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Personalization and Visual Representation through Learning Analytics: A Meaningful Approach to Guide Self-Directed Learners

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Abstract--- *Due to technological advancement and global needs, educators are challenged with creating professionals who can exceptionally apply skill and competence in a changing world. In order to accomplish this, an educator must come up with a structure of Self-Directed Learning techniques. This technique subsequently should enhance the student's capabilities and provide a platform to self-evaluate their performance and proficiency without compromising their learning frequency. The field of Learning Analytics is significantly matured in tracing learner's data from their digital footprint and provide valuable insights for improving the teaching-learning process. The researchers of this study aim to identify how learning analytics can be used as a tool for personalizing learning and what information can analytics dashboard provides self-directed learners to scale up key competencies and skills.*

Keywords--- *Learning Analytics, Self-directed Learning, Information Visualization, Personalization, Learning and Development.*

I. INTRODUCTION

Malcom Knowles an American adult educator defined Andragogy (Self-Directed Learning) as "the art and science of helping adults learn". According to him, adults are naturally motivated, objective, viable, as to be regarded and bring benefit to learning circumstances [1]. Enhancing the learning experience for the 21st century has been an interest in several academicians and researchers. The field of Learning Analytics(LA) originated from multidisciplinary roots such as academic analytics, education system, statistical analysis, big data, machine learning and business intelligence [2]. Data and analytics have attracted business pioneers and innovators. Analytics can lead to new insights by carrying out in depth analysis and examination of the data trails [3].

LA is defined in [4] as a field of analytics for learning and the context in which it occurs. The development of e-learning has added to the progression of learning investigation as leaners information can be captured and analyzed. When learners use a Learning management system, public network or similar platform, their digital footage can be tracked [5]. The current advancements in LA had given way to new and improved techniques and methodologies adopting which the students can enhance their learning experience and improve their capabilities [6]. LA visualizes data to learners through the dashboard, suggest recommendations for further learning, self-assessments, additional links to related video tutorials. In addition to this learner's behavior in the learning environment and personalized prompts are also featured [7]. LA abstract data relying on predictive pattern abilities and display through interactive visual representations [8].

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II. METHOD

To synthesizing this literature on learning analytics, the researcher conducted a seven-step Comprehensive Literature Review [9]. This review process was conducted in three phases; Exploration, Interpretation, and Communication. The process of the comprehensive literature review is presented in *Table 1*. The focus of learning analytics is exclusively on the learners. It can showcase individual learning habits, recommend an area of improvement, set and track personal goals to motivate and encourage [10]. The type and the nature of analytics are generally influenced by the context in which it exists. The learning process can be optimized by social network analysis, automated marking system, and content recommender systems [11 In order to identify how learning analytics can be used in personalized learning and how learner data generated is going to help them we have formulated two research questions and started our research.

RQ1: How Learning Analytics can be used as a tool for personalized learning and development?

RQ2: How information visualization can assist self-directed learners?

Table 1: Synopsis of seven-step Comprehensive Literature Review on Learning Analytics

Exploration Phase		
Step 1	Explore beliefs and topics	As an educator, we believed effective learning occurs in a self-directed path. We identified our worldview philosophy to be Self-Directed Learning and we conducted our literature review on how learning analytics can be helpful for self-directed learning.
Step 2	Initiate the search	Google Scholar was used for extracting papers from journals and conference proceedings with the keywords “Learning Analytics”, “Self-Directed Learning”, “Learning Analytics and Information Visualization /Dashboard”, “Learning Analytics and Personalization”, “Personalization and adaptation”.
Step 3	Storing & Organizing the search	Mendeley, a referencing management software was used to store and sort the search.
Step 4	Selecting / deselecting information	Used google sheet to list various parameters from articles for shortlisting information.
Step 5	Expand the search	Explored various professional networks in the field of Learning Analytics and related field and getting to know the current trends. Example: Learning Analytics Research Community (SoLAR), EI-design and Heutagogy Community of Practice.
Interpretation Phase		
Step 6	Analyzing information	Read the abstract and results, understood objectives and grouped articles by themes.
Communication Phase		
Step 7	Presenting the Report	Followed Comprehensive Literature Review report [9] typically containing Introduction, Method, Results, Discussion, and Reference.

III. RESULTS

In this section, the findings based on the research problem identified are stated, to do this we found 124 research and review articles on LA and grouped them into different themes as LA foundations, Personalization and adaptation, Ethics & Privacy, Predictive Analytics, and Information Visualization/Dashboard. For the current literature, two themes were shortlisted and articles that addressed the given problem were included.

RQ1: How Learning Analytics can be used as a tool for personalized learning and development?

Muslim A et. al. investigated and reported extensive research on personalized learning analytics with LA tools to

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set goals are none. They proposed the concept of personalized and goal-oriented learning analytics tools that can help learners to set their own goals, pose questions and self-define the indicators

and proposed a goal indicator engine in an open learning analytics platform.[12][13]. Yousef A. M. F assessed the personalized links of recommendation tools available for MOOC and found information aggregation capabilities of the recommender system can improve teaching-learning in an automated way which would also direct personalized tutoring and consulting [14]. Dimitrova V et. al. designed architecture for personalized nudges in video watching systems using learning analytics and stated methodologies to analyze learners' target behavior, attention intervals, and patterns [15]. A Pardo et. al. strongly believe, the accessibility of learner's digital trace offers the chance to investigate and innovate the way of providing personalized feedback for a large pool of students. As per their study, it was revealed, technology captured learning traces backed by instructor knowledge can result in personalized feedback [16].

Mavroudi A et. al. strongly suggest fostering a learner-centric approach will enhance the learning experience and emphasized performance indicators of student's process in narrow and fail to capture many learning experiences [17]. Maseleno A et. al. mentioned personalized learning approaches could probably involve students to effectively join learning conditions and methodologies that work best for them [18]. Vesin B et. al. developed an adaptive and interactive platform that can provide a personalized learning experience with attractive visualization and also mentioned high levels of personalization and customization may increase the complexity of the system [19]. As mentioned in the findings, LA can be effectively used as a tool for personalization and adaptation by using indicators, recommender and marking systems, personalized feedback by capturing all possible traces of learning backed by instructor knowledge.

RQ2: How information visualization can assist self-directed learners?

Bodily R and Verbert K pointed out learning analytics dashboards, outcome prediction and systematic interventions are generally presented to close the feedback loop and provide constant access to student information to improve self-awareness, reflection, and accomplishments. Further, they reported that there were two sorts of systems, recommendation and data visualization that emerged out of their investigation which used data mining and descriptive statistics for system representation [20]. Bodily R et. al. emphasized if the learner's awareness tool provides information to the learners about their ongoing or completed learning activities in an interactive manner will help them regulate self-learning and boost academic performance with the assumption that learners effectively use the information provided. They suggested shreds of evidence based on the traces of individual learning and actual knowledge will help students to self-assess and also highlighted the similarities between Open Learners Model(OLM) and LA dashboard and believe OLM can drive cutting edge learning analytics tool [21].

Jivet I et. al. grouped the different evaluation criteria such as understanding, agreement, impact on awareness & reflection, impact on performance, impact on behavior, usage of the system, impact on motivation, impact on affect, self-regulated learning, satisfaction, usability, usefulness into six evaluation levels such as metacognitive, cognitive, behavioral, emotional, self-regulation and tool usability believing it could be a strong connection to bring noticeable benefits in learners. In addition, they reported comparison with peers was not positively acknowledged among

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learners [22]. J X Seaton et. al.proposed a learning analytics dashboard for educational games for players to a) understand habits b) improve skills c) overcome challenges d) re-familiarize concepts e) find clues and strategies. The metacognitive skill was visualized using line graphs and performance scores were interpreted through scatter plots [23].

Aljohani N R et. al. developed the Learning Analytics Dashboard framework (AMBA Prototype) to extract behavior and attitude patterns from learner's trace data. The results stated that the customized learning analytics dashboard significantly helped students to access their learning traces and improved social interaction and peer learning through discussion [24]. Harvey A J et. al. stated hypothetical Dashboard displays compare individuals' performance of a student with course average, above and below performance. They also report that such information on social comparison affects students' self-esteem [25]. Molenaar I et. al. outlined the design of dashboards that reveals the accomplishment, progress and learning path of leaners by formulating self-set standards and goals. They mentioned explicit instructions and the transparent interface can provide effective feedback to learners for self-growth [26].

Matcha W et. al. mentioned most of the dashboard, tracked learning progress of students in various learning platforms. They also identified the different themes of dashboards which include tracking of competency, emotion, plan of study, learning design, learning difficulty detection, teamwork and game-based learning [27]. As interpreted from the findings, self-directed learners can discover and interpret their accomplishments, progress, behavior path, strategy to regulate self-awareness and learning. In addition to this game-based learning environment dashboards, can refamiliarize concepts, clues, and strategies to scale up the learning experience.

IV. DISCUSSION

This literature review examined, the use of LA in particular themes like personalization and visualization rather than discovering how technically personalization is achieved or which visualization techniques were adopted. Rather than a generic learning approach, engaging learners in a more meaningful customized approach would enable them to achieve their learning goals effectively. Addressing specific needs with greater control over learning, customizing as per their pace by choosing their own milestones and goals, provide just-in-time feedback, interoperable systems with various interaction levels and provision to interact with peers and experts can scale up personalized learning.

Personalized learning would be critical for individual success and it is evident from the current literature that LA has the full potential in doing this. The outcome of LA dashboards focusses on supporting individual and collaborative learning. Through dashboards, learners can attempt to understand learning habits, compare learning paths, analyze learning outcomes, track progress towards goals. Self-Directed learners can highly be engaged and successful in learning by receiving automated interventions through feedback, and various learning paths matching learning frequency. This study had its own limitations, the literature review for the given research problem ended up in minimal though the total number of sourced articles in proceedings and journals were good numbers.

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