USING ANALYTICS TO IMPROVE LEARNER-CENTERED APPLICATION DESIGN

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Abstract
Data analytics is one of the content analysis techniques which are being used in many disciplines to make informed decisions by understanding the existing data. In education, analytics is very popular term which is used to measure and analyze the learner's data to make appropriate improvements in learning and teaching designs. In this study, an online support system is being analyzed with the help of analytics in order to recommend key parameters for learner-centered application design. One year data from April 2015 to April 2016 is being acquired and examined based on learner's parameter. In particular design attributes have been proposed for future applications to make them learner-centered. The basic yet effective parameters such as geographic location, device, operating system, browser and system language are analyzed which provides an insight into users' preferences. This knowledge is used to build advanced personalized learner-centered applications.

Keywords: Analytics, learner-centered design, analytics, distance education

INTRODUCTION

Learner-centered or sometimes referred as student-centered is an approach or method of teaching from teacher's perspective and method of learning from student's perspective which motivates and encourages the learner to reflect on what they are learning and how they are learning. (Students at Center, 2016). Similarly, learner-centered design deals with the instructional design or the design of educational contents which is learner-centered. We can also define this like the learning content having a student-friendly design or framework rather than teacher-friendly. According to Jackson, learner-centered design demands re-development of tasks and supporting students in their learning process and activities. (Jackson, Stratford, Krajcik, & Soloway, 1995)

Recent trends and advancements in teaching and learning methods have challenged the educators and instructors. The most studied concept in this domain is the comparison between traditional way of teaching referred as teacher-centered approach and the latest way of teaching referred as learner-centered approach. Many researchers have criticized the traditional way of teaching and learning. According to researchers, traditional or teacher-centered method fails to focus on practical problems and hence students lack in real life problem solving skills. They become more blind followers rather than thinkers and innovators. According to (Hannafin & Land, 1997), technology supported learner centered environment is not a complete alternative to other methods. Different methods can be used to achieve different learning goals.

The study conducted by (Students at Center, 2016) as illustrated in Figure 1. This states that the learner-centered framework should cover the following parameters to make the learner-centered designs:

1. Personalization
2. Competency Based
3. Ownership
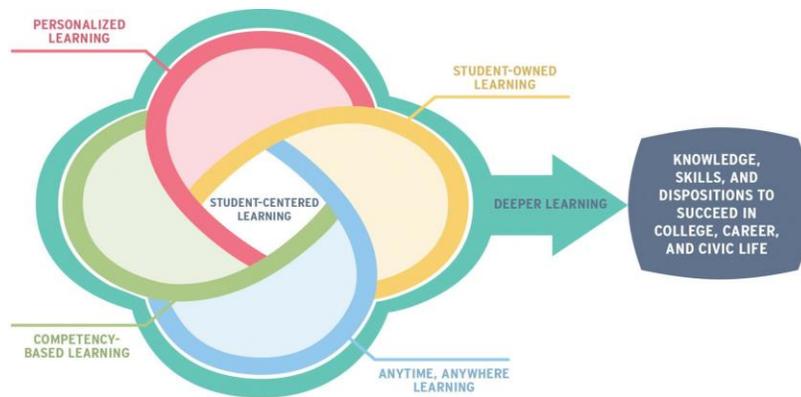4. Independent of location and time

Figure 1: Learner-centered Framework **(Students at Center, 2016)**

The first one is personalization. If the way of teaching or learning is personalized, content is not irrelevant but explained by giving local example of society or environment from which learner is aware. This may be called as personalized learning. This may also include personal interests of a single student or interests of a group. For example, if students belong to such society where students have interest in politics or games, teachers should try to give examples from politics or games or whatever interest belongs to the learners instead of teachers. Personal interests may matter while giving personal class activities or home assignments.

The second useful factor is competency based learning, which means learning or teaching should be based on competency of an individual student or group of students. The content, assessment, tasks and activities should relate with the existing competencies of the learner. For example, if the learners belong to a group who are not physically strong may not be given a task or activity which requires physical hard work or which may cause difficulty for some or all learners. Similarly, assessment or test must relate with the individual or class competency.

The third factor is student owned learning. According to framework, the learning or teaching method should cover student owning. The content developed during the learning process should not only come from teacher side rather than initiated from students side. The most important factor is that students should own the material developed by the students. The concept of Wikipedia or open-blogging is similar to this concept where students answer is not just read by the teachers but all students can read the answers given by a single student which will increase the motivation of student and sense of responsibility.

The last but not least factor is about location and time. The traditional education was dependent on time and location. However, in recent times, technology and communication can be effectively used as an alternate to historical traditional teaching methods.

Besides these, data analytics is one of the content analysis techniques which are being used in many industries to make better decisions by visualizing the existing data. In education, learning analytics is very popular term which is used to measure and analyze the learner's data to make appropriate improvements in learning and teaching designs. In this paper, following research questions were in focus: How analytics can be used in making learner-centered software applications? and what are the important parameters with respect to learner in developing a new software application for learners?

The remainder of the paper is as follows. The next section describes the related work. After that detailed methodology is discussed followed by results and discussion. Finally conclusions and direction to future work are given towards the end of this paper.

RELATED WORK

Personalization is the key factor is many domains. For example, web links (Atahan and Sarkar, 2011), blogs (Liu et al, 2014), movies (Ying et al. 2006), news (Shapira et al, 2009), maps (Tahir et al, 2010; Tahir et al, 2012) and emails (Ansari and Mela, 2003) are some of the common application areas of personalization. However there are relatively a fewer studies on learner centered approach.

Collective work of different researchers like John Dewey (1859-1952), Jean Piaget (1896-1980), Lev Vygotsky (1896-1934), Al-Ghazali and Shah Waliallah (1703-1763) focused on student's learning behavior and teaching methods which may not be given the same term as student-centered at that time. However all of their research had a similar type of domain which further led to teaching and learning approach.

According to Morphew, learner-centered design is not an easy job. This requires a lot of effort and planning. The major challenge is arrangement of the content and converting them as per the requirements of learner-centered. The new idea has to be incorporated with new activities. It may take a while during transition from traditional method to learner-centered method. Nevertheless, this develops self-confidence and motivation in students to create their own approach of learning. (Morphew, 2012)

An experimental study by Peggy et al. 2012, shows the result improved up to 68% after implementing learner-centered approach. This shows the clear benefits and the 21st century need of learner-centered approach. Most teachers had a view that factors like passion for technology, problem-solving skills and support from peer students had a key role in improving the learning process. (Ertmer, Sadik, Sendurur, Sendurur, & Ottenbreit-Leftwich, 2012)

The existing research shows that the leaner-centered approach is the need of time. Over the time, teaching methods have also evolved. The state-of-the-art teaching and learning techniques are in-line with the information and communication technologies in learner-centered approach. This is more than an approach rather a complete science; it may and may not include technology and tools but the basic concept behind using any tools is to give prime importance to learner according to its need and abilities.

MATERIAL AND METHODS

This study is based on the user analytics of an online student support system deployed at Allama Iqbal Open University to provide immediate online support to student queries coming from different sources as illustrated in Figure 2.

Figure 2: Sources of queries

Previously, support to students was provided in isolation using different mediums such as emails and telephone calls. For some queries, the record was maintained while not for others which caused administrative delays in decision making. Figure 3 depicts a methodology which is used in this study to analyze analytics in identifying parameters important for learner-centered application design.
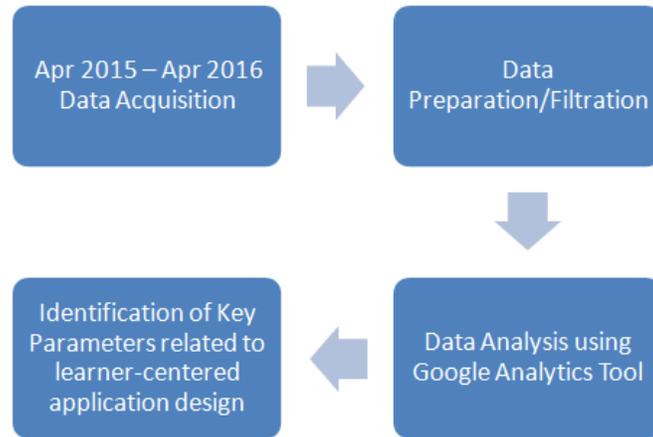
Figure 3: Methodology Flow Chart

RESULTS AND DISCUSSION

One year analytics data is acquired using Google Analytics script which was configured on an online student support system starting from April 1, 2015 to April 1, 2016. Figure 4 shows that during this period of one year around 156 thousands unique users accessed this system and more than 715 thousand times different pages were viewed. Each user spent approximately 3 minutes in each session. On average 3 pages are visited by each user in each session. The 47% bounce rate reflects that 47% visitors leave the system after visiting first page.
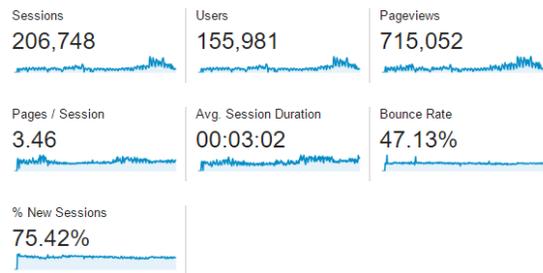

Figure 4: Audience Overview April 2015-April 2016

In this initial study, following design parameters were analyzed

   i)   User System Language ii) Geo-location Analysis iii) Brower and OS Analysis iv) User Device Analysis

a) User System Language
      Data analysis of system language shows that a majority (80%) of users use US English as default language settings in their systems. Such kind of information is very valuable for designing a localized language application. In this case, application design should be compatible with US English language.

Language	Sessions ▼ ↓	Sessions
	206,748 % of Total: 100.00% (206,748)	206,748 % of Total: 100.00% (206,748)
1. ■ en-us	165,026	79.82%
2. ■ en-gb	27,184	13.15%
3. ■ en	10,009	4.84%
4. ■ (not set)	3,175	1.54%
5. ■ en-pk	253	0.12%

Figure 5: User System Language

b) **Geo-location Analysis**

The second parameter which is analyzed is the location attribute. Using location data and co-relating it with other parameters show that most of the users (80%) are from Pakistan, however users from countries where university is not providing services is questionable and needs further analysis from application security point of view (see Figure 6).

Country ?	Sessions ? ↓	% New Sessions ?	New Users ?	Bounce Rate ?	Pages / Session ?	Avg. Session Duration ?
	206,748 % of Total: 100.00% (206,748)	75.57% Avg for View: 75.42% (0.20%)	156,246 % of Total: 100.20% (155,938)	47.13% Avg for View: 47.13% (0.00%)	3.46 Avg for View: 3.46 (0.00%)	00:03:02 Avg for View: 00:03:02 (0.00%)
1. ■ Pakistan	165,847 (80.22%)	75.01%	124,394 (79.61%)	46.23%	3.67	00:03:10
2. ■ Kenya	9,139 (4.42%)	73.83%	6,747 (4.32%)	46.74%	2.76	00:02:40
3. ■ United States	7,808 (3.78%)	81.42%	6,357 (4.07%)	53.89%	2.33	00:02:14
4. ■ India	6,899 (3.34%)	81.07%	5,593 (3.58%)	47.47%	2.57	00:02:30
5. ■ United Arab Emirates	3,507 (1.70%)	73.54%	2,579 (1.65%)	47.05%	2.87	00:02:47

Figure 6: Geo-location analysis

c) **Browser and OS Analysis**

The browser is the client-based software which translates a webpage code in a presentable form. Cross-browser compatibility is one of the hot design issues in web application development.

Browser	Sessions ▼ ↓	Sessions
	206,748 % of Total: 100.00% (206,748)	206,748 % of Total: 100.00% (206,748)
1. ■ Chrome	126,449	61.16%
2. ■ Firefox	24,379	11.79%
3. ■ Opera Mini	13,469	6.51%
4. ■ UC Browser	13,218	6.39%
5. ■ Android Browser	9,742	4.71%

Figure 7: Browser Analysis

Figure 7 shows that majority of users (61%) use Google Chrome as browser, however other browsers like Firefox, Opera Mini, UC and Android browser are also significant. This information is very useful for application designer to consider while designing screens for any student related application. Similarly, information regarding operating

system is also vital for developers and designers to develop or design such kind of application which is supported by all such operating systems which are used by potential or existing clientage. Figure 8 depicts the operating systems used by the most users. From application design viewpoint, it should be such that it is equally compatible with all operating systems used by users as shown priority wise in Figure 8.

Operating System	Sessions ▼ ↓	Sessions
	206,748 % of Total: 100.00% (206,748)	206,748 % of Total: 100.00% (206,748)
1. ■ Windows	130,609	63.17%
2. ■ Android	51,248	24.79%
3. ■ (not set)	12,481	6.04%
4. ■ iOS	4,357	2.11%
5. ■ Macintosh	3,373	1.63%

Figure 8: Operating System Analysis

d) User Device Analysis

The device type or category is one of the key parameters to consider while designing any application. Applications which are compatible with all kinds of devices are called responsive applications In this case, Figure 9 illustrated that users belong to different category of devices such as desktop, mobile and tablet. Application design must be responsive so that it may support all kinds of device categories as shown in Figure 9.

Device Category ↑	Sessions ▼	Sessions
	206,748 % of Total: 100.00% (206,748)	206,748 % of Total: 100.00% (206,748)
1. ■ desktop	139,157	67.31%
2. ■ mobile	63,528	30.73%
3. ■ tablet	4,063	1.97%

Figure 9: Device Category Analysis

CONCLUSIONS

This study concludes that analytics have a great potential in analyzing the users data to design advanced personalized learner-centered applications. Parameters analyzed such as users language, location, device category and operating system are very significant design factors which should be kept in consideration while designing new applications for the learners. Using such analytics, existing design of software applications can be improved to make them more personalized and learner-centered. The same analytics can also be integrated with online learning management systems to relate different parameters with students' performance. In future work, using analytics learners' behavior can also be studied by relating it with their location, time, gender, age and personal interests.

REFERENCES

Anees, S. M. (2011). Muslim Thinkers of Education. In M. I. Yousuf, S. M. Anees, M. L. Sajjad, & M. N.

Anwar, Islamic System of Education. Islamabad: Allama Iqbal Open University.

Ansari, A., & Mela, C. F. (2003). E-customization. *Journal of marketing research*, *40*(2), 131-145.

Atahan, P., & Sarkar, S. (2011). Accelerated learning of user profiles.*Management Science*, *57*(2), 215-239.

Ertmer, P. A., Sadik, O., Sendurur, E., Sendurur, P., & Ottenbreit-Leftwich, A. T. (2012). Teacher beliefs and technology integration practices: A critical relationship. Computers & Education , 423-435.

Hannafin, M. J., & Land, S. M. (1997). The foundations and assumptions of technology-enhanced student-centered learning environment. *Instructional Science* , 167-202.

Jackson, S. L., Stratford, S. J., Krajcik, J. S., & Soloway, E. (1995). Model-it: A case study of Learner-Centered Design Software for Suppoting Model Building. *WCTASC*.

Liu, D. R., Tsai, P. Y., & Chiu, P. H. (2011). Personalized recommendation of popular blog articles for mobile applications. *Information Sciences*, *181*(9), 1552-1572.

Morphew, V. (2012). A constructivist approach to the national educational technology standards for teachers. International Society for Technology in Education .

O'reilly, T. (2007). What is Web 2.0: Design patterns and business models for the next generation of software. *Communications & strategies*, (1), 17.

Shapira, B., Shoval, P., Tractinsky, N., & Meyer, J. (2009). ePaper: A personalized mobile newspaper. *Journal of the American Society for Information Science and Technology*, *60*(11), 2333-2346.

Students at Center. (2016). Jobs for the future. Retrieved 02 24, 2016, from Studentsatthecenterorg: http://www.studentsatthecenter.org/about

Tahir, A., McArdle, G., & Bertolotto, M. (2012, June). Identifying specific spatial tasks through clustering and geovisual analysis. In *2012 20th International Conference on Geoinformatics* (pp. 1-6). IEEE.

Tahir, A., McArdle, G., Ballatore, A., & Bertolotto, M. (2010). Collaborative filtering-a group profiling algorithm for personalisation in a spatial recommender system. *Proceedings Geoinformatik, Kiel, Germany*, 44-50.

Ying, Y., Feinberg, F., & Wedel, M. (2006). Leveraging missing ratings to improve online recommendation systems. *Journal of marketing research*,*43*(3), 355-365.