

# Chapter 9

## Considering Learning Styles When Designing for Emerging Learning Technologies



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**Abstract** An examination of what learning styles really mean, where they came from, how they are used and their impact on the design and delivery of education is the focus of this chapter. Learning style theories have had a long history in the West and were born from a plethora of learning theories developed mostly in the early twentieth century. The definitions of learning styles have evolved since its inception in the late 1800 s with many opinions defining and redefining them. Criticism about the truthfulness and usefulness of learning styles for both pedagogical and learning practices has been and continues to be part of decades-long debates and discussions. How learning styles are identified, assigned and the subsequent meanings attached to them have historically guided research and educational practices, many say in the wrong direction. There is much literature that clearly negates the claims of one main learning style used for learning in all contexts, with evidence showing that several modalities work best for higher-level learning. Yet, even with such hard and clear evidence against the way learning styles theory is often interpreted and used, it has, and continues to have, great influence in both research and educational practices, why is this? Cultural implications around learning styles naturally need to be examined especially within this broad, digital world. As online and e-learning continue to take hold in the global classroom, it makes sense to examine what learning styles theory means for online learning for both teachers and students.

**Keywords** Emerging technologies · Learning styles · Learning preferences · Learning inventories · Multiple intelligence · Learning styles theory

### 9.1 Introduction

The theory of learning styles has been discussed and re-examined for decades with much of this research done in the classroom setting. This has generated much debate as to the pedagogical usefulness of learning styles as a productive method of teaching

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and learning. Ample literature has discredited the early claims of learning styles theory, showing that no scientific evidence supports the claims (Lethaby and Harries 2016; Martin 2010). Although seemingly unfounded, learning style theories still guide much educational research and practice, and even though largely discredited, learning style theories are still a part of teacher education training programs as well, thus remaining very influential (Lethaby and Harries 2016; Martin 2010). Howard-Jones (2014), showed that within five countries (UK, Netherlands, Turkey, Greece and China), teachers agreed that students learn better when they receive information tailored to their preferred learning style.

With online learning in higher education becoming a global phenomenon, considering learning styles in this new context of globalization with emerging technologies is important as well. Emerging technologies common in distance education today include massive open online courses (MOOCs), mobile and ubiquitous learning and virtual reality (VR). MOOCs can indeed be massive with its digital classroom's walls bulging to capacity from several hundred to several thousand students (Atiaja and Guerrero 2016). Although emerging technologies are found in almost every field imaginable, they are considered optional and not yet a requirement for learning; many have a futuristic feel that has not truly taken hold or is really still in its infancy (Emerging technologies in education n/d; Miller et al. 2005; Atiaja and Guerrero 2016). Miller et al. (2005) offer a clear explanation of emerging technology:

A technology is still emerging if it is not yet a “must-have.” For example, a few years ago email was an optional technology. In fact, it was limited in its effectiveness as a communication tool when only some people in an organization had regular access to it. Today, it is a must-have, must-use technology for most people in most organizations. In this sense a technology can be a standard expectation in the commercial or business world, while still being considered as “emerging” in the education sector. (p. 6)

Do learning styles therefore have a place in this new world of education? This chapter will examine the definition of learning styles, what they mean, where they came from, how they are used and their impact on education. Cultural implications will also be examined along with the biases of Western developed learning style tools and, most importantly, learning styles in the realm of online education or e-learning.

## 9.2 Description

### 9.2.1 *What Are Learning Styles?*

A learning style was initially described as a student's consistent way of responding to and using stimuli in the context of learning (Keefe 1979). Willingham et al. (2015) explain that although many learning style theories are varied, each holds that individuals learn in different ways (learning styles) and that learning is optimized if the instruction is tailored to an identified learning style. The definition has evolved through the years with later definitions offering a broader explanation. Keefe (1979) defines learning styles as the “composite of characteristic cognitive, affective, and

physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment” (p. 4). Stewart and Felicetti (1992) define learning styles as those “educational conditions under which a student is most likely to learn” (p. 15). Learning styles are therefore not concerned with *what* learners learn, but rather *how* they prefer to learn.

Learning styles can therefore be better described as learning preferences, describing how students prefer to learn, not necessarily that they learn more or better through any such self-identified style. This more apt descriptor is still not quite how teachers tend to view learning styles. Many educators still think of learning styles as students learning better through their self-identified style. Topical literature shows us that learning preferences, combined with other methods, are the most optimal approach for higher-level learning (learning styles as a myth n/d). One alternative to understanding how students learn, although often confused as the same as learning styles, is multiple intelligence theory which focuses more on how students prefer to process information. Gardner (2017) describes the purpose of multiple intelligence theory (MI) that it “seeks to describe and encompass the range of human cognitive capacities. In challenging the concept of general intelligence, we can apply an MI perspective that may provide a more useful approach to cognitive differences within and across species” (p. 1).

### 9.2.2 *History of Learning Styles*

How people learn has been a subject of speculation and study since at least the 1800s. At that time, teachers began to look beyond just their role in teaching and look at the experiences of the children in the classroom, recognizing their individuality and interest in learning and this in turn began to influence teachers’ pedagogical training and practices (Boone 1894). The term “learning style” has been with us a long time and first appeared in 1892; in 1954, it was applied in a study by Thelen to groups at work (Honey and Mumford in Fatt 2000). Jung developed a theory of personality types in the 1930s, and several theories from other theorists have been presented since. Learning style inventories come directly from these personality theories. One of the first learning style inventories offered in the West is by Betts and was published in 1909; over 70 instruments have been developed in the following years. There has been an abundance of learning styles described through the decades and are labelled by self-identifying instruments. The purpose of self-identification is best described by Kolb (2014) and is twofold: firstly, an understanding of the different ways in which students learn can enhance their own learning; secondly, teachers would have valuable information that would assist in the teaching and planning process resulting in enhanced educational performance.

Some of the most popular learning styles describe learning as happening through the senses: visual, auditory, read/write, kinetic, verbal, social, logical, emotional, field dependant, field independent, to name but a few. Each offers a preference for learning or places the individual on a continuum between two identifiers. Truong

(2016) discusses some of the most notable for the e-learning environment, beginning with Felder-Silverman's learning style theory. This theory divides learners based on their information input, information process, perception and understanding. The author also identifies Kolb's learning style inventory and Honey and Mumford's learning styles; both these styles describe the learning style based on the student's proposed learning cycle (concrete experience, reflective observation, abstract conceptualization and active experimentation). Even though learning style theories and inventories have enjoyed much popularity, there has been a considerable concern from the many nay-sayers.

Throughout much of the twentieth century, learning styles have been critiqued as having no scientific evidence to support its claims, and although this is the case, they continue to be a part of popular culture and in the educational setting. The implications of accepting the theory of learning styles are its entirety that if, for example, a "visual learning style" is reported, then all learning should take place more efficiently through this modality, yet evidence shows that this is not so. Learners can identify subjective or self-identified preferences for learning but this does not mean that deeper or more efficient learning is taking place when using this preference. While learning style still drives education research and pedagogy, it has been viewed as somewhat of a pseudoscience that continues to influence education (Goodwin and Hein 2017). Nonetheless, even with much doubt and lack of clear evidence, learning style theories have been driving educational research, practice and programming for decades (Parslow 2012).

### ***9.2.3 Evolution of Learning Styles***

Learning theory began early in the twentieth century with the mid-twentieth century seeing an increase in many learning theories. Learning theories produce ideas and with those ideas come instruments that permit some modification for application. The pedagogical piece accompanies these instruments, influencing how teachers view learners and how they organize, create and implement their learning materials. Each instrument created for each theory is, in essence, a "theory-in-action" measuring tool. The purpose of each tool is to help understand where on a continuum or which end of the binary an individual lies. Learning styles work to inform both the student and the instructor. Once the description of how a learner learns best is established, the reaction to this claim in the world of education is to tailor teaching to match the learning style of a student, and in this way, a student's learning is optimal. A plethora of learning styles have grown through the decades with each attempting to answer the question of "what is learning style"? With each identification follows a descriptor of how one learns and subsequent advice about how to create learning materials around the identified style.

Management organizations and education were and are great supporters of all things learning styles. Many teacher training programs explore learning theories and educational institutions have adopted particular learning style theories that seem to fit well into pedagogy or, seem to enlighten the learning process to ensure that students

learning experiences are complete (Martin 2010). Martin (2010) goes on to say that “The use of instruments reporting individual learning or cognitive style is attractive for educators, especially within high-pressure to reach or improve upon high levels of student performance in public examinations and to promote individualized learning” (p. 1583). It is therefore understandable that learning styles remain a part of education with the heavy support they receive from educational institutions.

Concurrently, a vast number of researchers from varying disciplines, each focused within their research, can muddy the waters as each interprets evidence and theories aimed at and focused in their own fields. The commercial production and distribution of all these various instruments has a tremendous impact on education. The selling of instruments and sometimes training to interpret these instruments, along with books and other supporting information, can be quite financially lucrative. These instruments are developed accepting the assumptions, analyses and goals of the theorists, which are often as commercial as they are research orientated (Coffield et al. 2004).

### ***9.2.4 Assignment of Learning Styles***

Throughout most of the twentieth century, learning styles were assigned through self-identification inventories but technology can also assign learning styles. Learning style inventories have always been a popular activity and rely on students answering questionnaires; the choices then determine the most accurate and appropriate learning style for that individual. Li and Abdul Rahman (2018) explain these detections of learning styles in two distinct ways: (1) static detection, based on learning style inventories and (2) dynamic detection through the learning behaviour. Although self-identification is a common way to identify learning styles, in recent years, the application of machine learning and the accompanying computerized algorithm analyse online behaviours, creating a huge database of online learning preferences. McLean (2018) describes machine learning (ML) as “a discipline within artificial intelligence (AI), and is the science of getting computers to do something, without explicit programming” (p. 1). The use of technology to assign learning styles through learning behaviour is an interesting concept. The emerging technologies of today, such as MOOCs and VR, are becoming more and more familiar to students so technology-based instruments to measure or identify learning styles would seem relevant and in line with the technological experience.

Online behaviours include: participation in forums, chat boxes, emailing, accessing online journals, blogs and other articles, movement within a platform, amount of time spent in a platform, accessing links within a platform. Machine labelling has offered interesting results; the software examines online learning activities of students and then assigns learning styles/preferences based on said activities. This is an interesting way to examine learning preferences in the online learning environment. It takes the subjective perspective of student self-identifying away, focusing solely

upon actions of students. As students become more engaged in emerging technologies, an understanding of learning preferences in these contexts can be proactive as it can guide pedagogical approaches.

### ***9.2.5 Pros and Cons of Assigning Learning Styles***

Knowing about individual learning preferences has many benefits for both the student and for the teacher. Knowledge about a student's own learning can offer a sense of confidence in learning which can be extremely motivating (Coffield et al. 2004; Truong 2016). Labelling a preference for learning can offer a place to begin new tasks. This knowing is often shared with teachers, or even implemented by teachers, and the discovery of learning styles can also help a teacher become more mindful of pedagogical practices and ensure that a variety of approaches will be explored when planning and subsequently implementing programming. Coffield et al. (2004) state that "A knowledge of learning styles can be used to increase the self-awareness of students and tutors about their strengths and weaknesses as learners. In other words, all the advantages claimed for metacognition (being aware of one's own thought and learning processes) can be gained by encouraging all learners to become knowledgeable about their own learning and that of others" (p. 43). This knowing can also offer disadvantages in the learning environment for both student and teacher as well.

A label can pigeonhole a learner which can have several drawbacks. A student's expectation about learning can limit not only the student's approach to learning but also the expectation of learning; a student may not attempt anything beyond the realm of what they believe is attainable through the preferred learning style only. Not only can a student be limited by a "one-size fits all" perspective with regard to approaching learning, a teacher's attitude can be impacted as well (Martin 2010).

A teacher with a limited view of how an individual can learn can narrow the pedagogical approach and expectations towards a student. Much of the literature concludes that approaching learning in just one way can inhibit "deep learning". One more negative about this way of thinking is that the onus for learning is shifted from the student and towards the teacher. Should the student fail to progress, it is then the teacher's fault for not directing teaching exactly towards a student's identified learning style. This may have particularly ominous consequences in jurisdictions that adjudicate teachers by their classroom scores on universal tests.

## 9.3 Literature Review

### 9.3.1 Critiques

Learning styles have had a volatile history during the last 100 years and has had, and continues to have, an impact on educational research and classroom pedagogy. As the brick and mortar institutions of learning give way or at least share the face-to-face classroom with the digital online classroom world, an exploration of learning styles in general, how they have developed and the impact of them in the realm of online learning and emerging technologies, is worth examining. Allport (1937) describes an individual's cognitive style as the typical and habitual mode of problem-solving, thinking, perceiving and remembering. Learning styles can be described as the application of this cognitive style in the learning environment (Riding and Cheema 1991). Many researchers conclude that the research around learning styles, what they mean and how they are used, has been somewhat misinterpreted.

The terms, learning styles and multiple intelligence, have been used interchangeably for decades. Both seem similar but are quite different. Gardner (2013) clarifies this confusion by explaining that learning styles are simply a hypothesis about how an individual will approach a range of materials, whereas multiple intelligence is about how the brain uses, stores and interprets this information. Gardner has identified nine multiple intelligences and everyone uses them all, some to differing degrees. Multiple intelligences represent different intellectual abilities and include: naturalist (nature smart), musical (sound smart), logical–mathematical (number/reasoning smart), existential (life smart), interpersonal (people smart), bodily–kinesthetic (body smart), linguistic (word smart), intra-personal (self-smart) and spatial (picture smart). Cherry (n.d.) claims that Gardner's theory is not without criticism either and has come under fire from both psychologists and educators. These critics reason that Gardner's definition of intelligence is too broad and that his nine different "intelligences" simply represent talents, personality traits, and abilities, not intelligence. It is also maintained by the Cherry (n.d.) that Gardner's theory also suffers from a lack of supporting empirical research; despite this, the theory of multiple intelligences still enjoys considerable popularity with educators.

Within education, there are many problems associated with the identification and subsequent pedagogical direction based on the results of any learning style instrument. Pashler et al. (2008) conclude that students do not necessarily learn better when using their preferred learning style but learn equally well using a variety of styles. Curry (1991) determines that identifying learning styles and the characteristics most relevant to learners in an educational environment is problematic. Confusion around terminology and definitions, along with issues in validity and reliability, adds to the problems of learning styles in education. Coffield et al. (2004) go on to say that "Yet beneath the apparently unproblematic appeal of learning styles lies a host of conceptual and empirical problems. To begin with, the learning styles field is not unified, but instead is divided into three linked areas of activity: theoretical, pedagogical and commercial" (p. 2).

Learning styles are born from the models forged under the psychology discipline yet are implemented and practised strongly in other disciplines. Much of the researches around learning styles have taken place in other domains, such as management, vocational training and education, to name just a few. Cassidy (2004) postulates that the reason that the topic has become so fragments and disputed is a direct result of each domain having its own research focus. Coffield et al. (2004) state that “Mainstream use has too often become separated from the research field. More problematically, it has also become isolated from deeper questions as to whether a particular inventory has a sufficient theoretical basis to warrant either the research industry which has grown around it, or the pedagogical uses to which it is currently put” (p. 2).

Supporters of learning style theory postulate that tailoring instruction around identified learning styles optimizes both instructor and subsequent learning for students (Parslow 2011). There have been many identifying instruments developed from the theories and the results offer useful information for placing or sorting individuals on a continuum, based on self-identified answers on the created instruments. The popularity of learning styles in popular culture and within education seems to not take the conclusions of the critics seriously. If learning styles are here to stay, then perhaps ensuring that students become aware of their “preferences” rather than focusing on one style and if teachers begin thinking this way as well, then perhaps we can lessen the negativity of this phenomena.

As previously discussed, the impact of learning styles on online learning for both students and teachers can be both positive and negative. Learning style theory is embedded in much teacher training (Lethaby and Harries 2016). Learning styles seem intuitive and commonsensical. There is much social influence in this area; there is a plethora of books, websites, experts and articles dedicated to uncovering learning styles which subsequently increases teacher efficiency (Willingham et al. 2015; Pashler et al. 2008). The claims seem reliable, we may, for example, not understand the science claims behind gravity but still accept it (Goodwin and Hein 2017). Widespread belief is the confusion between ability (which is multifaceted) and style or preference for learning, which hinges on one modality.

### ***9.3.2 Emerging Technologies***

Emerging technologies have essentially brought the world together through the digital classroom. This phenomenon has forced us to look at changes in pedagogy. Employing emerging technologies in distance education is described by Veletsianos (2010) who says that “to further educational goals may necessitate the development of different theories, pedagogies, and approaches to teaching, learning, assessment, and organization” (p. 18). The text goes on to say that although not likely well researched, as emerging technologies are relatively new, a true understanding of the relationships between pedagogies and technologies warrant analysis. Learning styles fall under this examination as well. Massive online learning classrooms (MOOCs) can have



thousands of students from a barrage of different cultures and socio-economic backgrounds. It is the contentious view of this author that we, as educators, simply cannot continue to approach teaching as if all students are a homogenous group in a brick and mortar institution; this simply will not work. Cultural expectations are bound to influence how we present, monitor and facilitate the online learning classroom experience. A broader look at learning styles within this context is worth exploring. Emerging technologies are influencing the evolution of the digital classroom. Within this evolution, we must ensure that we respond with an aligned pedagogy. This examination will not only influence pedagogical practices but also enhance our understanding of the impact of emerging technologies on the design of the digital classroom and will also offer an innate understanding of its participants in this digital world as well.

### ***9.3.3 Cross-Cultural Implications for Learning Styles***

Cultural differences and preferences for learning can be quite different from the Western view of learning styles and preferences. Different cultures look differently upon learning and thinking. Gu et al. (2017) discuss the research in cultural psychology that has emerged identifying individual learning differences which have arisen from cultural factors. These individual differences are described in terms of motivation and processing, thinking styles and learning styles. Students from different cultures need to be considered in the online learning world as well. In the global digital world, these students' differences warrant a close and considered examination. Thus, online learning has meant a re-examination of learning styles and their potential contribution.

The growth and expanse of the global digital community means that students from all over the world have access to online learning from all over the world. Different cultures have different expectations about the roles of learner and student. In some cultures, it is disrespectful to ask the teacher any questions and it is frowned upon if females ask any questions. Other cultures dedicate weekends to family and prayer so teachers need to be cognizant of what expectations they have for assignments over weekends (Kumar and Bhattacharya 2007).

An awareness of culturally inclusive practices by the instructor may ensure that extra encouragement, modelling, consideration and clear directives are given to some students. Popov et al. (2013) noted that collaboration in culturally mixed groups is often challenging and may require extra facilitation. LaFever (2010) states that "The critical examination of standard teaching practices in North American schools were catalysed by the civil rights movement and the recognition that educational institutions were not serving society as a whole" (p. 1). Tran (2012) concludes that "students from CHC (Confucian -heritage-culture) may hold a different perspective on the appropriateness of behaviours and reactions in the classroom environment" (p. 64). The author goes on to say that for students to move to a more active learning

environment, it takes time and that they will need help and guidance from instructors to recognize and handle the differences and adapt.

Understanding that we need to be aware of Western bias and embrace cultural differences when managing, creating and delivering content for online classes cannot be ignored. Instructors need to strive towards inclusiveness with these new global electronic classrooms. Alalshaikh (2015) reinforces the role that teachers and instructional designers need to take with culturally different students. “Teachers and instructional designers need to develop online course content this is culturally appropriate and culturally sensitive” (p. 74). The author goes on to say that this need to be culturally sensitive and to take this information into consideration when designing courses and programs, ensures inclusivity for different cultural groups. The goal always being that learning is enhanced.

Online learning can be different from the face-to-face classroom; considering those from different cultures and their differences in the online classroom is an important piece of culturally sensitive pedagogy. Alalshaikh (2015) identifies four categories in the online learning environment: perceptual learning styles; cognitive processing learning styles; social learning styles and problem-based learning styles. Each style is broad and encompasses a wide group of preferences. Perceptual learning styles describe learners who prefer textual information and may have strong auditory component to learning (reading and listening with their mind’s ear). Cognitive processing learning styles discuss learners who prefer abstract concepts, learning through concrete examples. Also included in cognitive processing learning is the holistic or global style. Social learning styles are about social engagement. Students may want to study alone or with peers; they may also need guided learning. Finally, problem-based learning styles seem to combine the previous styles. Wheeler et al. (2005) say that problem-based learning promotes skills through “complex, real-life problems and motivates student to adopt deeper approaches to study” (p. 126).

Students from differing cultures have some culturally specific behaviours when participating in the online learning environment. Yu-Chih et al. (2013) reported on a study about many different cultural groups, and several interesting results were noted. Several ethnic groups in the study preferred learning that is kinesthetic, auditory and tactile except for Anglo students who preferred visual learning styles and did not like cooperative learning. It was noted too that Asian students are more visual than verbal learners. These are, of course, generalizations but some commonality should alert the instructor to take this information into consideration when planning and teaching (Alalshaikh 2015).

Popov et al. (2013) report that “collaboration in culturally mixed groups is less than optimal and may require extra facilitation” (p. 36). This implies that teachers need to ensure their course planning matches the cultural needs and differences of their students. Popov et al. (2013) go on to discuss that the “results reveal that cultural differences could be understood in terms of differences in thinking styles, and that these differences could affect the collaborative process” (p. 22). Cultural differences in the global world of online learning must be considered when planning. Popov et al. (2013) found that teachers assigning scripted roles according to cultural backgrounds may have value in assisting students who collaborate with others. Teachers who are

considerate of their culturally different student population by planning activities and assignments accordingly can only help but enhance these learners. Thinking of learning preferences with different cultural populations within emerging technologies is an important consideration in terms of adjusting pedagogical practices as well.

## 9.4 Assessment

### 9.4.1 *Informing Practice*

The applicability and usefulness of the various theories and research clearly inform distance educational practices and has many practical applications for educators. Students benefit from different kinds of instruction because, (“*Learning styles and myths*” n.d.)

learning requires complex, often uneven developmental steps like building on prior knowledge, forming conceptual structures slowly, and varieties of repetition, students benefit when instruction provides various ways to enter into learning. Alternating modes can serve different students’ aptitude, level of self-awareness as a learner, and cultural background. (p. 4)

Cassidy (2004) laments that although research into learning styles has no real scientific evidence to back its claims, knowing about differing learning styles within individuals and within oneself can promote valuable insight into both learning and teaching in the educational setting. Teachers offer varied presentations when planning is best for students as they learn in a variety of ways.

### 9.4.2 *Practical Application for Online Learning*

There is an expectation for students in the online learning environment to manage their own learning (Alalshaikh 2015). We are well beyond distance learning of yesterday with packages arriving in the mail and learning taking place in isolation. Today, the online learning environment offers both real-time synchronous experience as well as asynchronous experience. Students do have a preferred way to learn, and some of these preferences have cultural influences; both need to be considered when planning and implementing programming. Important too, is the consideration of the specific and likely different needs of students when participating in and using emerging technologies, such as MOOCs and VR. It should also be noted that the learning preferences that students have identified or are aware of for face-to-face learning may be different during their online learning experience.

Within both synchronous and asynchronous learning, there are many practical applications one can implement that have been influenced by learning style theories meant to enhance learners’ experiences. An understanding that students prefer to learn in a particular way, but they actually use many modalities for deep learning, encourages teachers to ensure that they are offering content in many ways.

Learners, in turn, experience content and participate in varying ways on the learning platform. Within synchronous environment, there are several suggestions to ensure that students remain engaged. All these suggestions can appeal to several learning preferences. Group discussions during class-time, with very clear directions, text with visuals with any supporting materials will appeal to those who prefer material presented visually. Synchronous group discussions can be challenging in the online classroom. Using clear, concrete language is important for individuals who need precise direction, often a need with some culturally diverse groups. Videos are useful for keeping students engaged. Articles to read during class can offer active engagement for students. Small group discussions are valuable as well, students remain engaged and can come back to the group with feedback; assigning roles is important as some students need this directive. Small group discussions also give the students a sense of belonging and participation. Giving time for forum discussions during class time helps keep students, who prefer this mode of participation, engaged. Online presentations also work well within a synchronous environment. It allows for active engagement and time for a thoughtful response. Removal of time constraints for students who experience test anxiety, etc....is valuable as well (Oh and Lim 2005; El-Bishouty et al. 2014).

Asynchronous learning, although similar to synchronous learning with regard to types of activities, is different because there is no real-time interaction. It is important for the instructor to provide guidance and structure for forum discussions. Teacher moderation is important, especially for culturally different students who have an expectation about the roles of teacher and student. Emailing feature is also a great communication tool for both students and teachers in an asynchronous environment. Closed, small group forums allow students to discuss assigned (or unassigned) topics with small groups. This allows students who would not normally participate in a larger discussion group to participate. Responding to posted assignments and offering time to reflect on those assignments is useful too as well (El-Bishouty et al. 2014).

Suggestions about how learning styles can assist online learning are relevant and useful. Both asynchronous and synchronous learning can be improved upon by ensuring that student learning preferences are considered. As the machine-based identifier of learning preferences noted, students do have preference for how they participate in the online learning environment so ensuring that the activities, assignments and tools are made available to them is important for students continued participation and maximum learning.

## 9.5 Conclusion

Learning style theory has been with us for a very long time. It grew from learning theories, and although it has been criticized for several decades, it is still extremely influential in both research and education. The overall belief is that we learn a particular way, and this has been proven to be untrue. The literature shows that we all have learning preferences but we use several ways to learn information with parts of our

brains working together, rather than in isolation and depending on the context, we learn differently. Inviting students to reflect on their learning (metacognition), rather than focus on “a” learning style, has shown to improve learning outcomes (Ambrose et al. 2010).

Instructional methods can vary across disciplines and course content. Cultural influences have an impact on learner preferences and need to be considered when planning and implementing programming. For optimum educational performance for both teacher and student, we need to understand and even embrace the ideas of learning preferences, multiple intelligences and cultural differences. All must be acknowledged and taken into consideration, in both the brick and mortar institutions and within the online environment. The shift towards emerging technologies and learning styles/preferences within these environments is an important part of the evolution of education. Most learning style research and instruments were developed before emerging technologies were introduced in education. Further research is required to determine learner preference when using emerging technologies. In addition, it may be advantageous for the learner to function in all of the dimensions of learning style so that they can maximize their learning. The challenge for education is how to develop the “whole person” with many learning preferences so that they can learn using any technology and delivery method.

## Glossary of Terms

**Asynchronous learning** Delayed interaction with teachers and other students during the learning process.

**Learning style** An individual preference during the learning process and interacting with others.

**Synchronous learning** Simultaneous interaction with teachers and other students during the learning process.

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