ORIGINAL RESEARCH PAPER

Medical Education

TO ANALYSE AND CORRELATE THE LEARNING STYLES PREFERRED BY THE STUDENT ASSISTED BY ONLINE TEACHING WITH THEIR ACADEMIC PERFORMANCE (ORIGINAL ARTICLE)

KEY WORDS: Online teaching, Offline teaching, Academic performance, Learning style

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ABSTRACT

Background: Since time immemorial, traditional or classroom teaching was always in the forefront in medical education, but the sudden shift to digital teaching and online learning during the period of Covid, made us ponder , its consequences on the medical students using varied methods of learning with their personalized learning style. But while technological innovation is necessary to the development of online education, it is not sufficient to assure that online education is effective. Different learners have different cognitive styles and their own mode of perceiving, remembering, thinking, and problem solving. In this research study diversified learning modalities of student supported by the mode of teaching applied was found to have varied impact on their academic performance. **Study design:** It is an observational quantitative study. **Method:** The present study involved, 125 1st phase MBBS students of 2020-21 batch of ESI Medical College, Joka who attended offline classes during pre-coronavirus era, shifting to online mode during covid pandemic. Students were categorized according to their learning style using VARK questionnaire. Formative assessment of the students in offline mode was conducted to judge their academic performance, theoretically and practically, succedding, online and offline teaching. **Result:** 40-50% of students showed poor performance in theory, in all the learning modalities irrespective of the mode of teaching. In practicals , 45-54% of students fared well after offline mode of teaching, mainly in bimodal and trimodal learning style , whereas only 8-14% could perform after online mode. **Conclusion:** The need is to focus on student learning during assessment in medical education, giving scope for adapting to changing circumstances, and thus refining by use of information about students' abilities.

INTRODUCTION

With the advent of Covid in December 2019 and a rapid surge by March "global emergency" was declared by WHO , and the pandemic status was imposed Many countries subsequently imposed containment measures including nation-wide shutdowns. Novel coronavirus pandemic (COVID-19) had profound impact on the health-care systems and medical education worldwide. Closure of the medical schools and universities disrupted the learning and education of future health professionals[1] This pandemic has resulted in a sea change toward online learning throughout the world .Traditional (i.e. face to face) teaching is considered an essential long-standing approach in medical education[2] As traditional approaches in medical education are facing increased challenges because of the increase in clinical demands and reduction in available time[3], a shift in traditional medical education practice to online, distance, or electronic learning has been noticed in the last few decades[4]. Until recently , anatomists relied on cadaveric prosections, virtual anatomy platforms and importantly , face to face interactions for research and teaching activities[5], but Covid -19 scenerio , led to the emergence of online learning as major mode of teaching , to maintain the continuity of medical education. Education and training in medicine need innovative ideas that match the students' styles. Blended Learning (BL), became a fundamental method of education in the COVID-19 era, integrating, conventional face-to-face and online learning when students were permitted to attend practical classes in small batches , when covid situation improved and relaxations were brought to the fore. Exploring the learning style perception among students is a necessity, because students can realize their own strengths and use their talents to improve their learning. Any discrepancy between teaching methods and students' learning styles will have a negative impact on the educational process.[6]The students' learning style is a key factor and priority that needs to be addressed during this shift in the educational system to achieve student satisfaction and better academic outcomes. The change in teaching and assessment methods during the COVID-19 era should match the students' learning styles to achieve more satisfied learning with better academic performance. Results of this study reveals, students with varied learning styles showed disparities in performance, when assessed after this shift in teaching method, thus prompting us to judge, whether blended learning will be beneficial in medical education in context to both theory and practical applications. The main expected contribution of this research is to provide empirical evidence of the impact of learning styles on academic performance in online and face-to-face assessment activities

AIMS AND OBJECTIVES :

1) To understand the learning style preferred by the students using VARK inventory
2) To evaluate student's performance in offline mode , succeeding both after offline and online teaching
3) To correlate the learning styles with their academic performance , assisted by offline and online mode of teaching .

MATERIALS AND METHODS :

Study Design: This is an Observational Quantitative study

Study Sample: The study population comprised of 125, 1st phase medical students of 2020-2021 batch, ESIPGIMSR & ESIMC, Joka. Students were selected by convenient sampling method.

Inclusion criteria:
Students who appeared in the internal assessments in the offline mode, preceding and succeeding online mode of teaching

Data Collection Tools:
Data included students' transcripts and VARK questionnaire. The scores of two formative assessments, succedding offline and online mode of teaching was compiled in excel sheet. VARK Questionnaire, comprising 20 questions was used to identify learners' learning styles

Statistical Analysis :
For statistical analysis SPSS package was used and tests conducted were the Kruskal-Wallis test to compare

performance among the different modalities and one way Anova test to compare between varied learning style within each modality with academic performance , after offline and online mode of teaching .

Ethics:
The study was approved by the Institutional Ethical Committee of the parent institution . The objectives of the study were stated for all participants, and written informed consent was obtained.

RESULTS OR FINDINGS :
91.2% students from 1st phase MBBS batch (2020-2021), participated voluntarily following sensitization regarding the study. Students, who didn't appear in the two formative assessments (both theory and practical) and failed to respond to the VARK questionnaire, were not included in the study.

Students were divided according to their learning style i.e quadrimodal, trimodal, bimodal and unimodal, according to the VARK learning style inventory tool, introduced by Fleming that defines the preferred mode of learning in terms of four sensory modalities. Completed questionnaires were scored for each VARK category and the frequency of VARK preferences for each individual component and combination of components was analyzed. The data was reported as percentage of respondents in each category of learning preference . Unimodal were grouped into Visual(V) , Aural(A), Kinesthetic(K) or Read and Write(RW). The "multimodal learners" have a balanced set of learning preferences, including the bimodal, trimodal and quadrimodal. 38.59% students belonged to quadrimodal learning style (Aural , Visual , Kinesthetic Read and write), 27.19% belonged to trimodal learning style 34.21% belonged to bimodal category and only 1.75% had unimodal mode of learning **(Fig 1**)

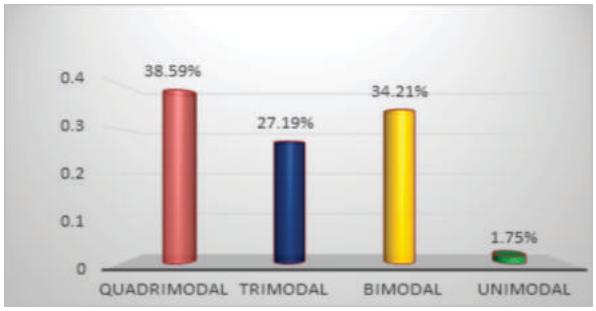

FIG.1 Distribution of students within sensory modalities
Fig.1

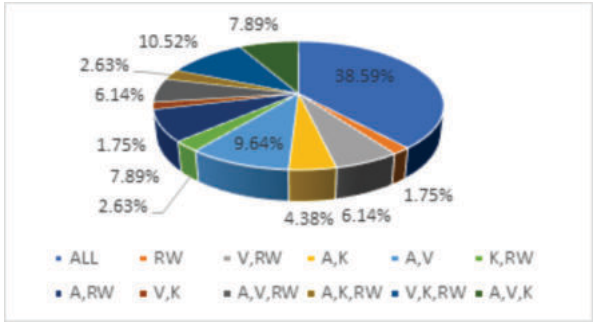

FIG.2 Student distribution with varied learning preferences within same modality

In quadrimodal learning style, 50% students fared poorly after both modes of teaching, whereas 20.44% of students performed better after offline teaching in theory whereas , in practicals 45.44% fared well in practicals after offline as compared to 13.63% after online classes and 13.63% maintained their status quo. In trimodal type, 45.15% performed poorly in theory, succeeding both offline and online teaching and 19.35% performed well after offline teaching . 48.38% of students performed well after offline teaching in practicals , whereas a very negligible amount of 3.22% could perform after online teaching. In bimodal learning style 43.58% students fared poorly in theory after both modes of teaching , whereas 25.63% students displayed remarkable performance after offline mode. 53.85% of students performed well in practicals after offline mode of teaching as compared to 7.68% after online (**Fig 3**) . Only 2 students had unimodal style of learning (Read and write) , not displaying much difference in their performance after both modes of teaching. On comparing the results in different modalities of learning after two varied modes of teaching, it was found that , In theory , performance of 40-50% of students was poor in all the modalities irrespective of the mode of teaching . In practicals 45-54% of students fared well after offline mode of teaching as compared to a very negligible population of 8-14% who could perform after online mode of teaching. Result is insignificant while comparing the performance of students in all the modalities of learning without taking into account the subsections of learning style in both theory and practicals after the online and offline mode of teaching

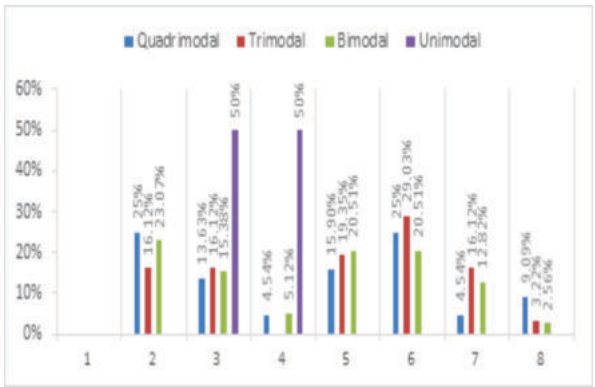

FIG.3 Performance between learning modalities prior to and after online teaching in theory and practicals Blue (Quadrimodal) , Red (Trimodal) , Green (Bimodal)

Within varied learning modalities, students of bimodal category, with aural and visual dominance followed by visual and Read and write, and in trimodal mode, combination of visual, read and write kinaesthetic, performed better in theory after offline mode of teaching. Students belonging to the trimodal group with dominance of aural, visual and Kinesthetic could perform better after online mode .**(Table 1 , Fig 5).** Read and write method occupies a central part for better performance in theory assisted by a strong sense of visualisation. Offline mode of teaching seems to extract the best from the students, irrespective of learning style . Statistical analysis using Anova test was found to be significant with P value at .012599.Students under bimodal and trimodal sensory modality performed better in theory after offline mode of teaching compared to those with quadrimodal learning style. Visual and kinesthetic habits yielded better results, within same modality in practical assessments **(Table1).** Students having better grasping capacity using their visual and aural senses performed better after online mode of teaching. Statistical analysis by Anova test was found to be significant at $p<.05$ where F-ratio value is 22.83747 and p value is .000572 .

The percentage of students who fared successfully in both theory (**Table 1, Fig4**) and practical exams (**Table 1,Fig.5**) were found to be higher after offline mode of teaching as compared to performance after online mode of teaching irrespective of their individual learning style, which was more significant in the practical scores. But, among the same modality, a difference in performance was significant depending on the type of combination of learning habits prefered .

Table 1 Pass Percentage In Theory And Practical In Varied Learning Styles After Offline And Online Mode

Learning Style	Pass %age after offline teaching mode (Theory)	Pass %age after online teaching mode (Theory)	Pass %age after offline teaching mode(Practical)	Pass%age after online teaching mode(Practical)
A,V,K,RW	36.7	20.4	70.6	27.8
V.RW	57.1	42.9	57.1	42.9
A.K	20	0	10	0
A,V	63.7	18.8	90.8	18.18
A,RW	22.2	0	77.8	22.2
V,K	0	0	100	0
K.RW	33.3	0	100	0
A,V,RW	42.9	14.28	71.42	42.9
A,V,K	25	50	91.7	41.7
A,K,RW	33.3	33.3	66.6	33.3
V,K,RW	66.6	44.4	77.7	44.4
RW	100	0	50	50

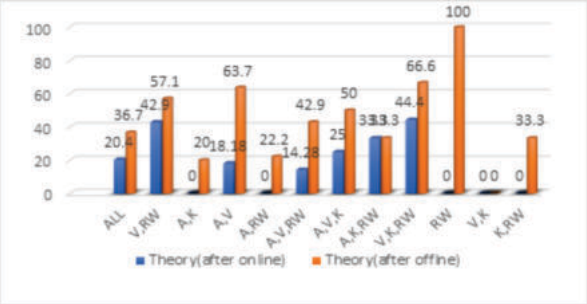

FIG.4 Performance in theory within different learning styles (online and offline)

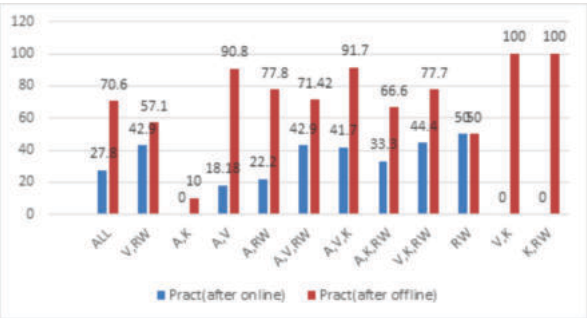

FIG.5 Performance in practicals within different learning styles (online and offline)

DISCUSSION :

A learning style itself cannot cause an increase or decrease in academic performance [7,8] and it is the mismatch or match between learning style and teaching mode that should affect performance During the pandemic period the students were attending only theoretical classes. For online learning that consisted mainly of static, noninteractive learning resources that largely resembled offline learning, usually no significant difference was found when compared to offline learning [9]. To some extent, online learning might not compete with some aspects of offline learning, like interactive knowledge building between teacher and students.

Studies on the correlation between learning style and form of teaching , help to identify how people prefer to learn in virtual environments and ways to guide didactic and pedagogical applications to improve teaching and learning, considering the different learning styles[10] Learning in virtual environments offers personalized and adaptive mechanisms to meet students' preferences the moment that students know their preferences, they have the ability to guide their own learning, which justifies knowing the learning styles, which is an important step to promote individuality and to take advantage of skills[11]. To identify and understand the different learning styles of students, on the other hand, also helps teachers in planning activities and in the availability of resources that meet a multitude of students, contributing to their motivation[12], which was the need of the hour during the sudden switch to online mode of teaching. In the virtual learning environment, knowing what are the learning styles of students allows for adequate planning in the use of computing resources. Knowledge of the students' learning styles can maintain the positive results and promote improvements in the teaching-learning process in general.

Equivalent teaching and instructional modes are effective for some and ineffective for others[13]. The students' learning style is a key factor and priority that needs to be addressed during this shift in the educational system to achieve student satisfaction and better academic outcomes. Virtually all of these studies found that online instruction resulted in lower student performance relative to in-person instruction - differences in the characteristics of students themselves may drive differences in the outcome measures we observe that are unrelated to the mode of instruction[14].

In same educational environment, each individual has different learning habits and grasping capacity is not of the same level and quality in all students. Paiboonsithiwong's study showed that the most preferred VARK learning style among medical students was quadrimodal[15]. Study conducted here shows that 44% students was quadrimodal followed by bimodal and trimodal learning style. Ojeh's study of pre-clinical medical students showed that students with the multimodal learning style had better academic performance[16] . Individuals exhibit different approaches in the learning process and a single strategy or approach cannot provide optimal learning conditions for all individuals .

Previous studies showed that students who were aware of their learning style had improved academic performance [17,18]. Moreover, the review of Pashler et al. showed that there was virtually no evidence that people learn better when teaching style is tailored to match students' preferred learning style [19] . It should be noted that learning style is a self-reported measure that can change based on experience and the demands of a situation. Therefore, it is subjective and able to provide adaptive behaviour [20]. The authors found that in general, web-based training was slightly more effective than face-to-face training for acquiring declarative knowledge (“knowing that”), but not for procedural knowledge (“knowing how”)[21]. In this study, it was clearly revealed that the disparity of performance in theory was much less then that in the practical performance after offline and online mode of teaching. Post hoc tests revealed that the K group scored significantly lower than the other three modality group[22] Alkhasawneh et al[23] did find a significant relationship between VARK preferences and course grades which correlates with the present study. Conclusion of the study is that students with K perceived sensory modality preferences tended to perform more poorly in their course , whereas in this present study K group performed better as compared to others .

Students' learning and study styles played a crucial role in their success in online course; perhaps even a bigger role than their learning styles play in the traditional classroom[24] . Clariana (1997) has shown that online assessments allow students to tailor their use to their own learning style[25] Some studies reveal that the online pedagogy had a negative effect on student academic performance when compared with the traditionally taught group[26] . Motii and Sanders (2014) determined that student performance in the online instructional modality was at least as good as student performance in traditional F2F classes based on overall semester grades[27] From the survey results of teachers and

students, it can be seen that the traditional face-to-face education is irreplaceable for medical courses, which was consistent with a recent study . As a matter of fact , the scenario depicts , that online mode of teaching creates negative effect on academic performance as compared to offline mode , irrespective of the learning style preferred .

Studies reveals , students (63.8%) preferred multiple modes , 2 modes (24.5%), 3 modes (32.1%), or 4 modes (43.4%)] of information presentation[28], which corelates with the present study. Specifically, student motivation and performance improves when instruction is adapted to student learning preferences and styles[29]. Study confirms that Visual (V) and Kinesthetic (K) learning style preferences are positively and significantly influence students' academic performance. This indicates that different subjects required different kinds of learning styles and instructions to optimally potentiate and benefit the students[30]. Mismatches between learning style and teaching instruction may lead to negative effects on the academic performance, quality of the students and on their attitudes toward their education [31].

Assessment is an integral part of the teaching and learning process that challenges teachers to consider the variety of the assessment techniques that will meet the subject's learning needs. So far as studies predict student performance, indications are that the format of learning, i.e. offline or online, is not a sufficient treatment to influence significant difference in a performance outcome[32]. Students in online courses performed substantially worse than students in traditional in-person courses. Student's learning style is adaptable to situational aspects of the learning environment[33].

CONCLUSION :

The results of the present study , which was solely concentrated in anatomy provided an insight , in the disparity of learning style among the students and its effect on their academic performance , following offline and online mode of teaching. As a major part of the students had multimodal learning , its implied that most of the students learn effectively as long as the teaching methods include a blend of activities that stimulate the visual, aural, read-write and the kinesthetic sensory modalities . Integration of new technologies remains challenging , not just in anatomy , but a vast area of medical field , if remote learning is to play a role , which was very evident when the whole world had to shift into online mode . Students should be encouraged to use their learning preferences to their advantage through practice of appropriate learning strategies. At the same time, students should be motivated to develop the ability to use other learning styles. Medical education needs to use assessment that focuses on student learning, can respond quickly to changes, and is continuously refined by use of information about students' abilities . The teachers can address learner's needs by utilizing a variety of teaching methods and teaching styles so that learners are exposed to both familiar and unfamiliar ways of learning.

When considering the development of on-line course material, faculty must gain an understanding of how student characteristics influence success in on-line learning, while being sensitive to students' perceptions of quality and quantity of instructor interaction [34]

Conflict Of Interest: None

Funding: None

Table 4

Learning style	THEORY OFFLINE	THEORY ONLINE	PRACTICAL 0FFLINE	PRACTICAL ONLINE
ALL	36.66%	20.45%	70.45%	27.27%
V,RW	28.57%	21.42%	28.57%	21.42%
A,K	16.66%	0.00%	83.33%	0.00%
A,V	33.33%	9.52%	47.61%	9.52%
A,RW	18.18%	0.00%	63.63%	18.18%
A,V,RW	25%	8%	41.66%	25.00%
A,V,K	24%	12%	44%	20%
A,K,RW	20%	20%	40%	20%
V,K,RW	28.57%	19.04%	33.33%	19.04%
RW	50%	0%	25%	25%
V,K	0	0	100%	0%
K,RW	25%	0%	75%	0%

REFERENCES

1 Chatterjee S. The COVID-19 pandemic through the lens of a medical student in India. Int J Med Stud 2020;8:82-3.
2 Albarrak A. Education in a technological world: Communicating current and emerging research and technological efforts [Internet]. 1st ed. Formatex Research Center; 2011.
3 Moberg TF, Whitcomb ME. Educational technology to facilitate medical students ' learning: background paper 2 of the medical school objectives project. Acad Med. 1999;74(10):1146–50.
4 Shachar M, Neumann Y. Differences between traditional and distance education academic performances: a meta-analytic approach. The International Review of Research in Open and Distributed Learning
5. Gray, D. L., & Walker, B. A. (2015). The effect of an interprofessional gerontology course on student knowledge and interest. Physical and Occupational Therapy in Geriatrics, 33(2), 103–117
6 Hebat-Allah M.S .Gabal, Rasha S. Hussein: Learning Styles and Academic Achievement among Medical Students at Ain Shams University: An Experience During COVID-19 Era
7. Sadler-Smith E Learning styles : A Holistic approach Eur India Train 1996 ; 20 : 29-36
8. Romanelli F , Bird E , Ryan M .Learning styles : A review of theory , application , and best practices . Am J Pharm Educ. 2009; 73:9
9. Leisi Pei & Hongbin Wu (2019) Does online learning work better than offline learning in undergraduate medical education? A systematic review and meta-analysis, Medical Education Online, 24:1, 1666538
10. Denise Mendes da Silva , Edvalda Araujo Leal, Janser Moura Pereira, Jose Dutrade Oliveira :Learning styles and academic performance in Distance Education:a research in specialization courses.
11. Barros, D. M.V. (2010). Estilos de Uso do Espaço Virtual: Novas Perspectivas para os Ambientes de Aprendizagem Online. Revista Estilos de Aprendizagem, 6(6), 1-32
12. Silva, D. M. & Oliveira Neto, J.D. (2010). O impacto dos Estilos de Aprendizagem no ensino de Contabilidade. Contabilidade Vista & Revista, 21(4), 123-156.
13. T. Larkin & D. Budny: Learning styles in the classroom: approaches to enhance student motivation and learning , July 7 – 9, 2005, Juan Dolio, Dominican Republic ITHET 6th Annual International Conference
14 . How does virtual learning impact students in higher education ? Stephanie Riegg Cellini , Friday , August 13 , 2021.
15. Paiboonsithiwong S, Kunanitthaworn N, Songtrijuck N. Learning styles, academic achievement, and mental health problems among medical students in Thailand. J Educ Eval Health Pro.
16. Ojeh N, Sobers-Grannum N, Gaur U, Udupa A, Majumder MA. Learning style preferences: A study of pre-clinical medical students in Barbados. J Adv Med Educ Prof. 2017;5(4):185–94.
17. Nelson B, Dunn R, Griggs SA, Primavera L. Effects of learning style intervention on college students retention and achievement. J Coll Stud Dev. 1993;34:364–9.
18. Sandmire DA, Boyce PF. Pairing of opposite learning styles among allied health students: effects on collaborative performance. J Allied Health. 2004; 33(Suppl 2):156–63
19. Pashler H, McDaniel M, Rohrer D, Bjork R. Learning styles: concepts and evidence. Psychol Sci Public Interest. 2008;9(3):105–1.
20. Cassidy S. Learning styles: an overview of theories, models, and measures. Educ Psychol-Uk. 2004;24(Suppl 4):419–44.
21. BARBARA MEANS ,YUKIE TOYAMA , ROBERT MURPHY , MARIANNE BAKI :The Effectiveness of Online and Blended Learning: A Meta-Analysis of the Empirical Literature
22. John L. Dobson. "A comparison between learning style preferences and sex, status, and course performance". Adv Physiol Educ 34: 197–204, 2010
23. Alkhasawneh IM, Mrayyan MT, Docherty C, Alashram S, Yousef HY. Problem-based learning (PBL): assessing students' learning preferences using VARK. Nurse Ed Today 28: 572–579, 2008.
24. Learning Styles and Asynchronous Learning: Comparing the LASSI Model to Class Performance Kenneth D. Loomis, Ph.D
25. Clariana, R. B. (1993). A review of multiple-try feedback in traditional and computer based instruction. Journal of Computer Based Instruction 20(3), 76-74
26. Devayan Debashis Bir. comparison of academic performance of students in online vs traditional engineering course
27. Motii, B. B., & Sanders, T. J. (2014). An Empirical Analysis of Student Learning Outcomes in an Introductory Microeconomics Course: Online Versus Face-To-Face Delivery Methods. *Global Education Journal,* (3), 81–96
28. Heidi L. Lujan and Stephen E. DiCarlo. First-year medical students prefer multiple learning styles Article in AJP Advances in Physiology Education April 2006 .
29. Miller P. Learning styles: the multimedia of the mind. Educational Resources Information Center ED 451 140, 2001
30. Romanelli, F., Bird, F. & Ryan, M. (2009). Learning styles: A review of theory, application, and best practices. American Journal of Pharmaceutical Education, 73(1), 9-21
31. Prasad, J. J., Showler, M. B., Ryan, A. M., Schmitt, N., & Nye, C. D. (2017). When belief precedes being: How attitudes and motivation before matriculation lead to fit and academic performance. Journal of Vocational Behavior, 100, 27-42.

32. McFarland, D. and Hamilton, D. (2005-2006). Factors affecting student performance and satisfaction: Online versus traditional course delivery. Journal of Computer Information Systems, (Winter), 25-32.
33. Nulty, D. D., & Barrett, M. A. (1996). Transitions in students' learning styles. Studies in Higher Education, 21(3), 333 – 345
34. Picciano, A.G. (2002). Beyond student perceptions: Issues of interaction, presence, and performance in an online course. Journal of Asynchronous Learning Networks, 6, 21-40.