

Knowledge Visualization of Students' Performances: Antecedent of Knowledge Generation Model and Decision Making Model

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Abstract

Visualization is critical to data analysis and has been used to portray intrinsic structure and pattern of data. However, there have been fewer study to visualize knowledge on the performance of student with respect to the internet and infrastructure provided by the institution of higher learning. The objective of this study is to propose a model that capable of visualizing knowledge on student's performance in the institution of higher learning. The proposed model was developed through the integration of knowledge generation and decision making models. The model is believed to serve as a basis for analyzing and evaluation of services provided to the students by their respective institutions.

Keywords: Knowledge Visualization, Prescriptive, Internet Usage, Students Performance.

1. Introduction

Knowledge Visualization has been portrayed to helpful in the rising examination field through visual methods. In the present period of mechanical advances, with information is overpowering, the best possible strategy ought to be utilized with the end goal of access, dialog, and assessment of every day the board of the individual who gave solid help to quick access to learning. Despite the fact that the investigation and examination of extensive informational collections can be testing, dynamic utilization of perception methods can give an incredible method to spot significant structures and examples quickly. This system is broadly utilized in different systematic representation assignments including exploratory information investigation, process observing, and detailing results [6]. Besides, thinks about have focused on that perception gives the client moment input dependent on the introduced and created results.

As indicated by William S Cleveland [41], "Representation is a bleeding edge assault and it is a basic part in breaking down information. It uncovers complex structure in which information can't be caught up in any capacity". For sure, information mining approach in learning investigation has been utilized to concentrate on the extraction of examples from the information point of view, though Knowledge Visualization can be viewed as a human-focused way to deal with information disclosure [9]. This has been demonstrated to have been generally used to show an investigation of the execution by giving a wide scope of graphically shows in an exceptionally intelligent condition [14], [39]. The utilization of perception is probably going to give watchers a few bits of knowledge into information through the examining of data and reaching determinations. Consequently, the two information and data set the phase for the disclosure of experiences which can impact

choices and drive change.

Numerous examinations have utilized representation approach in execution investigation, explicitly in the field of training. These days, instructive establishments, schools, and colleges are exceptionally engaged in investigating scholarly execution for understudies' scholastically [36]. As for scholastic accomplishments, scholarly execution is generally acknowledged and utilized as the evaluation pointer for the nature of instruction. Throughout the previous two decades, web use among the understudies has been the most focused on research zone in scholarly execution investigation [24]. In addition, different examinations have been concentrating on the conduct to discover the examples identified with web use and their effect on their separate exhibitions.

Today, the scholastic achievement of understudies in instructive foundations is the most essential issue which is the focal point of the administration. [36], [37]. This is to guarantee that the impacts of the got outcomes give a tremendous effect on the establishment and comprehension of use's dimension of gave framework by the administration. In any case, there is developing worry that this speculation has not brought about wanted objectives of expanding profitability and nature of understudy. Along these lines, there is requirement for the administration to audit the understudy's usage of the gave framework and settle on a choice on the congruity of the gave web administrations. In this way, the utilization of representation guarantees interpretation of data into learning, accordingly speaks to a successful way to deal with enhance basic leadership and execution [25]. Consequently, accomplishing compelling choices, bolster developments and anticipate issues require the manners by which the measures are imagined and conveyed [22]. Be that as it may, there are troubles to comprehend the most ideal approach to picture information to individuals because of variety in the dimension of comprehension [3]. Along

these lines, the utilization of visual portrayals sorts out data to pass on learning, to increment mental cognizance and in addition upgrade correspondence [35].

Besides, the utilization of PC framework application has been interpreted measurements of a few models towards making the progress of perception [17]. Be that as it may, perception itself may not be adequate for basic leadership because of the dynamic size of the information gathering [4]. Thus, there is requirement for a model to recommend correct measures to upgrade basic leadership dependent on representation. Consequently, the conflux of two developing regions of innovation inside the prescriptive information and learning representation into another examination bearing gives new research difficulties. In this way, the goal of this examination is to propose a model that fit for imagining information on understudy's execution in the establishment of higher learning by consolidating these two diverse model which are Knowledge Generation Model and Decision Making model as a base of the model.

2. Literature review

2.1. Knowledge visualization

The world has been professed to manage a gigantic measure of gathered information, where quite a bit of it is inclined to perception (pictures and recordings). Learning Visualization, which is a basic part in information the executives intends to exchange and make new learning through utilizing representation approach. As indicated by Sabrina Bresciani, Visualizing learning implies mapping of a realistic with the organizing and perception of sentences definitively and reasonable. Plus, information representation is alluded to fit in interdisciplinary field of research that consolidates discoveries of different sciences. Thusly, it isn't astounding that its idea has been found among correspondence, business and PC sciences, subsequently, rouses specialists to ponder it in comparative ways.

Mendel and Yeager [18] contend, perception take diverse jobs all through the procedure and is an incredible guide in critical thinking. It can fabricate information in an alternate point of view and give distinctive thoughts regarding potential future.

Moreover, information representation is explicitly critical in the beginning periods of misrepresentation examination, where the specialist is endeavoring to play out a proficient and viable information investigation and wants to a superior comprehension of the connections that might be available in an intricate informational collection. Extortion examiners have as of late perceived the significance of information representation for misrepresentation recognition, while the usage has been all the while done [8]. Also, information representation approach has been utilized by information agent to help with seeing and understanding information designs that are steady with deceitful movement.

On alternate hands, analysts have focused on that certifiable information representation bolsters visual reasoning. This has been precursor by the human thinking that equipped for handling an image a lot quicker than a table of numbers. The utilization of data perception is to guarantee effortlessness of arranging and comprehension of data [40]. Be that as it may, less examinations have possessed the capacity to analyze how information perception method may enable specialists to comprehend examples of information explicitly in the false movement..

2.2. Student performance and internet usage

Numerous investigations have been led dependent on the dimension of web use among college understudies as did by Ani [24], Bologna,

Maccagno, Somazzi, Oehlschager and Esbry [10] and Laguna [23]. As per Awais et al [1], understudies with high Cumulative Grade Point Average (CGPA) utilize the web all the more regularly for their examinations and increase significantly more learning and data over the world. Another study also reported that internet-competent students benefitted most from its usage, thus improving their academic performance. However, studies by Ellore, Niranjana and Brown [34] argued that there is no significant relationship between the usage of internet for study and academic performance. The influence of the internet on academic performance as shown in other literature that it could be positive or negative as discussed by Ogedebe [29] and Cerretani, Iturioz and Garay [26]. This also contradicts the perception that the enemy's usage of the internet affects academic performance [30], thus calling for further reviewed.

2.3. Prescriptive analytics and student performance

Previous studies on the internet usage and student performance such as those conducted by Mat, Buniyamin, Arsad & Kassim [12]; Sikder & Halder [11]; Saeed & Dixit [13]; Kurmiawan & Halim [43] have completely using descriptive and predictive techniques to evaluate students' performance. The technique was used to monitor and evaluate the students' internet usage and student academic performance at different year levels prior to the final test towards forecasting the weaknesses of the students [43]. In other words, prediction of student academic performance helps the institution to explore the relationships between student activities on their internet usage and their academic performance, while the analytic technique that has been used was proven to be a useful result and impact to the organization [16]. Thus, the use of prescriptive technique helps predict students' performance and enable intervention across learning process and improve student's success. However, the spirit of using analytics in education helps exploration of the huge amount of data and use the advanced analytic technique which is prescriptive analytic to inform the policy maker what students should do next in order to improve their performance [12]. Hence, applying prescriptive analytics helps to improve students' performances and institutional goals and strategies in actualizing quality of education [44].

According to Micheal Wu [42], prescriptive analytics guide decision maker towards making decisions. On the other hands, prescriptions or guidelines are essential in order for a theory to be applicable in practice and to improve the organization and practices and benefited from it. [31], [12], [2]. Recently, prescriptive knowledge has been using in the healthcare environment to assist medical practitioners in prescribing drugs and also to support a patient's condition and their recovery at home [33]. The goal of providing prescriptive or design knowledge has been debated by several authors [27], thus valuable to expand the scope of the subject area. However, there is less research on prescriptive knowledge in the context of IS research as argued by Seidel & Watson [31] and Iivari [19].

3. Prescriptive visualization model

3.1. Knowledge generation model

The Knowledge Generation model developed by Sacha et. al [5] shown in Figure 1 adopted by Keim et al. [7] comprises of components like Data, Models, Visualization and Knowledge representation in the process stage. This model is split into two parts, with the model consists of a computer and human parts. The PC framework with information, perception and expository models [45], and the human part which demonstrating the intellectual procedures related with a diagnostic session.

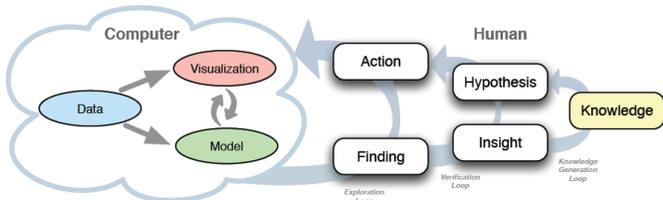


Figure 1: Knowledge generation model

3.2. Decision making model

The decision-making model is conceived to consist of six major modules as shown in Figure 2. The model was developed by Minstzberg, Raisinghani and Theoret (1976). It contains three-phase model; identification, development and selection phase.

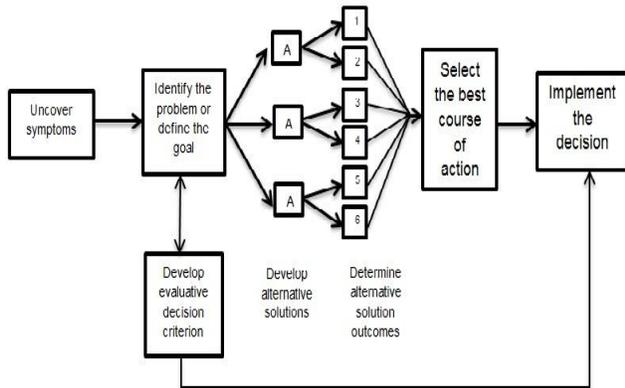


Figure 2: Decision making model

3.3. Conceptual model

The Knowledge Generation display as recommended by Sacha, Stoffel. A, Stoffel.F and Kwon [5] is received which comprise of two sections; PC and human parts. The segments spoke to in Figure 1 would be increasingly consummated by including psychological and thinking components. This has been contended that framework, human [46], insight and thinking are the most imperative segments to make an interpretation of the visual into learning [5]. As per Mayer (2002), gaining from visual models is an intellectual procedure that includes various mental procedures as clarified in the psychological hypothesis of mixed media learning [20]. In view of this line of reasoning, it is trusted that the subjective procedure of representation can be the important parts to be included the model.

A total investigation of visual examination requires an investigation of computational investigation as well as a comprehension of what is sensibly broke down. The thinking can be joint effort among people and furthermore perception, be that as it may, it can fill in as a communitarian exertion between numerous clients [47] and different representations. Henceforth, it is the procedure of deciphering the aftereffects of the computational examinations and information displayed inside the perception [48].

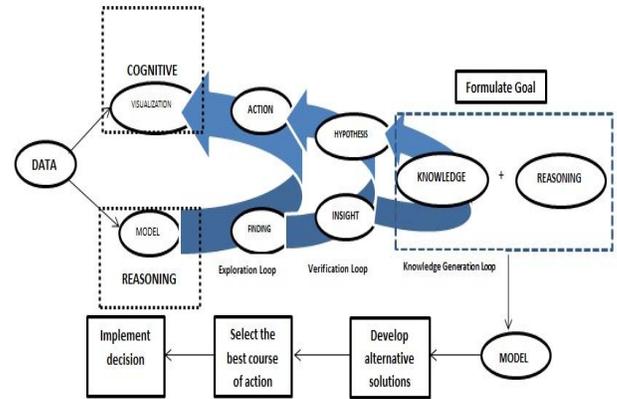


Figure 3: Prescriptive visualization model

The Prescriptive representation was produced by adjusted Decision Making model through the incorporation of thinking components [49]. Commonly, perception models are characterized at a low-dimension of deliberation since it ought to contain the data that is expected to actualize the framework [28]. The mix of learning and thinking are known as detailed objective embraced in Figure 1.

4. Prescriptive visualization model for student performance

The model created is intended to fulfill a specific purpose. In this study, the researcher will illustrate this model can be applied in determining the student performance based on their internet activity and will apply prescriptive analytics to formulate the recommendation and solutions for educational institution to solve student performance issues.

As a basis for Prescriptive Visualization model, the researcher takes and extends the Knowledge Generation model by Sacha et. al [5]. This model will combine with cognitive and reasoning analytics to process the data and mapped to visualization using dashboard. The function of dashboard is to visualize and display the result which has been process in interactive way in order to get the clear picture. This stage will transform the data and information into knowledge and it will require the cognitive ability of mapping data into knowledge through a great mind. In the context of student performance, the student internet activity was analyze to observe internet frequency, time spending on the internet, the log files that frequently accessed and which type internet services that have been browsing. After the computer process the data and the result of the internet usage will compare with the student's result of every semester. From the information, the computer will formulate the data and see the algorithm of both variables. The results will show in the dashboard in a meaningful way to create the knowledge.

A short time later, the outcomes indicate doesn't mean anything and faulty without thinking examination which allude as understanding the data. The field of thinking and learning by Human Cognition Model proposed by Green et.al [38] relies upon the Decision Making Model to created elective arrangements dependent on the representation. These options require the thinking investigation to process and deciphering the consequences of the computational examinations and the information which has been exhibited inside the perception. After the model has been produced, it will choose the best strategy and offer proposal to instructive organization to settle on the best choice to enhance understudies' execution.

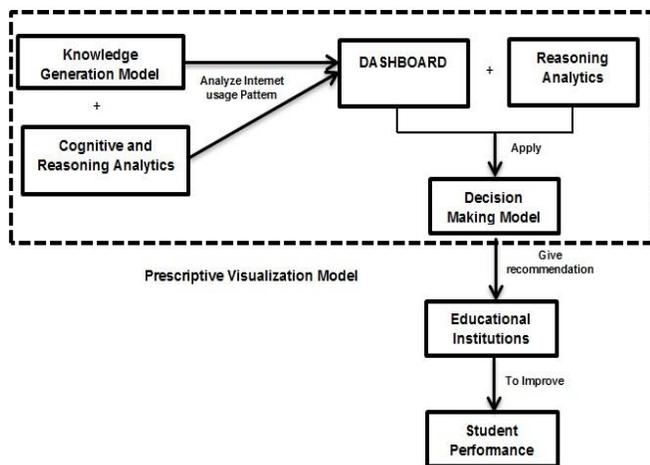


Figure 4: Relating the process model to improve student's performance

5. Conclusion

This paper has presented prescriptive visualization model by focusing on students' academic performance, which assists institution of higher learning while making a decision. The findings of this study will contribute to the benefit of education institutions in assessing the extent of the impact on student achievement with all the facilities provided by the universities. Based on the result, the organizations may take any action that it needs to make improvements or to be controlled for the purpose of learning. Besides, scholastic issues and instructors advantage for distinguishing the impact of web utilization on understudies' scholarly execution and if the essential choice for blocking or making some confinement for use of any sites amid the examination time frame. Moreover, this study will be helpful to the individual and organizations by making a process that is more efficient in choosing the best way to visualize information. It also serves as a future reference for researchers on the domain of knowledge. Besides, this study adds new information to the literature by integrating some elements of knowledge generation and decision making models towards obtaining prescriptive visualization model of student's performance. The future study of this study would come up with a prototype to evaluate the prescriptive visualization model in Figure 3.

References

- [1] Awais; Bilal; Usman, M. Waqas, and Sehrish (n.d). Impact of Internet use on student's academic performance. URL: <http://www.scribd.com/doc/9191411/Impacts-of-Internet-Usage-on-Students>.
- [2] A.R. Hevner, C. Davis, R.W. Collins, and T.G. Gill, "A Neurodesign Model for Is Research", *Informing Science: the International Journal of an Emerging Transdiscipline*, 17, 2014, pp. 103-132.
- [3] B. Shneiderman, C.B.H. Plaisant, "Improving health and healthcare with interactive visualization methods," *IEEE Computer Special Issue on Challenges in Information Visualization*, 1-13, 2013.
- [4] C. Görg, J. Kihm, J. Choo, Z. Liu, S. Muthiah, H. Park, and J. Stasko, "Combining Computational Analyses and Interactive Visualization to Enhance Information Retrieval", 2013.
- [5] Sridhar KP, Baskar S, Shakeel PM, Dhulipala VS., "Developing brain abnormality recognize system using multi-objective pattern producing neural network", *Journal of Ambient Intelligence and Humanized Computing*, 2018:1-9. <https://doi.org/10.1007/s12652-018-1058-y>
- [6] D. Milam, L. Bartram, and M. Seif El-Nasr, " Investigation of Expertise and Visual Balance in a Railed-Shooter game,"2012.
- [7] D.A. Keim, J.Kohlhammer, G.Ellis, and F. Mansmann. *Mastering the Information Age – Solving Problems with Visual Analytics*. Eurographics Association, 2010.
- [8] Deloitte. Visual analytics: revealing corruption, fraud, waste, and abuse. <http://www.slideshare.net/DeloitteForensicCenter/visualanalytics-revealing-corruption-fraud-waste-and-abuse-13958016?related=1>,
- [9] E. Bertini, and D. Lalanne, "Investigating and Reflecting on the Integration of Automatic Data Analysis and Visualization in Knowledge Discovery", 2010.
- [10] MuhammedShafi. P.Selvakumar.S*, Mohamed Shakeel.P, "An Efficient Optimal Fuzzy C Means (OFCM) Algorithm with Particle Swarm Optimization (PSO) To Analyze and Predict Crime Data", *Journal of Advanced Research in Dynamic and Control Systems*, Issue: 06,2018, Pages: 699-707
- [11] F. Sikder, " Predicting Students Yearly Performance using Neural Network : A Case Study of BSMRSTU, 524–529, 2016.
- [12] N. Buniyamin, P.M. Arsad, and R. Kassim, "Improve Students ' Achievement : A Proposed Proactive Intelligent Intervention", 126–130, 2013.
- [13] F. Saeed, and A. Dixit, "A Decision Support System Approach for Accreditation & Quality Assurance Council at Higher Education Institutions in Yemen", 163–168, 2015.
- [14] H.M.D. Eranjith, I.D. Fernando, G.K.S. Fernando, W.C.M. Soysa, and V.S.D. Jayasena, "A Visualization and Analysis Platform for Performance Tuning," 72–77, 2016
- [15] H. Hu, Y. Wen, T.S. Chua, and X. Li, " Toward Scalable Systems for Big Data Analytics: A Technology Tutorial," *IEEE Access*, 2, 652-687. <http://doi.org/10.1109, 2014>
- [16] I. Kouatli, , "Student Advising Decision to predict student ' s Future GPA based on Genetic Fuzzimetric Technique (GFT)", 2015
- [17] I.D. Muraina and H.H. Ibrahim, " Student ' s Perception to Learning of Innovative Skills through Multi- Dimensional Visualization System : Reliability and Validity Tests of some Measurements,"(August), 29–30, 2016.
- [18] J. Mendel, and J. Yeager, "Knowledge Visualization in Design Practice: Exploring the power of knowledge visualization in problem solving," 2010.
- [19] J. Iivari, " A Paradigmatic Analysis of Information Systems as a Design Science", *Scandinavian Journal of Information Systems*, 19(2), 2007, pp. 39-64.
- [20] L.E. Mnguni, " The theoretical cognitive process of visualization for science education," *SpringerPlus*, 3(1), 184. <https://doi.org/10.1186/2193-1801-3-184>, 2014.
- [21] M.H. Deniz, and S.K. Geyik, "An Empirical Research on General Internet Usage Patterns of Undergraduate Students,"*Procedia - Social and Behavioral Sciences*, 195, 895–904. <http://doi.org/10.1016/j.sbspro.2015.06.369>, 2015
- [22] M. Staron, K. Niesel, and W. Meding, " Selecting the Right Visualization of Indicators and Measures - Dashboard Selection Model," 2015.
- [23] M.I. Laguna, Estudio sobre el uso de Internet y sus aplicaciones en el alumnado de último a-no de carrera de la Universidad de Alicante [Study on the use of Internet and its applications in final-year students at the University of Ali- cante](Doctoral Thesis, University of Alicante, Alicante, Spain). Retrired from <http://rua.ua.es/dspace/handle/10045/35701>, 2013.
- [24] Shakeel PM, Baskar S, Dhulipala VS, Mishra S, Jaber MM., "Maintaining security and privacy in health care system using learning based Deep-Q-Networks", *Journal of medical systems*, 2018 Oct 1;42(10):186.<https://doi.org/10.1007/s10916-018-1045-z>
- [25] Okon E. Ani, (2010) "Internet access and use: A study of undergraduate students in three Nigerian universities", *The Electronic Library*, Vol. 28 Iss: 4, pp.555 – 567.
- [26] O. Kumar, and A. Goyal, " Visualization: A Novel Approach for Big Data Analytics," *2016 Second International Conference on Computational Intelligence & Communication Technology (CICCT)*, 121–124. <https://doi.org/10.1109/CICCT.2016.32>, 2016
- [27] P.I. Cerretani,E.B. Iturrioz, and P.B. Garay " Use of information and communications technology, academic performance and psychosocial distress in university students," *Computers in Human Behavior*, 56, 119–126. <http://doi.org/10.1016/j.chb.2015.11.026>, 2016

- [27] P.B. Goes, "Design Science Research in Top Information System Journals", *Management Information System Quarterly*, 38 (1), 2014, pp iii-viii.
- [28] R. Heldal, P. Pelliccione, U. Eliasson, J. Lantz, J. Derehag, J., and J. Whittle, "Descriptive vs Prescriptive Models in Industry," 2016.
- [29] P.M. Ogedebe, "Internet usage and students' academic performance in Nigeria tertiary institutions: a case study of University of Maiduguri," *Academic Research International*, 2(3), 334–343, 2012.
- [30] R.J. Oskouei, M. Askari, P. Rajendra, and P. Sajja, "Perceived Internet Usage Behaviours as Predictor to Outlier Detection in Students' Communities in Academic Environments," 2013.
- [31] S. Seidel, and R.T. Watson, "Improving the Societal Effectiveness of Is Research: The Pursuit of Prescriptive Accuracy", Available at SSRN 2477917, 2014.
- [32] S. Gregor, and A.R. Hevenr, " Positioning and Presenting Design Science Research for Maximum Impact", *MIS Quarterly*, 37(2), 2013, pp.336-355.
- [33] Baskar, S., & Dhulipala, V. R., "Biomedical Rehabilitation: Data Error Detection and Correction Using Two Dimensional Linear Feedback Shift Register Based Cyclic Redundancy Check", *Journal of Medical Imaging and Health Informatics*, 2018, 8(4), 805-808.
- [34] Shakeel PM, Baskar S, Dhulipala VS, Jaber MM., "Cloud based framework for diagnosis of diabetes mellitus using K-means clustering", *Health information science and systems*, 2018 Dec 1;6(1):16. <https://doi.org/10.1007/s13755-018-0054-0>
- [35] T. Mishra, K. Kumar, and S. Gupta, "Mining students' data for prediction performance," *International Conference on Advanced Computing and Communication Technologies*, ACCT, 255–262. <https://doi.org/10.1109/ACCT.2014.105>, 2014.
- [36] T. N. Nguyen, P. Haddawy, P. Janecek, "A comparative analysis of techniques for predicting academic performance", vol. 00, no. , pp. T2G-7-T2G-12, 2007, doi:10.1109/FIE.2007.4417993
- [37] T.M. Green, W. Ribarsky, and B. Fisher. Building and applying a human cognition model for visual analytics. *Information Visualization*, 8(1):1-13, Jan. 2009.
- [38] T. Taghavi, and A.D. Pimentel, "Design Metrics and Visualization Techniques for Analyzing the Performance of MOEAs in DSE," 67–76, 2016.
- [39] Tableau Software. Data visualization software: what business intelligence software should have been. <http://www.tableausoftware.com/data-visualization-software-old>.
- [40] W. S. Cleveland, *Visualizing Data*. Hobart Press, Summit, New Jersey, 1993.
- [41] X. Wu, "Performance Evaluation, Prediction and Visualization of Parallel Systems," Retrieved from <https://books.google.com.my/books>, 2012.
- [42] Y. Kurniawan, and E. Halim, "Use Data Warehouse and Data Mining to Predict Student Academic Performance in Schools : A Case Study (Perspective Application and Benefits)," (August), 98–103, 2013
- [43] D. Sacha, A. Stoffel, F. Stoffel, B.C. Kwon, G. Ellis, and D.A. Keim, "Knowledge Generation Model for Visual Analytics", 2014.
- [44] E. Bologna, A. Maccagno, C. Somazzi, A. Oehlenschlager, and N. Esbry, "Characteristic of university students' Internet use. The case of the Retrieved from <http://www.oei.es/congreso2014/memoriactei/751.pdf>, 2014.
- [45] Selvakumar S, Inbarani H, Shakeel PM. A Hybrid Personalized Tag Recommendations for Social E-Learning System. *International Journal of Control Theory and Applications*. 2016;9(2):1187-99.
- [46] S.B. Ellore, S. Niranjana, and U. Brown, " The Influence of Internet Usage on Academic Performance and Face-to-Face Communication," *Journal of Psychology and Behavioral Science*, 2(2), 163–186, 2014
- [47] S. Bresciani, and M.J. Eppler, " The risks of visualization: A classification of disadvantages associated with graphic representations of information," *ICA Working Paper*, 2008.
- [48] S. Simmons, R. McCrindle, M. Sperrin, and A. Smith, "Prescription Software for Recovery and Rehabilitation Using Microsoft Kinect, 323–326, 2013.