

## Big Data Emerging Technology: Insights into Innovative Environment for Online Learning Resources

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**Abstract**—Attempts to adopt the network data massively from the social media refer to provide the particular means in extracting the value from information space such as message, conversation, transaction and others, where the sources of structured data come from enterprise resources data and sources of unstructured data come from audio and video. It can be achieved to expand the process of extracting the value from social network to pattern the data sources to fulfil the organisation goal. This paper aims to reveal the way of big data approach in extracting data value from data complexity involving variety and velocity into the volume. This study was conducted using contents analysis by reviewing some literatures in peer-reviewed journals, chapters, books and proceedings in developing prototype using data analytics associated from the topic, users and time analytics. The findings reveal that big data emerging technology with analytic process provides particular advantages to transform the pattern of information fitted into the innovative environment of online learning resources (OLR) to enhance in developing the learning resources. Both prototype and model of data extraction value could be enhanced to facilitate the learning environment in supporting implementations with ease and convenience. This study is expected to contribute to improve the learning environment and outcomes

with performance and achievement by enhancing students' learning process development to provide online resources in higher education context.

**Keywords**—Big Data, online learning, data analytics, innovative environment, ease and convenience, online learning resources (OLR), Higher Education

## 1 Introduction

In the last decade, the shift paradigm of human life has been widely emerged from face to face interaction basis to virtual one. Especially in the information age to aid the life sphere including all aspects of our life, We are relying on information and communication technology (ICT) directly or indirectly. As a result, ICT use in all dimensions of human life can be generated into the data volume set into the pattern followed by the needs and demands. These distributions should be involved with the analytics patterns with big data approach. The data can come from online activities where the users usually upload, retrieve and also store the information shared through the Internet platform [1][2][3]. This will lead to fulfil in forming the model pattern of big data which can directly be engaged in supporting the human daily needs.

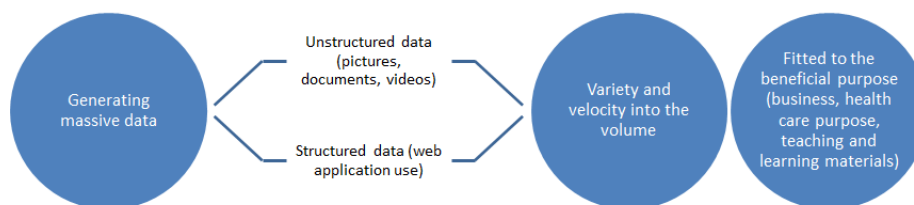
In terms of getting and collecting information with big data approach, this can be proposed to enhance the innovative learning model design [4][5]. Moreover, attempts to design and manage big data model for innovative learning refer to engage with managing and storing such kind of intangible assets such as report and documents referring to knowledge and information pattern with the purpose of administration basis [42]. As a result of providing electronic learning with pointing out the application software which is capable and designed to basically yield an integrated platform in delivering the content configured into supplying the accessibility with a wide range of users involving students, content creators, lecturers as well as administrators [6], such kind of benefit can be achieved with the attempts to ease the learning activity [7]. With pointing out the beneficial tool as provided in the online learning basis, academic institutions like schools and universities should facilitate in managing the expertise among the users by providing the number of corporations of training programs.

In line with supporting learning management aiming to successfully implement the learning process, providing online learning basis can be set up with the number of managing the process of automating the record-keeping with employing registration. Although many studies were conducted on big data in enhancing teaching and learning process [8][9][10], there are few scholarly attentions to address the approach of emerging technology with big data to generating to online learning sources. Thus, this study aims to fulfil this gap by reviewing literature on the big data emerging technology in giving insights into the innovative environment for online learning resources (OLR). Extracting the social network value is followed by the critical analysis to propose the model framework in delivering the material resources for the learning process.

## 2 Big Data Emerging Technology

Big data is a platform to generate massive data gathered from the user’s communication using digital devices such as tablets, smart phones, and laptop. With the numeric figures of data gathered particularly from the huge data amount, facts of statistics are being generated among the digital devices such as mobile phone, computer or laptop to extract the value of social network [11]. Towards the platform of big data emerging technology, data collection from the sources of traditional basis and digital one can be more complex and larger to manage with the computing technology use [12]. In the way to basically manage and analyse massive data amount, extra tools in generating big data analysis are required to settle such kind of several difficulties on the complexity of big data in both unstructured data referring to the unorganised information interpreted easily like pictures, documents, videos, and also social network site like Twitter, Facebook and WhatsApp, and structured data deriving from data obtained from the interaction among the users with machines such as web application use. Interpreted in many different ways in the way to describe massive data, both interaction and application use can be enhanced using volume, velocity and variety [13]. All these refer to assist in adopting the generated data to be delivered into the pattern which would benefit to the organization in terms of demands and needs. Moreover, the supplying system was also assisted by introducing the two characteristics including complexity and variability. As a result of handling the massive data generated from the Internet platform, these components would be adopted to analyse data appropriately in order to give insights of big data emerging technology which may later be fitted to the beneficial purpose as shown in Figure 1.

In line with the scales of data explored into the big data volume, attempts to manage the wide range of sources including structured and unstructured data should concisely proceed into the velocity with the way in streaming data to be analysed in further.



**Fig. 1.** Big Data Emerging Technology

These like text messages, videos, pictures and many others need to gather the analytic process in order to generate the sources [14]. In terms of gathering the various sources which need the process with analysing the variety together with the velocity, the disparity of data flow depends on certain developmental indicators usually assumed to make decision and act quickly without wasting time. With this regard, velocity becomes more significant to let data information interpreted in the basis of big data approach on emerging technology. Thus, the companies or organisation have

chance to transmit such data to be interpreted referring to the needs and demands for instance health care purpose, teaching and learning materials.

Along with information divergences deriving from a variety of types such as Facebook contents and email as unstructured data and cash transaction as structured data, the variability of massive data could be generated into the trends of social media data. With this regard, the flow of data gathered from the variability refers to daily and seasonal and other reasons using big data methods in addressing interrelation with pointing out practical indications of relations among the variables [15]. Considering such events with the behavioural basis in high rate data flow, the categorizations which can be possibly linked to the data complexity should not be confused with data variety [13]. Moreover, the divergent types of data which comes from conversation, electronic messages, and photos or videos enable the initiative of data variety in finding the corresponding and connection among them which might later be organised using the analytic programs to transform the data from other sources like blogs, webpage and social network site (SNS). As a result, operational and analytical systems can be adapted into different type of data formats as an attempt to recognise the pattern of their connection in corresponding to organize data sources from other parts in transforming across the systems.

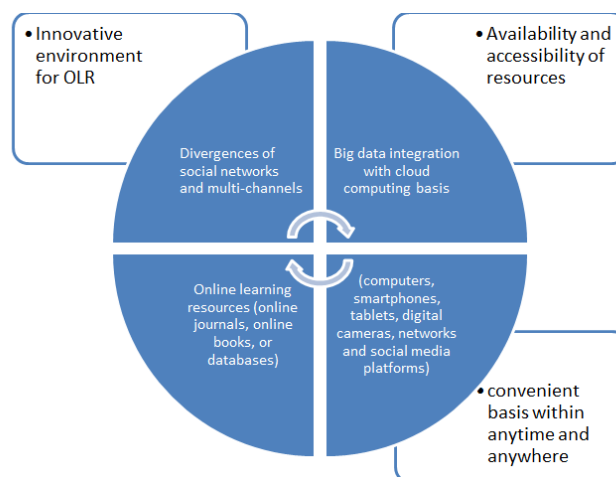
Furthermore, the result in utilizing such massive data should be enhanced in organizing and finding connection among diverse data sources like governments and corporations. Adopting data in helping to discover the issues, the way of operational systems in providing interactive workloads can be offered with a particular enhancement in offering the capabilities with an actual time primarily set out keeping the operational system together with analytical systems [16]. This initiative refers to enhance the basis of analysis on complex data bringing into the action through emerging technologies of big data approach. As a result, attempts to enhance the massive data generated to select their value can be combined into the operational big data system. It can be generated into databases for instance in the way to address a broad set of applications deployed in optimizing specific applications like database of graph [17][18]. Towards new cloud computing architectures to effectively use efficiently and inexpensively, operational big data can be made with easier attempts together with managing to address the limitations of traditional databases system. In the attempts to make faster in applying the analytical big data, these analytical workloads give insights in providing valuable information with the particular systems used to measure the resources by increasing data volume [19]. The ability to operate beyond the single server with operational and analytical big data system can generate the precious information to fit for the good purpose.

### **3 Innovative Environment for Online Learning Resources (OLR)**

Addressing the basis of online learning in covering the system of information is configured into technology where this is involved between the users and their performance way including the strategies and capabilities. Enhancing online learning re-

sources is widely addressed into supporting the learning process. This is followed in sharing OLR based innovative environment to adopt the strategies which can be employed in facilitating the processes and stores, disseminating educational material, and supporting communication and administration configured into teaching and learning [5]. Attempts to run online learning process can be initiated to signify the course materials with pointing out management, distribution, and retrieval [13]. OLR is signified into the information systems where the process itself can be recorded well in convincing the efficient and efficient teaching basis [20][21]. With this regard, establishing the basis in supporting the teaching and learning process should accommodate dynamic interactive and alternative learning experiences among the students. Attempts to incorporate OLR with knowledge management from divergences of social networks and multi-channels could be generated into the process in providing learning experiences with comprehensive requirements.

As a result of aiming to reveal the big data emerging technology, the wide range of percentages among the teachers needs to understand the way of using technology as a dynamic tool to apply it well. In terms of OLR in assisting the framework of big data integration with cloud computing basis, the need to get improve the skills development should be considered as the task in supporting adaptive teaching performance and competencies. Among interpersonal skills in enhancing their teaching skills, students learning experience can be yielded into the myriad of useful resources together with the sustainable learning culture [22][23]. In terms of the dynamics of learning with ethical consideration, they can understand the good way to the learning process to enable them be aware of circumstance sphere [24][25]. In particular, sharing the knowledge together with pointing out the result about the academic performance can be carried out the engaged basis of integrating the video presentation, Internet sources use, and so on. This opportunity refers to maximise the use of resources from such divergent platforms throughout inevitably learning to achieve teaching and learning quality.



**Fig. 2.** Innovative Environment for Online Learning Resources (OLR)

Moreover, innovative environment refers to accommodate in realising the benefits of OLR among the teachers and learners. As an entire opportunity which can be adopted among the higher education (HE) context, the component of learning and teaching including interactive online video presentation for instance should be adopted in underlying the learning styles to meet the needs and demands among them as shown in Figure 2.

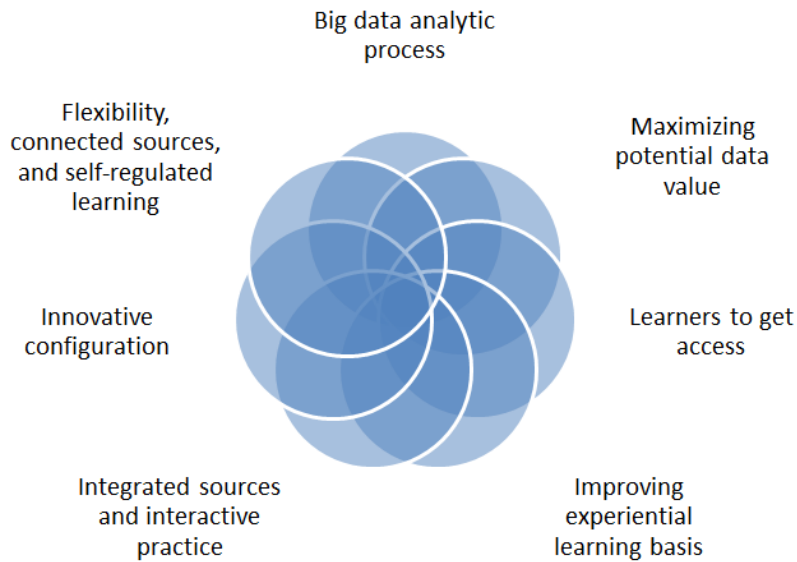
In line with addressing the wide ranges of needs for teaching and learning purpose, online resources such as data sets or podcasts where the teachers show the video in class would emerge in providing the gateway with a whole level of learning. In this view, addressing the range of learning styles to point out individual online interaction needs to support technology resources including computers, smartphones, tablets, digital cameras, networks and social media platforms, etc. [26][27]. As a result, OLR can be initiated to integrate among the lesson plans, curriculum, and subjects exposed easily available among the learning activities to make it successful. With this initiative to all sorts of learning activities integrated through themed activities in daily classroom practices, the skills development in the management of accommodating the frequent online resources types such as online journals, online books, or databases can be more manageable through more unique approaches with the plenty of benefits for the online resources [28][29]. It can be accessed with progressing the professional opinions combined into the teaching management covering space, time and frequency in the way to get information data using medium of online electronic message such as e-mail [30][31]. Both availability and accessibility of resources in pointing out convenient basis in the adoption within anytime and anywhere need to arrange the knowledge construction which may possibly be integrated into technology tool. In particular, the massive pervasive knowledge could be accommodated through the ICT advancement in learning and teaching activities.

#### **4 Big Data Emerging Technology for OLR based Innovative Environment**

The innovative environment basis which is distinctively engaged into big data emerging technology to support the learning interaction refers to enhance the way in transmitting the platform to transfer the data value. With an entire process to extract the social network in engaging the learning sources, the pattern here refers to structured and unstructured data [6][12]. Extracting the potential content value aims to improve the experiential learning basis with regard to adopt the massive open basis which enables the learners to get access on online sources freely [11][14]. In terms of enhancing the number of participants, the convenience in underlying the learning process can be managed in pointing out the competence of technological basis. As a result, working together with managing the learning style in the way to assist the learners with the strategies configured into the innovation with big data analytic process would enhance information in enabling to effectively reach their interest and needs [32]. In particular, online activities can be deployed with technology adaptive skills which may help accommodating the learning material resources. In this view,

the raise of the potential enhancement in finding out unlimited number on online activities is entirely configured using any subject aligned to assist the learning performance. In terms of the way to achieve the effective online learning with the easy access, the usability extent towards the technology-based learning refers to an initial requirement with a particular achievement in the way of human awareness to drive it appropriately [33][34]. Both process and management skills should be engaged into the application guideline to support assessing the multi-channels of sources of knowledge [35][36]. With regard to attempting to obtain the computer interface design in determining the benefit about the big data application, making useful about the potential data refers to get involved into the learning style designed with the basis of innovative approach. It refers to transform the reflective essence in empowering the learning environment innovatively in providing OLR platform basis.

In terms of providing the opportunities in the way to maximize the potential data value collected within big data approach, attempts to obtain the distinct feature in online learning systems refer to the pattern of integrated learning innovatively to transform the interactive practice configured with self-regulated inquiry [35][37]. With this regard, the inquiry basis regulated into the customized and personalized services into the learning process offers the knowledge delivered to explore the potential data with an entire initiative to see the behaviour performance [38][39]. As a result of viewing the students' learning way, the ability with more precision in managing the materials prepared in such extents of the system needs to take in particular to supply the resources of link which is fitted to the relevant needs and interest.



**Fig. 3.** Big Data Emerging Technology for OLR based Innovative Environment

Moreover, developing the structure of learning course through understanding the learning quality in the way to determine the activities is entirely a pivotal essence to

generate learning activities with enabling them to get access among the wide ranges of webpage [40][41]. Figure 3 shows big data emerging technology for OLR based innovative environment. Performing the detailed activities frequently refers to an entire effort to undertake innovative environment in big data emerging technology for OLR. As a result of understanding the initiative to provide the topic content, it can be achieved from the pattern by adopting their activities to the system related to the needs of personal learning appropriately. In terms of the initiative to raise the platform in attracting increasingly to the attention basis, big data emerging technology for effective learning integrated into the approach with an essential competence could be engaged into the operational system design.

In particular, technology usage demand on Internet basis would make the model of learning style adopted specifically among the learners in their own capacity basis. Enhancing the serious effort with the models of big data integration stage attempts to get access for online resources using electronic devices convert to shift from the traditional basis to virtual approach in the way with a variety of innovative learning interactions through high-impact educational experiences [43]. Big data emerging technology offers an entire enhancement with its data analytics to generate the massive data patterned into the need and demand referring to the online resources for teaching and learning. As an attempt to obtain the initiative in improving the students' learning process and achievement, the extent to propose the innovative learning design configures the empowerment by expanding pedagogy and technology skill. With this regard, the basis of big data emerging technology analytic process attempts to support the initiative way of teaching and learning process. Big data approach integrated into online learning in the way to addressing the learning behaviour is supposed to give insights in contributing the reference model of big data emerging technology for OLR initiative basis.

As a result of contributing the insights for the research agenda, the idea initially in focusing on multi sources data provides the recommendation to propose the model framework in delivering the material resources in the learning process. With big data emerging technology, adopting the network data massively from the social media would enhance in providing the particular means in extracting the value from information space such as message, conversation, transaction and others [44], where the sources of structured data come from enterprise resources data and sources of unstructured data come from audio and video [32]. Expanding the process of extracting the value from social network to pattern the data sources to fulfil the organisation goal aims to reveal the way of big data approach in extracting data value from data complexity involving variety and velocity into the volume. It can be achieved to develop prototype using data analytics associated from the topic, users and time analytics.

## **5 Big Data Emerging Technology in Supporting Resources for Online Learning**

The basis of innovative environment for OLR provides the learning sources with its distinctive pattern specifically in enhancing the learning performance. It rises to



advance the way more convenient and active to contribute in supporting the learning performance [10]. The pattern with innovative basis in assessing the learning resources refers to engage in assessing learning material resources. As a result, the convenient and innovative basis in the approach for adopting intervention, customization and personalization should be engaged with adopting the way in absorbing the massive data amounts. Moreover, attempts to adopt data sources such as surveys, social network sites, newspaper and other sources would be achieved in the practical basis to cover the assortment and volume [45]. In terms of supporting ORL in the way to configure the self-regulated inquiry, attempts with interactive essence configured into the innovative style may become an entire element to commit the learning style by maximizing the resources of learning material assessed in the way to strengthen the learning environment basis [5][46]. Empowering the OLR with big data approach can be seen in assessing material resources more flexible and to maximize the way in operating time and place. In particular, contributing the significant enhancement in terms exploring online resources has an insight to do with the big data emerging technology initiative in supporting the learning process. Determining the guide way in gaining multitude resources refers to attempt to enable them in getting more benefits with encouraging controlling particular technology basis.

In line with determining the way supported in learning instruction, the subsequent enhancement in the way to transform the performance basis to raise the achievement can be taken in benefiting the students' development to strengthen the entire interaction within the process of interaction. Attempt to achieve in encouraging the learning style more actively engaged into getting the way entirely with instructional process to improve thinking skills has to do consequently with boosting their confidence to raise the skills of learning enhancement [46]. Adopting big data emerging technology with actively presenting the knowledge basis and skills is fundamental with powerful skill and adaptive technology in achieving flexibility and connectedness.



Fig. 4. Big Data Emerging Technology in Supporting Resources for Online Learning

Moreover, the committed mission in giving insights into the online learning basis undermines the control basis within integrating high-quality information [47]. The effort which students may employ in interacting with the learning environment can be engaged into the following extent of engagement including meaningful learning with its interaction. Allowing them to interact with such distinct kinds is significant to assist learning process attentiveness. Designing the innovative learning referring to integrate knowledge and skills generates the valuable insights of skills integrated into the approach of innovative basis on learning enhancement. This regard would be adaptively strengthened with big data emerging technology.

Figure 4 shows big data emerging technology in supporting resources for online learning. The way of big data emerging technology to support OLR refers to progressively strengthen the subsequent extent of introducing, preparing and managing the arrangements of learning within online basis [46]. As a result, considering the learning approach to improve necessary implementation basis will lead to enhance the convenient way of learning style. With more upgrade to cover such usability on the technology platform, successfully implementing the way of learning process should be prepared in providing the better facilitation with the support of technological tool within the activities of learning process with borderless space. Through utilizing extraction of massive data amounts created every second across the social network, innovative based learning model considered into the kind of learning activities is subsequently regulated in providing the entire extent of beneficial values in strengthening pervasive knowledge based learning enhancement [5][45]. With regard to the technological empowerment in enhancing the learning basis within the perspective of anywhere and anytime context, technological tool with big data-based learning sources points out the academic skills on the availability of influencing the effectiveness of learning with a sufficient support in the way to incorporate the collaboration basis. An attempt to empower the orientation in enhancing the practical strength would enhance to make easily in gaining the learning sources with the big data analytic approach [48]. Emphasizing the voluntary data complemented particularly into the big data analytics with the learning process should be engaged in making a whole context to underlie online learning sources indicators in the way of assessing the practice by widening the data complexities.

In particular, perfecting the use of whole load of information modified to check in enabling the students to have chance in creating their interest into the particular subject about the certain topic gathered through online sites when connecting technology that acts as a medium in the Internet basis. The form of collecting such different structured data needs to expand worldwide of information within the development concept of pedagogy in the digital era [49]. Moreover, information pattern referring to data elucidation in SNS basis offers sites to let the users to have such different experiences in searching for materials collection. In terms of storing the uploaded materials used within wide range of programmes, big data emerging technology refers to have the skills particularly in using the digital devices required into the good Internet connection [50]. Towards the highly advanced modern technology, the completion of setting the skills with allowing the technology connection among the users is reserved to entering the particular web address. As a result, the Internet basis for postings and

uploads of webpage or websites in addressing the process being made in the way which is formed into the basis of numerical format and words through online would automatically be saved in the big data. This initiative would be viewed in the basis of getting information data massively. Moreover, taking roughly about the set up for the specific web address would show the screen computer which can be managed among the users.

## 6 Conclusion

Revealing the theoretical basis on big data emerging technology to give insights into the innovative environment of OLR, this paper provides a model of framework designed to help teaching and learning through the facility on learning resources. Designing the interactivity of big data on OLR construction refers to enhance in giving experiences in distinct educational exploration to assist the students' learning environment. Big data emerging technology with analytic process provides particular advantages to transform the pattern of information fitted into the innovative learning environment to enhance in developing the learning resources. Both prototype and model of data extraction value could be enhanced to facilitate the learning environment in supporting implementations with ease and convenience. This study is expected to contribute to improve the learning environment and outcomes with performance and achievement by enhancing students' learning process development to provide online resources in higher education context.

## 7 References

- [1] Hixon, E., Buckenmeyer, J., Barczyk, C., Feldman, L., & Zamojski, H. (2012). Beyond the early adopters of online instruction: Motivating the reluctant majority. *The Internet and Higher Education*, 15(2), 102-107. <https://doi.org/10.1016/j.iheduc.2011.11.005>
- [2] Omar, A., Kalulu, D., & Alijani, G. S. (2011). Management of innovative e-learning environments. *Academy of Educational Leadership Journal*, 15(3), 37.
- [3] Puzziferro, M., & Shelton, K. (2008). A model for developing high-quality online courses: Integrating a systems approach with learning theory. *Journal of Asynchronous Learning Networks*, 12, 119-136. <https://doi.org/10.24059/olj.v12i3.58>
- [4] Anshari, M., Alas, Y., Sabtu, N. I. P. H., & Hamid, M. H. S. A. (2016). Online Learning: trends, issues and challenges in the Big Data Era. *Journal of e-Learning and Knowledge Society*, 12(1), 121-134.
- [5] Anshari, M., Alas, Y., & Guan, L. S. (2016). Developing online learning resources: Big data, social networks, and cloud computing to support pervasive knowledge. *Education and Information Technologies*, 21(6), 1663-1677. <https://doi.org/10.1007/s10639-015-9407-3>
- [6] Chen, M., Mao, S., & Liu, Y. (2014). Big data: a survey. *Mobile Networks and Applications*, 19(2), 171-209. <https://doi.org/10.1007/s11036-013-0489-0>
- [7] Anshari, M., & Alas, Y. (2015). Smartphones habits, necessities, and big data challenges. *The Journal of High Technology Management Research*, 26(2), 177-185. <https://doi.org/10.1016/j.hitech.2015.09.005>

- [8] Huda, M., Anshari, M., Almunawar, M. N., Shahrill, M., Tan, A., Jaidin, J. H., ... & Masri, M. (2016). Innovative Teaching in Higher Education: The Big Data Approach. *The Turkish Online Journal of Educational Technology*, 15(Special issue), 1210-1216.
- [9] Huda, M., Shahrill, M., Maseleno, A., Jasmi, K. A., Mustari, I., & Basiron, B. (2017). Exploring Adaptive Teaching Competencies in Big Data Era. *International Journal of Emerging Technologies in Learning*, 12(3), 68-83. <https://doi.org/10.3991/ijet.v12i03.6434>
- [10] Huda, M., Haron, Z., Ripin, M. N., Hehsan, A., & Yaacob, A. B. C. (2017). Exploring Innovative Learning Environment (ILE): Big Data Era. *International Journal of Applied Engineering Research*, 12(17), 6678-6685.
- [11] Arifin, F., Hariadi, M., & Anshari, M. (2017). Extracting Value and Data Analytic from Social Networks: Big Data Approach. *Advanced Science Letters*, 23(6), 5286-5288. <https://doi.org/10.1166/asl.2017.7360>
- [12] Kitchin, R. (2014). Big Data, new epistemologies and paradigm shifts. *Big Data & Society*, April–June: 1–12.
- [13] LaValle, S., Lesser, E., Shockley, R., Hopkins, M. S., & Kruschwitz, N. (2011). Big data, analytics and the path from insights to value. *MIT sloan management review*, 52(2), 21.
- [14] Hashem, I. A. T., Yaqoob, I., Anuar, N. B., Mokhtar, S., Gani, A., & Khan, S. U. (2015). The rise of big data on cloud computing: Review and open research issues. *Information Systems*, 47, 98-115. <https://doi.org/10.1016/j.is.2014.07.006>
- [15] Lyon, D. (2014). Surveillance, snowden, and big data: capacities, consequences, critique. *Big Data & Society*, July–December: 1–13 <https://doi.org/10.1177/2053951714541861>
- [16] Boyd, D., & Crawford, K. (2012). Critical questions for big data: Provocations for a cultural, technological, and scholarly phenomenon. *Information, communication & society*, 15(5), 662-679. <https://doi.org/10.1080/1369118X.2012.678878>
- [17] Villars, R. L., Olofson, C. W., & Eastwood, M. (2011). Big data: What it is and why you should care. *White Paper, IDC*.
- [18] Mayer-Schönberger, V., & Cukier, K. (2013). *Big data: A revolution that will transform how we live, work, and think*. Houghton Mifflin Harcourt.
- [19] Chandarana, P., & Vijayalakshmi, M. (2014, April). Big data analytics frameworks. In *Circuits, Systems, Communication and Information Technology Applications (CSCITA), 2014 international conference on* (pp. 430-434). IEEE.
- [20] Anshari, M., Almunawar, M. N., Shahrill, M., Wicaksono, D. K., & Huda, M. (2017). Smartphones usage in the classrooms: Learning aid or interference?. *Education and Information Technologies*, 1-17. <https://doi.org/10.1007/s10639-017-9572-7>
- [21] Livingstone, S. (2012). Critical reflections on the benefits of ICT in education. *Oxford review of education*, 38(1), 9-24. <https://doi.org/10.1080/03054985.2011.577938>
- [22] Huda, M., Jasmi, K. A., Basiran, B., Mustari, M. I. B., & Sabani, A. N. (2017). Traditional Wisdom on Sustainable Learning: An Insightful View From Al-Zarnuji's *Ta 'lim al-Muta 'allim*. *SAGE Open*, 7(1), 1-8. <https://doi.org/10.1177/2158244017697160>
- [23] Huda, M., Sabani, N., Shahrill, M., Jasmi, K. A., Basiron, B., & Mustari, M. I. (2017). Empowering Learning Culture as Student Identity Construction in Higher Education. In A. Shahriar, & G. Syed (Eds.), *Student Culture and Identity in Higher Education* (pp. 160-179). Hershey, PA: IGI Global. <https://doi.org/10.4018/978-1-5225-2551-6.ch010>
- [24] Huda, M., Jasmi, K. A., Embong, W. H., Safar, J., Mohamad, A. M., Mohamed, A. K., Muhamad, N. H., Alas, Y., & Rahman, S. K. (2018). Nurturing Compassion-Based Empathy: Innovative Approach in Higher Education. In M. Badea, & M. Suditu (Eds.), *Violence Prevention and Safety Promotion in Higher Education Settings* (pp. 154-173). Hershey, PA: IGI Global. <https://doi.org/10.4018/978-1-5225-2960-6.ch009>

- [25] Huda, M., Jasmi, K. A., Alas, Y., Qodriah, S. L., Dacholfany, M. I., & Jamsari, E. A. (2018). Empowering Civic Responsibility: Insights From Service Learning. In S. Burton (Ed.), *Engaged Scholarship and Civic Responsibility in Higher Education*(pp. 144-165). Hershey, PA: IGI Global. <https://doi.org/10.4018/978-1-5225-3649-9.ch007>
- [26] Huda, M., Jasmi, K. A., Mustari, M. I., Basiron, B., Mohamed, A. K., Embong, W., ... & Safar, J. (2017). Innovative E-Therapy Service in Higher Education: Mobile Application Design. *International Journal of Interactive Mobile Technologies*, 11(4), 83-94. <https://doi.org/10.3991/ijim.v11i4.6734>
- [27] Huda, M., Jasmi, K. A., Hehsan, A., Shahrill, M., Mustari, M. I., Basiron, B., & Gassama, S. K. (2017). Empowering Children with Adaptive Technology Skills: Careful Engagement in the Digital Information Age. *International Electronic Journal of Elementary Education*, 9(3), 693-708.
- [28] Maseleno, A., Huda, M., Siregar, M., Ahmad, R., Muhamad, N.H.N., Hehsan, A., Haron, Z., & Ripin, M.N., Ihwani, S. S., Jasmi, K. A. (2017). Combining the Previous Measure of Evidence to Educational Entrance Examination. *Journal of Artificial Intelligence* (in press). <https://doi.org/10.3923/jai.2017.85.90>
- [29] Harasim, L. (2017). *Learning theory and online technologies*. New York and London: Taylor & Francis.
- [30] Ko, S., & Rossen, S. (2017). *Teaching online: A practical guide*. New York and London: Taylor & Francis.
- [31] Maseleno, Sabani, N., A., Huda, Ahmad, R., Jasmi, K.A., Mustari, M.I., and Basiron, B. (2017). Understanding Learning Analytics to Improve Personalised Learning. *Journal of Engineering and Applied Sciences*. (in press).
- [32] Franke, B., Plante, J. F., Roscher, R., Lee, E. S. A., Smyth, C., Hatefi, A., ... & Hoffman, M. M. (2016). Statistical inference, learning and models in big data. *International Statistical Review*, 84(3), 371-389. <https://doi.org/10.1111/insr.12176>
- [33] Huda, M., Jasmi, K. A., Mohamed, A. K., Wan Embong, W. H., & Safar, J. (2016). Philosophical Investigation of al- Zarnūjī's Ta'lim al-Muta'allim: Strengthening Ethical Engagement into Teaching and Learning. *Social Science*, 11(22), 5516-5519.
- [34] Huda, M., Siregar, M., Ramlan, Rahman, S.K.A., Mat Teh, K.S., Said, H., Jamsari, E.A., Yacub, J., Dacholfany, M.I., & Ninsiana, W. (2017). From Live Interaction to Virtual Interaction: An Exposure on the Moral Engagement in the Digital Era. *Journal of Theoretical and Applied Information Technology*, 95(19), 4964-4972.
- [35] Huda, M., Yusuf, J. B., Jasmi, K. A., & Nasir, G. A. (2016). Understanding Comprehensive Learning Requirements in the Light of al-Zarnūjī's Ta'lim al-Muta'allim. *Sage Open*, 6(4), 1-14. <https://doi.org/10.1177/2158244016670197>
- [36] Huda, M., Maseleno, A., Jasmi, K. A., Mustari, I., & Basiron, B. (2017). Strengthening Interaction from Direct to Virtual Basis: Insights from Ethical and Professional Empowerment. *International Journal of Applied Engineering Research*, 12(17), 6901-6909.
- [37] Othman, R., Shahrill, M., Mundia, L., Tan, A., & Huda, M. (2016). Investigating the Relationship Between the Student's Ability and Learning Preferences: Evidence from Year 7 Mathematics Students. *The New Educational Review*, 44(2), 125-138.
- [38] Huda, M., & Kartanegara, M. (2015). Islamic Spiritual Character Values of al-Zarnūjī's Ta'lim al-Muta'allim. *Mediterranean Journal of Social Sciences*, 6(4S2), 229-235.
- [39] Huda, M., Yusuf, J. B., Jasmi, K. A., & Zakaria, G. N. (2016). Al-Zarnūjī's Concept of Knowledge ('ilm). *SAGE Open*, 6(3), 1-13. <https://doi.org/10.1177/2158244016666885>
- [40] Yang, T. C., Fu, H. T., Hwang, G. J., & Yang, S. J. (2017). Development of an interactive mathematics learning system based on a two-tier test diagnostic and guiding strategy. *Australasian Journal of Educational Technology*, 33(1), 62-80.

- [41] Ahad, A. D., & Anshari, M. (2017). Smartphone Habits Among Youth: Uses and Gratification Theory. *International Journal of Cyber Behavior, Psychology and Learning (IJCIBPL)*, 7(1), 65-75. <https://doi.org/10.4018/IJCIBPL.2017010105>
- [42] Anshari, M., & Lim, S. A. (2016). E-Government with Big Data Enabled through Smartphone for Public Services: Possibilities and Challenges. *International Journal of Public Administration*, 1-16.
- [43] Zulkarnain, N., & Anshari, M. (2016, November). Big data: Concept, applications, & challenges. In *Information Management and Technology (ICIMTech), International Conference on* (pp. 307-310). IEEE.
- [44] Eynon, R. (2013). The rise of Big Data: what does it mean for education, technology, and media research?. *LEARNING MEDIA AND TECHNOLOGY*, 38(3), 237-240. <https://doi.org/10.1080/17439884.2013.771783>
- [45] Daniel, B. (2015). Big data and analytics in higher education: Opportunities and challenges. *British journal of educational technology*, 46(5), 904-920. <https://doi.org/10.1111/bjet.12230>
- [46] Tulasi, B. (2013). Significance of Big Data and Analytics in Higher Education. *International Journal of Computer Applications*, 68(14), 21-23. <https://doi.org/10.5120/11648-7142>
- [47] Chen, X. W., & Lin, X. (2014). Big data deep learning: challenges and perspectives. *IEEE access*, 2, 514-525. <https://doi.org/10.1109/ACCESS.2014.2325029>
- [48] Provost, F., & Fawcett, T. (2013). Data science and its relationship to big data and data-driven decision making. *Big Data*, 1(1), 51-59. <https://doi.org/10.1089/big.2013.1508>
- [49] Richtárik, P., & Takáč, M. (2016). Distributed coordinate descent method for learning with big data. *The Journal of Machine Learning Research*, 17(1), 2657-2681.
- [50] Chen, C. P., & Zhang, C. Y. (2014). Data-intensive applications, challenges, techniques and technologies: A survey on Big Data. *Information Sciences*, 275, 314-347. <https://doi.org/10.1016/j.ins.2014.01.015>

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