



A Proposal of a Conceptual Model for the Development of Adaptive E-Content based on Learning Styles

Ibrahim Adam¹, Tenku Putri Norishah¹, and Zainudin Bin Siran¹

¹Multimedia University, Cyberjaya, Malaysia

1161403286@student.mmu.edu.my

Abstract. The concept of e-learning has evolved over the past decade and the needs of distance learners have changed significantly with the advancement in technology. Therefore, it is crucial for e-learning environments to be advanced and adaptable to accommodate and support the diverse needs of learners. However, providing the same static content to all students without considering their needs or abilities and inability to handle the differences of the varying needs, goals, backgrounds, knowledge levels and learning capabilities of the students has been found to be one of the biggest issues within most of the e-learning environments. E-learning systems that lack an environment with adaptive features that provide only the same materials to all students and do not consider their needs or abilities are considered a failure. E-learning needs to be developed to accommodate and support personalized learning, where instruction is tailored to a students' individual preferences and learning styles. Through literature review, this article proposes a conceptual model for the development of adaptive e-content for the personalized e-learning environment based on student's learning styles.

Keywords: Personalized Adaptive E-learning, Adaptive E-content, Learning Styles

1 Introduction

It can be agreed that the higher education is undergoing a shift from instructor-centered pedagogies to student-centered pedagogies. One of the drivers of this change is due to the increased attention towards personalized and adaptive learning within the academia. The argument behind this concept is that when instruction is customized to meet each learner's needs, students learn more effectively. This new pedagogy of personalization recognizes that every student is different (Taylor, Yeung, & Bashed, 2021; Dockterman, 2018). Personalized learning refers to “the pedagogy where the pace of learning, the instructional preferences and the learning objects are optimized as per the needs of each learner.” (Raj & Renumol, 2018) The main goal of this approach is to ensure that every student has an effective, customized, and efficient learning experience. By tailoring the learning path to each individual, we can ensure that every student can actively

participate in the learning process, making education accessible and engaging for everyone (Hussein & Al-Chalabi, 2020).

Personalization in learning environments involves creating a perfect fit for each learner's profile which would result in enhancing their performance and the overall quality of their learning experience (Hussein & Al-Chalabi, 2020). Even though, personalized learning can be achieved in a classroom, it becomes more challenging to achieve as the number of students in a class increases. It can be quite a daunting task to ensure that each student receives individualized attention and support. However, the development of educational technologies has made it much easier to provide personalized learning in various contexts and to a diverse range of learners. With the advancements in technology, we now have the tools and resources to cater to learners who differ across dimensions such as skills, knowledge, and motivation. (McCarthy, Watanabe, Dai, & McNamara, 2020). Adaptive computer-based learning allows learners to study the content in a way that aligns with their specific learning style. (El-Sabagh, 2021).

With the increasing integration of technology in education, scholars like Stella & Gnanam (2004) have recognized the emergence of a distinct educational approach known as e-learning (Oliver, 2005). Over the past decade, the concept of e-learning has undergone significant evolution. With advancements in technology, the needs of distance learners have also changed, leading to a revolution in the delivery of e-learning (Ahmed, Hussain, & Bagram, 2017). Therefore, there is a requirement for e-learning environment to be advanced to accommodate and support the needs of the learners. However, according to Aciad & Meziane (2019), one of the major issues in many e-learning environments that still exists is providing the same static content to all students without considering their unique needs, abilities, and backgrounds.

Adaptive e-learning has gained significant traction in higher education institutions recently. One of the reasons is that adaptive e-learning environments greatly enhance the quality of e-learning as it offers customized content. A review of the literature has indeed shown that adaptive e-learning environments can have a significant impact on learning outcomes, bridging the gap. Numerous studies have shown the effectiveness of adaptive e-learning in delivering content that aligns with learners' needs and learning styles. This personalized approach greatly enhances the acquisition of knowledge and experiences, while also fostering the development of higher-order thinking skills (Ali et al., 2019).

While adaptive learning holds great potential in promoting access and quality in higher education, its implementation in teaching and learning is still limited and inconsistent (Becker et al., 2018). Further research is required to have a thorough understanding on how to design and teach an adaptive learning course in a higher education context requires so that its benefits and how it can cater to different learning styles can be studied (Kirschner, 2017; Truong, 2016). While there are many elements available in the educational process, there can be weaknesses in the design of electronic educational content and the adaptation between these elements. It's important to address these weaknesses and ensure a meaningful design of electronic educational content to create a more effective learning experience.

1.1 Detail of the Research Problem

The importance of e-content development is now recognized as a major factor of e-learning design. The quality of content and the effectiveness of learning methodologies are indeed crucial criteria for assessing the effectiveness of e-learning platforms in higher education (Al-Alwani, 2014). Today, success of e-learning outcomes is ensured based on the flexibility, adaptability towards students' needs, effective and official design of electronic content (e-content). However, one of the greatest challenges of integrating technology in education is lack of quality e-content. Providing the same static content to all students has been found to be one of the biggest issues within the most of the e-learning environments (Aciad & Meziane, 2019). E-learning systems that lack adaptive learning environments or fail to provide personalized materials to students can be considered ineffective. It's essential for e-learning platforms to consider the unique needs and abilities of individual learners in order to provide a tailored and engaging learning experience (Radenković, Despotović, Bogdanović, & Barać, 2009).

The emerging field of Adaptive E-Learning Environment (ALE) focuses on developing approaches that cater to students' individual learning styles by adapting the learning environment within the Learning Management System (LMS). This adaptive approach aims to transform the way e-content is delivered, making it more personalized and effective for each learner. "Adaptive e-learning is a learning process in which the content is taught or adapted based on the responses of the students' learning styles or preferences." (Nor-madhi et al., 2019; Oxman & Wong, 2014). Higher educational institutions often have standardized learning materials that don't take into account students' individual learning styles, knowledge levels, or time constraints. As a result, implementing adaptive learning is a current challenge for these institutions. Yet, it is an important task for these institutions need to address. (Morze, Varchenko-Trotsenko, Terletska & Smyrnova-Trybulska, 2020). If the learning environment doesn't meet the needs of the users, it can lead to dissatisfaction and may even push them to seek alternative options. (Cheok, Wong, Fauzi, & Rosnaini, 2017). E-learning should be developed to accommodate and support personalized learning, where instruction is tailored to students' individual needs and learning styles.

Creating high-quality content and delivering it effectively is indeed a challenge in modern e-learning systems. Traditional content may not meet the academic needs of distance learners, considering the geographical separation between learners and tutors. To address this, it's crucial to develop specialized e-content that matches the learning styles of distance learners. By designing and preparing tailored e-content, the quality of e-learning environments can be enhanced. The geographical distance between the learner and the teacher can be accommodated by developing specialized e-content for the learners. Learning style is an important consideration for the design of learning contents in an e-learning environment (Ahmed, Hussain, & Bagram, 2017).

2 Literature Review

Literature review was carried out focusing on the application, types, methods and ways of designing, development and implementation of personalized adaptive learning

environment. A specific focus was on implementation of personalized e-learning environments. The literature review commences with the identifications of determinants for the conceptual model for the development of adaptive e-content.

2.1 Personalized Adaptive Learning

Personalized adaptive learning is formed with the combinations of the terms; “personalized learning” and “adaptive learning”. The emergence of personalization in education is a direct response to the diverse and multicultural classrooms we have today. With students having various learning styles and paces, and professionals facing high demands in the workplace, it's crucial to address these needs through personalized approaches. American psychologist and behaviorist B. F. Skinner (1968), who is considered to be “a founder of personalized learning”, stated in his book “The Technology of Teaching” that “one of effective ways of teaching is dividing material into small parts and adapting learning tasks to current level of students’ knowledge.”

The phrase “adaptive learning” implies “the ability to vary, change and to modify consistent with any learning competencies of a student, as a function of information which is obtained through their execution on set tasks or assessments.” (González, 2010) Adaptive learning is a method that aims to provide personalized learning by offering tailored learning pathways for each student. It focuses on creating competent and successful learning experiences that engage students on an individual level (Arsovic & Stefanovic, 2020). Research has shown that when the learning environment is personalized for the students, it greatly enhances the learning process and results in improved learning outcomes and achievements.

2.2 Adaptive Learning Based on Learning Styles

Researchers report that a student's learning style plays a crucial role in adaptive learning as by understanding and recognizing the unique ways in which learners process information, the presentation of content can be tailored to meet their individual needs (Bernard et al., 2017). Some individuals learn quickly, while others may require more time and practice. Some may benefit from solving more problems, while others may prefer learning through examples. These preferences are generally referred to as an individual’s learning styles.

The word “learning style” refers to “the process by which the learner organizes, processes, represents, and combines this information and stores it in his cognitive source, then retrieves the information and experiences in the style that reflects his technique of communicating them.” (Fleming & Baume, 2006; Jaleel & Thomas, 2019; Jonassen & Grabowski, 2012; Klasnja-Milicevic et al., 2011; Nuankaew et al., 2019; Pashler et al., 2008; Zhang, 2017)

2.3 Theories of Learning Styles

Researchers have indeed recognized the importance of learning styles and have developed various models and theories to categorize them. These models aim to provide a framework for understanding and accommodating different learning preferences.

While there are multiple theories and models, the common goal is to create a more personalized and effective learning experience for students. Some of the major such models and their arguments are summarized on Table 1 below.

Table 1. Summary of common learning style models/theories.

Model/Theory	Major Arguments	Orientation of learning styles
Jung's Model of Typology (1987)	This theory states that individuals have a dominant mental function from the four functions that they prefer when it comes to learning.	1) thinking 2) sensation 3) feeling 4) intuition
Kolb's Experiential Learning Cycle and the Learning Style Inventory (1984)	According to this model, the learner will, over time, show a preference for a certain stage in the cycle and that will then help determine their learning style. as learners progress and gain more experience, they tend to develop a preference for a specific stage in the learning cycle. This preference then helps determine their unique learning style.	1) Diverging 2) Assimilating 3) Converging 4) Accommodating
Fleming's VARK theory (2006)	The VARK theory does not involve intelligence or skills but is related to how learners acquire new information or knowledge, which can be tested and implemented into the classroom in order to accommodate a larger number of learners	1) Visual 2) Aural 3) Read/Write 4) Kinesthetic
Felder-Silverman Learning Style Model (FSLSM)	FSLSM distinguishes preferences or characteristics of learning styles into four dimensions: perception dimension, processing dimension, input dimension and understanding dimension. It further describes a single student in four dimensions: Active and reflexive learning style, Sensitive and intuitive learning style, Visual and verbal learning style, Sequential and global learning style.	1) Active Learners / Reflective learners 2) Visual learners/ Verbal learners 3) Sensing learners / Intuitive learners 4) Sequential learners / Global learners

2.4 Development of Personalized Adaptive E-learning

E-learning has become an integral part of modern educational systems. E-learning in higher education has a crucial role to play in creating new and innovative learning environments. By leveraging technology, it can provide access to digital resources that may not be available locally, create interactive learning materials, and offer

personalized guidance and support. E-learning also facilitates collaboration between teachers and students, and provides tools for creativity and design. Additionally, data analysis and organization tools can help enhance the learning experience.

The most recent concern regarding e-learning is the presentation of static content where the same learning resources are provided to all learners. Indeed, learners may have different interests, levels of expertise and learning styles (Aciad & Meziane, 2019). Nowadays, simply making small adjustments to e-learning systems isn't enough to ensure successful outcomes. It's crucial to address other important elements like system flexibility, adaptability to students' needs, and the effective design of electronic content. Research has shown that failure can occur when these aspects are overlooked. Hence, there's a shift towards learner-oriented platforms that prioritize student expectations, motivation, habits, learning styles, needs, etc. in the center of interest.

E-learning can be progressively more practicable in the event if it is adjusted to the necessities of students. (Ahmed & Hina, 2019). The adaptive e-learning environment (ALE) focuses on developing approaches to cater to students' learning styles by adapting the learning environment. As a result, it provides alternative concepts for the delivery of e-content.

2.5 Adaptive E-content for Quality E-learning

Content development plays a crucial role in adaptive e-learning. It's important to cater to the diverse needs and preferences of learners who have different competencies. By presenting the right content at the right time, we can enhance their knowledge level. Adaptive content presentation allows us to customize learning materials based on the specific requirements of each learner.

The quality of content and the effectiveness of learning methodologies are crucial factors in assessing the effectiveness of an e-learning platform for higher education studies. The importance of e-content development cannot be overstated. It plays a vital role in designing effective e-learning experiences. To cater to diverse social strata, especially tutors, e-content should be learner-focused, easily accessible, flexible, and user-friendly. By prioritizing these aspects, we can create e-content that is engaging, effective, and meets the needs of learners from different backgrounds. Building specific adaptive content that aligns with the learning style of each student is essential in adaptive e-learning. By carefully planning, designing, and delivering adaptive content, we can meet the individual learning needs of students in this dynamic learning environment (Ahmed & Hina, 2019).

2.6 Application of Multimedia in E-Content Development

Higher education institutions have indeed embraced multimedia technologies and content to create more engaging and social learning experiences. By incorporating multimedia, they can enhance the delivery of education and make it more cost-effective. These tools allow for interactive and dynamic learning, making the educational journey more enjoyable and effective.

Multimedia plays a significant role in various learning theories, such as Cognitivism, Constructivism, and Connectivism. It is known to be beneficial in reaching different

learning styles. While selecting a learning instrument based on learning style can be challenging, multimedia has the advantage of appealing to multiple learning styles simultaneously. It's true that not all research supports the idea of learning styles, but multimedia has the ability to engage learners on multiple levels, making it invaluable in creating a learner-centered environment. It promotes deeper, more meaningful learning experiences (Li, 2016).

As learning transitions to the online digital environment, multimedia plays a vital role in creating engaging and interactive learning experiences. With the use of videos, audios, animations, chats, and interactive content, multimedia technologies are integrated into the design, development, and delivery of e-learning courses. This integration enhances the overall learning experience and facilitates effective knowledge transfer. (Yusuf & Prasad, 2016). The growth of multimedia technology has indeed played a significant role in enabling several online educational activities (Mast, 2018). The introduction of multimedia has had a tremendous impact on the way e-learning is conducted nowadays. It is one of the most powerful approaches to facilitate learning in today's e-learning environment (Alsadhan, Alhomod, & Shafi, 2014).

3 Proposed Conceptual Model for the Development of Adaptive E-Content

The review of literature related to personalized adaptive learning and specifically in e-learning environments lead to the following major conclusions:

- For e-learning environments e-content is vital as the basic principle of e-learning is the use of technology that provides online resources to the learners. However, presentation of static, “one-size-fits-all” content has been recognized as a concern in most of the current e-learning environments.
- Adaptive content presentation would therefore be the appropriate approach for a personalized e-learning environment.
- Learning styles are considered as most valuable factor for adaptive presentations of e-content.
- For e-content to be effective, the design and development of e-content should be systematic with applications of relevant theories and strategies
- Multimedia is the driver for e-content and best practices of integration of multimedia should be followed in the design and development of e-content

Based on the above conclusions, the identified determinants of the model for the development of adaptive e-content include; 1) Learning Style Theory, 2) Type of Content, 3) Multimedia, 4) Instructional Design.

As stated earlier, personalized adaptive e-learning is a new field and still researches are required to figure out best approaches for the implementations. Especially related to content, there are weaknesses in the design of electronic educational content, and educators require training and knowledge on creating e-content. Considering this, a need for a model that encompasses detailed constructs that would be used as guidance

for the development of e-content – especially adaptive e-content, an integrated model with constructs under each determinant identified was further formulated based on the relevant theories as shown in Fig. 1.

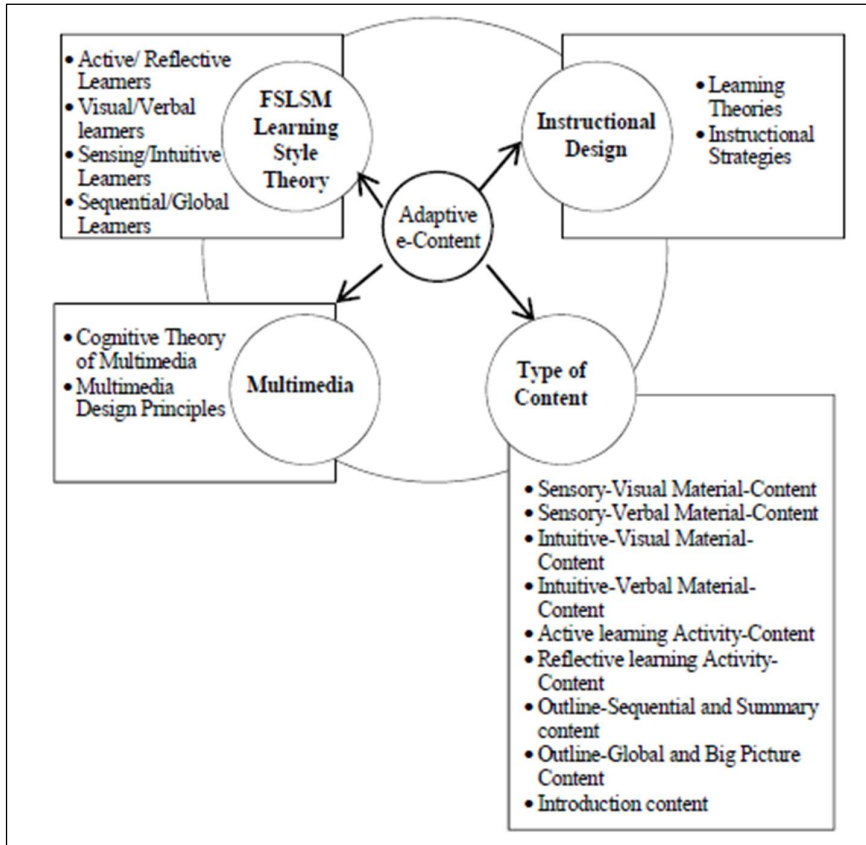


Fig. 1. Proposed integrated conceptual model for adaptive e-content development.

The model is based on The Felder-Silverman Learning Style Model (FSLSM) which is the prominent learning styles theoretical model that most adaptive systems utilize (Katsaris & Vidakis, 2021). Also, Cognitive Theory of Multimedia by Mayer was guided for the application of Multimedia as multimedia instruction can fail has to do with cognitive overload.

4 Educational Practice Implications

The effective applications of designing and developing adaptive e-content is a significant research area that is highly recommended within academia. The outcome of

this study will contribute to the research area by shedding light on the unclear issue of how-to best design and teach an adaptive learning course in a higher education context. Also, the aspects of the study will be helpful to add into the body of knowledge in culminating the exact profits of the learning process based on Learning Styles.

The controversial area of which the study mainly focused itself signifies the importance and necessity. Quality issues in e-learning and conventional learning is a major debate among the scholars. The strong view is that quality assurance of e-learning needs to be dealt with differently due to the philosophically, theoretically and pedagogically different modes of education. Quality is determining the future of e-learning. Hence, assuring quality is a major challenge, which needs to be faced in order to raise the future profile of e-learning to the same level as traditional teaching and learning measures. Adaptive e-learning environments are considered to improve the quality of e-learning. In addition, ensuring the design, development and implementation of high-quality e-content in e-learning enables the successful delivery of e-learning as it is the expansion of multimedia technology that has facilitated the e-learning. Especially for developing countries where there are serious challenges that inhibit the quality integration of e-learning in higher education institutions the outcome of this study will be beneficial. Furthermore, developing countries often face the challenge of weak content development when it comes to implementing e-learning (Aung & Khaing, 2015). The availability of electronic content and advanced applications in education is still relatively new in many developing countries, even at the higher education level. (Aljawarneh, 2020; Lara et al. 2020; Lizcano et al. 2020).

Essentially, enhancing learner satisfaction with a learning environment will result in their intention to continue using it (Lim, Lim, & Lim, 2022). Researchers have indicated that the success of an e-learning environment can be measured by learners' satisfaction and their intention to adopt it for a longer period of time. (Naranjo-Zolotov, Oliveira, & Casteleyn, 2019). Further, Martins, et al., (2018) highlighted the use of users' continued satisfaction as an indication of success of an e-learning environment. A personalized adaptive e-learning environment is believed to be having positive effect on learners' satisfaction.

Furthermore, the outcomes of the research will result in exposing people to high quality e-learning involving online learning experiences and make them understand the potential of technology, which is according to ASIC accreditation, the main reason why e-learning courses involving online learning are often surrounded by suspicion or uncertainty. So, the implementation of the model could be a step forward to provide evidence that a student continuing learning by the means of e-learning can have the same educational experience as their campus-based equivalents providing a better learning experience and superior outcomes for the graduates.

5 Conclusions

This paper was determined to propose a conceptual model for development adaptive e-content towards implementation of a personalized e-learning environment. The work is carried out to provide a solution for the problem of providing static content within the

current e-learning environments through implementation of personalized adaptive e-learning environment by presenting e-content based on student's learning styles.

After considering literature related to personalized adaptive e-learning environments and importance of adaptive content presentations, four dimensions were determined; learning styles theory, multimedia, type of content and instructional design which is believed to be factors that has to be considered for the development of adaptive e-content. Furthermore, the dimensions were further detailed with constructs with the application of Felder-Silverman Learning Style Model as the key learning style theory.

The model is being planned to be validated through a Delphi survey with indicators for the constructs and application of development of e-content for selected topics of a subject offered in one of the courses offered in The Maldives National University (MNU). In addition, it will be tested via a pilot implementation of a personalized e-learning environment through Moodle learning management system among a group of students of MNU and their levels of satisfactions will be measured.

References

1. Aciad, E., & Meziane, F.: An adaptable and personalised E-learning system applied to computer science Programmes design. *Education and Information Technologies*, 485-1509 (2018).
2. Ahmed, M., & Hina, S.: The Presentation of Adaptive Contents Based on Felder Silverman Learning Style. *Technical Journal, University of Engineering and Technology (UET)*, 35-46 (2019).
3. Ahmed, M. U., Hussain, S., & Bagram, M. M.: E-Content Presentation based on Learning Styles. *Technical Journal, University of Engineering and Technology (UET)* 22(1), 128-135 (2017).
4. Ali, N., Eassa, F., & Hamed, E.: Personalized Learning Style for Adaptive E-Learning System. *International Journal of Advanced Trends in Computer Science and Engineering*, 223-230 (2019).
5. Alsadhan, A. O., Alhomod, S., & Shafi, M. M.: Multimedia Based E-learning: Design and Integration of Multimedia Content in E-learning. *International Journal of Emerging Technologies in Learning* 9(3), 26-30 (2014).
6. Arsovic, B., & Stefanovic, N.: E-learning based on the adaptive learning model: case study in Serbia. *Indian Academy of Sciences*, 265-266 (2020).
7. Dockterman, D.: Insights from 200+ years of personalized learning. *NPJ Sci Learn* 3(1), 1-6 (2018).
8. El - Sabagh, H. A.: Adaptive e-learning environment based on learning styles and its impact on development students' engagement. *International Journal of Educational Technology in Higher Education* 18(53), 1-24 (2021).
9. Fleming, N., & Baume, D.: Learning styles again: VARKing up the Right Tree!. *Educational Developments*, 4-7 (2006).
10. Gonza lez, C.: What do university teachers think eLearning is good for in their teaching?. *Studies in Higher*, 61-78 (2010).
11. Hussein, A., & Al-Chalabi, H.: Pedagogical Agents in an Adaptive E-learning System. *SAR Journal of Science and Research.*, 24-30 (2020).

12. Jaleel, S., & Thomas, A.: Learning styles theories and implications for teaching learning. Horizon Research Publishing, (2019).
13. Jonassen, D. H., & Grabowski, B. L.: Handbook of individual differences, learning, and instruction Routledge, (2012).
14. Kerr, P.: Adaptive learning. *ELT Journal*, 88-93 (2016).
15. Kirschner, P. A.: Stop propagating the learning styles myth. *Computers and Education*, 166-171 (2017).
16. Klasnja-Milicevic, A., Vesin, B., Ivanovic, M., & Budimac, Z.: E-Learning personalization based on hybrid recommendation strategy and learning style identification. *Computers and Education* 56(3), 885–899 (2011).
17. Li, Y. W.: Transforming conventional teaching classroom to learner-centred teaching classroom using multimedia-mediated learning module. *International Journal of Information and Education Technology* 6(2), 105 (2016).
18. Mast, K.: Multimedia in E-Learning; How it Benefits, How it Detracts and the Dangers of Cognitive Overload A Review of the Literature. The University of Arizona, 1-8 (2018).
19. McCarthy, K. S., Watanabe, M., Dai, J., & McNamara, D. S.: Personalized learning in iSTART: Past modifications and future design. *Journal of Research on Technology in Education* 52(3), 301-321 (2020).
20. Nuankaew, P., Nuankaew, W., Phanniphong, K., Imwut, S., & Bussaman, S.: Students model in different learning styles of academic achievement at the University of Phayao, Thailand. *International Journal of Emerging Technologies in Learning (iJET)*, 133 (2019).
21. Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R.: Learning styles: concepts and evidence. *Psychology Faculty Publications* 9(3), 105–119 (2008).
22. Raj, N. S., & Renumol, V. G.: Architecture of an Adaptive Personalized Learning Environment (APLE) for Content Recommendation. In: *Proceedings of the 2nd International Conference on Digital Technology in Education*, pp. 7-22 (2018).
23. Skinner, B. F.: *The technology of teaching*. Appleton Century, New York (1968).
24. Taylor, D. L., Yeung, M., & Basset, A. Z.: Personalized and Adaptive Learning. In J. Ryoo, & K. Winkelmann, *Innovative Learning Environments in STEM Higher Education; Opportunities, Challenges, and Looking Forward*, Springer, Switzerland, pp. 17-34 (2021).
25. Truong, H. M.: Computers in Human Behavior Integrating learning styles and adaptive e-learning. *Computers in Human Behavior*, 1185-1193 (2016).
26. Willingham, D., Hughes, E., & Dobolyi, D.: The scientific status of learning styles theories. *Teaching of Psychology* 42(3), 266–271 (2015).
27. Yusuf, J., & Prasad, D.: The integration of multimedia for online and blended learning at the University of the South Pacific. *CONFERENCE: 8th Pan-Commonwealth Forum on Open Learning (PCF8)*, pp. 1-9 (2016).
28. Zhang, H.: Accommodating different learning styles in the teaching of economics: with emphasis on Fleming and Mills' sensory-based learning style typology. *Applied Economics and Finance* 4(1), 72–78 (2017).

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

