the school year, the students' final average was collected and compared to their learning styles profile and the web-based design components contained in the course.

## **Learning Styles**

A learning style is a preference. It is the manner in which we perceive and process information the best. It can also be defined as the method people use to concentrate when they have difficult information to learn. While the majority of people will fall into all of the different categories at some point, each individual has their own preferred method of learning, their learning style.

“The term ‘learning styles’ is commonly used throughout various educational fields and therefore, has many connotations. In general, it refers to the uniqueness of how each learner receives and processes new information through their senses” (Giles, Pitre & Womack, 2003). The theory of learning styles began in the late 1920s with the work of Carl Jung. “Jung (1927)... noted major differences in the way people perceived, the way they made decisions, and how active or reflective they were while interacting” (Silver, Strong & Perini, 1997, p. 22). While research into learning styles and learning preferences has evolved, many of the modern theories retain the fundamental principles that Jung espoused: sensation vs. intuition; logical thinking vs. imaginative feelings; and extroversion vs. introversion.

This particular study considers three of these learning style theories: traditional learning styles; David Kolb's theory of experiential learning; and Howard Gardner's theory of multiple intelligences.

### *Traditional Learning Styles*

Learning styles are simply different approaches to learning. The most commonly known learning style is accelerated learning, which is a clearinghouse term for individuals whose learning style preference is visual, auditory or tactile. Each of these three preferences is described in greater detail below.

**Visual Learners** - you have to see it to believe it

- needs to see it to know it
- strong sense of colour
- may have artistic ability
- difficulty with spoken directions
- over-reaction to sounds
- trouble following lectures
- misinterpretation of words

**Auditory Learner** - if you hear it, you remember it

- prefers to get information by listening

- needs to hear it to know it
- difficulty following written directions
- difficulty with reading and writing

**Tactile Learner** - if you can touch it with your hands, you will remember it

- prefers hands-on learning
- can assemble parts without reading directions
- difficulty sitting still
- learns better when physical activity is involved
- may be very well co-ordinated and have athletic ability (University of Northwestern Ohio, 1998)

The common theme between these three learning style preferences is that it refers to the primary way an individual takes in information. This process is known as perceptual modality. The field of accelerated learning relies heavily on modality to explain how learners can process information best.

### *Theory of Experiential Learning*

The theory of experiential learning was outlined in Kolb (1976), with the development of a Learning Styles Inventory. This inventory assessed four learning modes: (1) concrete experience, (2) reflective observation, (3) abstract conceptualization, and (4) active experimentation.

Since the learning modes [were] combined, he categorized them into four learning styles. The “converger” uses the abstract conceptualization with active experimentation. This type of learner asks how something works and solves problems by a coaching method. The “assimilator” uses abstract conceptualization with reflective observation. This analytical learner wants to know what the facts are and values sequential thinking. The “diverger” uses concrete experience with reflective observation. This creative learner wants to know why material is relevant. Finally, the “accommodator” combines the learning steps of concrete experience and active experimentation. This industrious learner asks “what if?” and learns by trial and error, has vision for the future, and learns best in a self-discovery method. (Lemire, 2000, p. 112)

For the purposes of this study, however, the researchers utilized the Kolb and Baker (1979-80) *Personal Learning Guide*, which includes the following descriptions of the four learning styles.

The Accommodative Learning Style - you have the ability to learn primarily from hands-on experience. You probably enjoy carrying out plans and involving yourself in new and challenging experiences. Your tendency may be to act on intuition and "gut feel" rather than careful analysis. When a thoughtful approach does not seem to be working out, you will be quick to discard it and improvise.

The Divergent Learning Style - you probably have the ability to view specific situations from many perspectives. For example, you may enjoy brainstorming and small group discussions. You also like to gather information and probably have broad interests. Your tendency may be to watch events rather than participate in them.

The Convergent Learning Style - you have the ability to find practical applications for ideas, concepts and theories. In particular you enjoy situations where there is a single or best answer to a question or problem. You may usually assume there is one best answer and use technical analysis to reveal it. You also may usually prefer to deal with technical issues rather than people issues.

The Assimilative Learning Style - you have the ability to create theoretical models (ideas that predict outcomes and descriptions of how different factors interact). You most likely enjoy inductive reasoning and distill disparate observations into logical explanations. (pp. 11-17)

However, during the past two and a half decades there have been a number of criticisms of the theory of experiential learning.

The main criticism of Kolb's theory of experiential learning is summarized by Smith (1996).

A number of criticisms can be made of the Kolb model. It pays insufficient attention to the process of reflection (see Boud et al 1983); the claims made for the four different learning styles are extravagant (Jarvis 1987; Tennant 1997); the model takes very little account of different cultural experiences/conditions; the idea of stages or steps does not sit well with the reality of thinking (Dewey 1933); and the empirical support for the model is weak (Jarvis 1987; Tennant 1997). (Greenaway, 2004)

Specifically, Smith (2001) describes six key problems with Kolb's model: "it pays insufficient attention to the process of reflection; the claims made for the four different learning styles are extravagant; the model takes very little account of different cultural experiences/conditions; the idea of stages or steps does not sit well with the reality of thinking; empirical support for the model is weak; [and] the relationship of learning processes to knowledge is problematic."

Finally, another criticism of Kolb's theory of experiential learning is that it is subject area specific. Atherton (2003) states that "broadly speaking... [the] practitioners of creative disciplines, such as the arts, are found in the "divergent" quadrant; pure scientists and mathematicians are in the "assimilative" quadrant; applied scientists and lawyers are in the "convergent" quadrant; and professionals who have to operate more intuitively, such as teachers, are in the "accommodative" quadrant." However, he is unsure if these differences are because "the discipline promotes a particular learning style or... preferred learning style leads to adoption of a discipline..."

### *Multiple Intelligences*

According to Gardner (1995) a learning style is a general approach to learning that can be applied in any situation, whereas an intelligence is a capacity for a specific content. In this respect, an individual can be "reflective, [a learning style,] with music but fail to be reflective in a domain that requires mathematical thinking or that a person is highly intuitive, [another learning style,] in the social domain but not in the least intuitive when it comes to mathematics or mechanics" (p. 205).

In 1983, Howard Gardner argued that "there [was] persuasive evidence for the existence of several *relatively autonomous* human intellectual competences" (p. 8) or multiple intelligences. In his initial work, Gardner utilized eight different criteria to identify a list of intelligences. These criteria included:

1. Isolation as a Brain Function - As medicine studies isolated brain functions through cases of brain injury and degenerative disease, we are able to identify actual physiological locations for specific brain functions. A true intelligence will have its function identified in a specific location in the human brain.
2. Prodigies, Savantes and Exceptional Individuals - Human record of genius such as Mozart being able to perform on the piano at the age of four and Dustin Hoffman's "Rainman" character being able to calculate dates accurately down to the day of the week indicate that there are specific human abilities which can demonstrate themselves to high degrees in unique cases. Highly developed examples of a true intelligence are recorded in rare occurrences.
3. Set of Core Operations - There is an identifiable set of procedures and practices which are unique to each true intelligence.
4. Developmental History with an Expert End Performance - As clinical psychologists continue to study the developmental stages of human growth and learning, a clear pattern of developmental history is being documented of the human mind. A true intelligence has an identifiable set of stages of growth with a Mastery Level which exists as an end state in human development. We can see examples of people who have reached the Mastery level for each intelligence.
5. Evolutionary History - As cultural anthropologists continue to study the history of human evolution, there is adequate evidence that our species has developed intelligence over time through human experience. A true intelligence can have its development traced through the evolution of homo sapiens.
6. Supported Psychological Tasks - Clinical psychologists can identify sets of tasks for different domains of human behaviour. A true intelligence can be identified by specific tasks which can be carried out, observed and measured.
7. Supported Psychometric Tasks - The use of psychometric instruments to measure intelligence (such as I.Q. tests) have traditionally been used to measure only specific types of ability. However, these tests can be designed and used to identify and quantify true unique intelligences. The Multiple Intelligence theory does not reject psychometric testing for specific scientific study.
8. Encoded into a Symbol System - Humans have developed many kinds of symbol systems over time for varied disciplines. A true intelligence has its own set of images it uses which are unique to itself and are important in completing its identified set of tasks.

Using these criteria, Gardener initially proposed seven of these intelligences and has added two more in 1999 with the publication of his book *Intelligence Reframed*. The original seven intelligences were

**Verbal/Linguistic intelligence** – refers to an individual’s ability to understand and manipulate words and languages.

**Logical/Mathematical intelligence** – refers to an individual’s ability to do things with data.

**Visual/Spatial intelligence** – refers to the ability to form and manipulate a mental model.

**Bodily-Kinesthetic intelligence** – refers to people who process information through the sensations they feel in their bodies.

**Musical-Rhythmic intelligence** – refers to the ability to understand, create, and interpret musical pitches, timbre, rhythm, and tones and the capability to compose music.

**Interpersonal intelligence** – is the ability to interpret and respond to the moods, emotions, motivations, and actions of others.

**Intrapersonal intelligence** – is the ability to know oneself. (Giles *et al*, 2003)

As mentioned above, two more intelligences were added in 1999. These included the Naturalistic intelligence, which “is seen as someone who recognizes and classifies plants, animals, and minerals including a mastery of taxonomy,” and the Existential intelligence, which

“encompasses the ability to pose and ponder questions regarding the existence – including life and death” (Giles *et al*, 2003).

Similar to Kolb’s theory of experiential learning, Gardner’s theory of multiple intelligences is not without its critics. There are general criticisms that the intelligences simply represent human characteristics or abilities (see Scarr, 1985; Scarr, 1989 & Herrnstein and Murray, 1994), while others have argued that the intelligences cannot be autonomous because traditional measures and complex functions have tended to indicate their interactions of these intelligences with one another (see Scarr, 1985 & Messick, 1992). However, with the exception of the Existential intelligence, Gardner’s theory of multiple intelligences has gained a fair measure of acceptance within the educational community (Gardner, Kornhaber & Wake, 1996, pp. 212-213).

## Methodology

The teacher of the business education course, who was also one of the two researchers involved in this study, invited their students to participate in a research study on learning styles and web-based design. Of the forty-two students in the course, thirty-one elected to participate.

Early in the 2002-03 school year, participating students were asked to complete a learning style inventory. This learning styles inventory was broken down into three different sections: a standard learning style guide; the Kolb’s theory of experiential learning; and Gardner’s original seven intelligences. After students completed the learning styles inventory, the researchers determined the students’ scores for each of the three measures. At the end of the course, students’ final marks were grouped based on their scored on the three learning style measure and averaged.

In addition to the learning styles inventory, the researchers also conducted an analysis of the content of the course web-based. This analysis was to determine the total number of different webpages that the course contained and the different media elements that were included in the course.

## Results

The consideration of the three traditional learning styles provided interesting results. Students were asked to determine their suitability to various statements, then the statements were then broken down into three categories; visual, auditory and tactile; and students were given a score from a low of 8 to a high of 24. The table below illustrates the student averages based upon their scores. The table can be understood to read that there were thirteen students who’s highest learning style score was in the visual category and they had a class average of 69.2%. However, there were only six students’ learning style score in the visual category was greater than 80% and they had a class average of 71.3%.

**Table 1 – Student averages based upon traditional learning style score**

	Visual	Auditory	Tactile
Students highest scores	69.2% (n=13)	54.7% (n=9)	57.6% (n=14)
Students scored 20 or above	71.3% (n=6)	45.0% (n=1)	65.7% (n=7)

Students scored 18 or above	65.7% (n=15)	57.2% (n=10)	62.3% (n=17)
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As it illustrated in the table, there appears to be a pattern that students who were visual learners performed better than those students who were tactile learners. The students who were tactile learners performed slightly better than those students who were auditory learners.

Prior to drawing any conclusion consideration utilizing a more detailed measure of learning style is necessary. Using Kolb's theory of experiential learning, students were asked a series of word association questions, which yielded results that were transcribed onto a graph. These results were joined to form a circle and the percentage of the circle that fell into each quadrant was measured to determine the students' score for each of the four experiential learning styles. The table below indicates the percentage of that circle that fell into each of the different learning styles. The table can be understood to read that there were six students who's highest learning style score was in the accommodative category and they had a class average of 60.8%. However, there were only four students who more than 40% of their circle was in the accommodative category and they had a class average of 59.3%.

**Table 2 - Student averages based upon experiential learning style score**

Number of students	Accommodative	Divergent	Convergent	Assimilative
Highest percentage	60.8% (n=6)	63.8% (n=15)	71.6% (n=9)	88.7% (n=3)
Above 40%	59.3% (n=4)	62.6% (n=10)	76.4% (n=6)	88.7% (n=3)
Above 30%	59.2% (n=11)	66.2% (n=18)	72.0% (n=11)	80.2% (n=6)

The table above indicates that students with the assimilative learning style tended to perform better than students from any of the other three learning styles. In addition, students with the convergent learning style tend to perform better than students from the divergent and accommodative learning styles.

Considering Gardner's original seven intelligences, students were provided with a list of statements and asked to indicate whether the statement was true, sometimes true and sometimes false or false. Each statement was then associated with one of Gardner's intelligences and students were to indicate the number of statements where they had selected true. This provided a measure of 0 to 5 for each of the seven intelligences, with a score of 4 or 5 indicating that students possessed that intelligence. The results are indicated in the following table. The table can be understood to read that there were four students who's highest intelligence score was in the interpersonal category and those four students had a class average of 70.8%. However, there were a total of twelve students' intelligence score in the interpersonal category was a 4 or a 5 (i.e., greater than 80%) and they had a class average of 66.5%.

**Table 3 – Student averages based upon Gardner's intelligence score**

	Inter-personal	Bodily-Kinesthetic	Intra-personal	Logical-Mathematics	Musical-Rhythmic	Verbal-Linguistic	Visual-Spatial
Students highest scores	70.8% (n=4)	67.6% (n=9)	92.0% (n=1)	66.7% (n=6)	53.3% (n=9)	58.7% (n=11)	65.7% (n=15)
Students scoring 4 or 5	66.5% (n=12)	64.7% (n=11)	71.0% (n=2)	63.7% (n=15)	59.4% (n=14)	55.7% (n=15)	63.0% (n=18)

While there are few differences in student performance based upon this measure, students who have aptitudes for “Musical-Rhythmic” and “Verbal-Linguistic” appear to be somewhat lower than the other five intelligences. It is also interesting to note that there were very few intrapersonal learners in this course, maybe indicating that students with this type of learning style were not comfortable in electing to take a course in this environment.

## Discussion

The consideration of the traditional learning styles is consistent with the findings from the initial study conducted during the CDLI’s pilot phase. Both studies found that students who showed a preference for the visual learning style tended to perform better than students from the other two styles. The consistency of the finding of both studies continued in the consideration of Kolb’s theory of experiential learning. As with the current study, in the initial study five of the seven students who had a final mark of 90% or higher showed a preference to the "Assimilative" and "Divergent" learning styles, while three of the four lowest performing students indicated a preference for the "Accommodative" learning style. Finally, the initial study also indicated that students with the lowest class averages also tended to show a preference for Gardner’s "Musical-Rhythmic" and "Verbal-Linguistic" intelligences.

The consistency in these findings seems to indicate that there is a definite bias in both the design of the web-based courses that are being offered and in the instruction of these courses in the e-learning environment. In terms of the web-based design of the business education course utilized in the follow-up study, a summary of the web-based components contained in that course are provided in Table 4. The table can be read as there were 9 pages in the “Introduction” section. Two of these pages contained a total of five images. There were also three pages that contained a total of three tables. There were no pages that contained interactive items, audio or video components.

**Table 4 – Web-based design components of the business education course**

	Pages	w/ Images	w/ Tables	w/ Interactivity	w/ Audio	w/ Video
Homepage	1					
Introduction	9	2 (5)	3 (3)			
Unit 1	76	9 (10)	2 (2)	7 (7)		4 (11)
Unit 2	63	3 (3)	2 (1)	6 (6)		1 (2)
Unit 3	80	17 (25)		3 (3)		1 (3)
Unit 4	62	9 (11)		4 (4)		2 (7)
Unit 5	72	16 (32)	6 (7)	4 (4)		6 (15)
Unit 6	31	2 (21)				1 (3)
Glossary	27					

Total	421	59 (107)	13 (13)	27 (27)		15 (41)
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# - number of pages with that item

(#) - total number of items included

The information present in the above table is to be expected, considering the student performance based upon learning style preference. The students who showed a preference to the auditory learn style and the students who showed a strength for the musical-rhythmic intelligence both had lower class averages than other categories. According to the table above, there were no strictly audio components in the entire course and the number of pages that contained videos (which did have an audio track in them) represented less than 10% of the total number of webpages in the course. While it is impossible to state that these students would have performed better had their been audio and more video components, it does indicate that there was a deficiency in the way that the web-based design of the course addressed all of the different learning styles and this may have contributed to the poorer performance for students who had learning style preferences in these deficient areas.

Based upon these findings, Kolb's theory does have implications for the design of web-based learning activities. Pimentel (1999) illustrates the various features that may be utilized in web-based courses and indicates which are better suited to a particular style as defined by experiential learning.

**Table 5 - Web-based design features based on experiential learning**

Web-based Design Feature	Affective		Perceptually	Symbolically		Behaviourally
	Accommodative	Divergent	Assimilative	Convergent	Accommodative	
Lecture notes	X		X	X		X
Slides, text						
Slides, text with audio						
Slides, text with audio and video						
Theory readings			X	X		
Case studies	X					X
Exercises, homework, quizzes			X	X		
Visualization			X	X		
Animation			X	X		
Simulations			X	X		
Peer feedback						X
Personalized feedback						X
Feelings are shared	X					
Apply skill/solve problem activity						X
Teacher is coach/helper						X
Teacher is expert/interpreter						X
Teacher as task master/guide			X	X		
Teacher as model of profession	X					
Expert talk/seminar	X					
Self directed (autonomous) learner			X	X		

Learner thinks alone		X		
Learner experiences being a professional	X			
Learner determines own criteria of relevance			X	
Focus on process		X *		
Information focus on tasks and their completion		X	X	
Symbolic tool			X *	
Information source is here and now				X
Small group discussion	X *			
Conferencing				
Synchronous broadcast				
Performance judged right or wrong			X	
Step by step solution to problem				X *

X - indicates an auxiliary feature

\* - indicates a fundamental feature

As shown above, each of the four forms of experiential learning styles has a preference to different web-based design components.

In addition to the implications for Kolb's theory of experiential learning, in terms of the design of web-based material, there are a number of different tools and applications that can be associated with each of the multiple intelligences. The following list provides examples for the original seven intelligences.

**Interpersonal intelligence** - Telecommunications programs; programs which address social issues; programs which include group presentation or decision making; games which require two or more players; TV production team approach;

**Bodily-Kinesthetic intelligence** - Software requiring alternate input such as joystick, mouse, or touch window; keyboarding and word processing programs; animation programs; programs which allow them to move objects around the screen; science probeware;

**Intrapersonal intelligence** - Computer assisted instruction/ILS labs; instructional games in which the opponent is the computer; programs which encourage self-awareness or build self-improvement skills; any program which allow them to work independently; brainstorming or problem solving software;

**Logical-Mathematical intelligence** - Database and spreadsheet programs; problem solving software; computer programming software; strategy game formats/simulations; calculators; multimedia authoring programs;

**Musical-Rhythmic intelligence** - Programs that combine stories with songs; reading programs which associate letter/sounds with music; programs which allow them to create their own song; constructing presentations using CD audio discs, videodisc player, and barcode program; sing along videodisc programs that display work "karaoke" style;

**Verbal-Linguistic intelligence** - Word processors that allow voice annotations; desktop publishing programs; programs with speech output; programs which encourage them to create poetry, essays,

etc.; multimedia authoring; using videodiscs and barcode programs to create presentations; tape recorders; telecommunications/electronic networking; and

**Visual-Spatial intelligence** - Draw and paint programs; reading programs that use visual clues such as rebus method or colour coding; programs which allow them to see information as maps, charts, or diagrams (i.e. charting capability of spreadsheet program; multimedia programs; science probeware. (Edwards, 1995)

While this list fails to account for the Naturalistic and Existential intelligences, it does provide an initial starting point for how different tools and applications can be utilized to stimulate different intelligences.

Osciak and Milheim (2001) provide suggestions for instructors in e-learning environments. They suggest that e-mail can be utilized to stimulate learners that have preferences for linguistic, interpersonal and intrapersonal intelligences. They indicate that feedback using the track changes feature of any word processor is useful with learners who also prefer the linguistic and intrapersonal intelligences. For learners who show a preference for bodily-kinesthetic and visual-spatial intelligences, instructors can use videoconferencing, which also stimulates the linguistic and interpersonal intelligences as well. Finally, “to transfer and test specific learning objectives in this type of environment, an assignment can be developed for students to collaboratively create a Web site (interpersonal), with some students preferring to do the writing or problem-solving (linguistic and logical) and other developing graphics, sounds and video clips (visual and musical)” (p. 360). According to McKenzie (2002) functions such as using the floppy disk, file manager and semantic mapping tools are useful for stimulating those with a preference for the naturalist intelligence, while virtual reality, virtual communities and simulations are helpful for students who show a preference for the existential intelligence (p. 30).

In addition to designing web-based courses or e-learning instructional methods for individual intelligences, Nelson (1998) suggested that some course components can be used to stimulate learners of all preferred intelligences. For example, simple class web sites can be used to “post class lectures, syllabi, assignments, tests and notes that include graphics, video and sound clips for students to access as needed. Tutorials, problem-based assignments, drill and practice, teaching games, simulation and programmed instruction can be also made available...” (p. 93). Based upon this view, the accommodations made for various learning preferences are made within the various class components and not through an application by application process.

## **Conclusion**

It is imperative that educators keep up-to-date with current trends in education that can make a difference in their classroom instruction. According to the Software & Information Industry Association (2001) “educators are beginning to leverage their investment: moving from access to integration mode, and from technology adoption to educational innovation”. Based upon the data that has been presented in this study, there are a number of issues that are raised for educators and instructional designers of e-learning material. The most important of these appears to be that in designing e-learning environments, developers should make sure to include more audio items.

There are also issues that are raised for educators who teach in an e-learning environment. The most important of these appears to be that e-teachers should attempt to provide additional opportunities for students to interact in a verbal (e.g., audio or text-based) way. "In final analysis, online learning or e-learning isn't about digital technologies any more than classroom teaching is about blackboards. E-learning should be about creating and deploying technology systems that enable constructive human interaction and support the improvement of all teaching and learning" (Blomeyer, 2002, 19).

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