Application of Bayesian Approach - Students' perspective of online learning

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ABSTRACT
Covid 19 has offered many challenges in academic domain with many educational institutions shifting their teaching to online platforms. In view of this, a study was conducted on 150 students to know the various parameters which can impact online learning. The study has indicated that traditional method of teaching was preferred by a vast majority of students over online teaching. A total of 12 parameters are considered and a survey with 4-point Likert scale was used. Bayesian statistical approach was done to analyse the results. Lack of focus, lack of self-discipline and self-motivation., lack of corelating theoretical knowledge with the practical world, group projects were some of the factors which made students preferring traditional classroom teaching over online teaching.
Keywords: Bayesian Approach, Student performance, Online teaching, Data Analysis, **Interference.**

I) INTRODUCTION
Students' academic performance can be largely impacted by psychological and environmental factors. Web learning portals can develop interest as well enhance learning potential for students. Using technical solutions and recent applications related to academic domain, the educational institutes can analyse, model the performance of students so that peer interaction and knowledge progress takes place. The emergence of COVID -19 virus has changed the methodology of learning and teaching process in all grades. Out study is an effort to analyse students' attitude, performance, and views of students towards online learning and how it has impacted their learning and skill development process. Many similarities and differences exist between traditional classroom teaching and online teaching. In education, change comes with questions. Despite all ongoing propaganda of encouraging as well championing online education, researchers still have a long way to confidently demonstrate its efficiency, Student learning, student performance, general scores of all cohorts, skill development, cost benefit analysis, student and teacher experiences form a core of today's research on the effectiveness of computer-based teaching.

BAYESIAN STATISTICS:
Decision theory, Bayesian knowledge Tracing and Cognitive Bayesianism have evolved in this century and Bayesian inference has been used to estimate the properties of latent factors that drive human behaviour (Chater&Oaksford, 2008) posterior probability. Cronbach & Snow (1981) has created a framework where the prior represents performance factor related to the student and the likelihood represents external factor related to student performance. The main goal of this approach is to develop likelihoods and priors that are particular to each student. The Bayesian methods essentially do not make distinction between model parameter (θ) and data (x). Both are considered as random variables so that 'data are observed variables and 'parameters' are unobserved variables. In Bayesian influence, the first aim is to calculate the posterior distribution of the parameters, which is the conditional distribution of parameters given the data. A modelling of uncertainty on the parameter θ can be done through a probability distribution π, called prior distribution. The inference is then based on the distribution of θ conditional on x, $p(\theta/x)$ called posterior distribution obtained using Bayes' theorem. Therefore, in the Bayesian approach to arrive at an inference consists of three stages which are assigning priors to all unknown parameters, define the likelihood of the data, determining the posterior distribution of the parameters. In each node in a belief network is assigned a 'conditional-probability table' that computes the local probabilities, in terms of the distributions on nodes at the end of incoming links (parent nodes), using the combination law

$p(A \cap B) = p(A|B) p(B)$

where p(A|B) is the conditional probability, i.e. the probability of event A given that event B has already happened.

Computation of Posterior Probability

Parameters	Prior Probability	Conditional probability	Joint probability	Posterior probability

II) REVIEW OF LITERATURE:

Sunder et al (2000) has reported a paradigm shift to online teaching during covid 19 lockdown and found that students faced a limited flexibility to obtain a quality education as compared with traditional classroom teaching. Rajinder Kaur (2021) has studied COVID scenario and attitude of medical college students towards online classes in Punjab and found that the students were fine to attend them in lieu of traditional classrooms but expressed that a combination of online teaching along with traditional classroom teaching would be more advisable. Bayes theorem as on date has been applied to various studies such as stock market prediction, interest rates of banks, and many more. But not many studies have shown the Bayes theorem application to online learning effectiveness and hence this study is undertaken. Rao (2019) has applied Bayesian structural time series model and has provided methods for creatively incorporating financial news. Kristine Beck (2012) has studies The use of Bayesian methods in financial research.Dawid (2020) has suggested method of determining the conditional probability that a break in the supply of water to consumers of a certain duration will be caused by a specific type of failure using Bayes theorem approaches. Ramalakshmi (2015) has explained the rudiments of the Bayesian approach and its potential applicability to marketing decisions. Regarding evaluating interest rates, with Bayes Theorem and estimated probabilities, companies can better evaluate systematic changes in interest rates, and steer their financial resources to take maximum advantage.

III) OBJECTIVE OF THE STUDY:

The main objective of the study is to analyse and understand the impact of online learning& teaching and study its effectives with simple statistical parameters and using Bayes theorem of conditional probability

Research question: How effective is online teaching and learning for students in their academic progress?
**Hypothesis**: Online learning by students is effective

IV) METHODOLOGY:

1) The present study attempts a preliminary analysis on the data collected from 150 students selected at random from different schools. The students' responses have been collected through survey questionnaire. Some students sent their choices online whereas few have given in person. The survey instrument included 12 items rated on four-point Likert scale to collect the students attitude responses, an analysis of those parameters was made with simple statistical procedures and applied Bayes conditional probability theorem to study the results.

2) The combination law $p(A \cap B) = p(A|B)\ p(B)$ where $p(A|B)$ is the conditional probability, i.e. the probability of event A given that event B has already happened is used. The following computation of posterior probability table is used to analyse the results.

V) DATA PRESENTATION:
Table: 1

S.No	Parameters	SA	A	D	SD	Mean	Standard deviation
1.	Online teaching is effective for me	48	20	28	54	2.41	0.15
2.	Concepts are clearly understood by me	54	31	34	31	2.72	0.16
3	Assignments & Hand outs are adequate for my study	120	20	10	0	3.73	0.26
4	Teachers are approachable to clear my doubts	75	32	30	13	3.12	0.81
5	I get distracted during	112	12	15	11	3.5	0.22

	online learning sessions easily						
6	I Feel physically isolated from my friends	120	10	8	12	3.58	0.22
7	Does small class sizes impart good learning?	92	26	20	12	3.32	0.24
8	I faced Internet/ Technical issues	98	29	13	8	3.42	0.49
9	I could not concentrate for a long time	74	35	30	11	3.14	0.83
10	I saved lot of time in travelling	135	15	0	0	3.9	0.25
11	I improved my practical skills	26	33	47	44	2.27	0.12
12	Were schools able to focus on overall development of the student?	28	23	60	39	2.26	0.12

student responses on various factors on online teaching
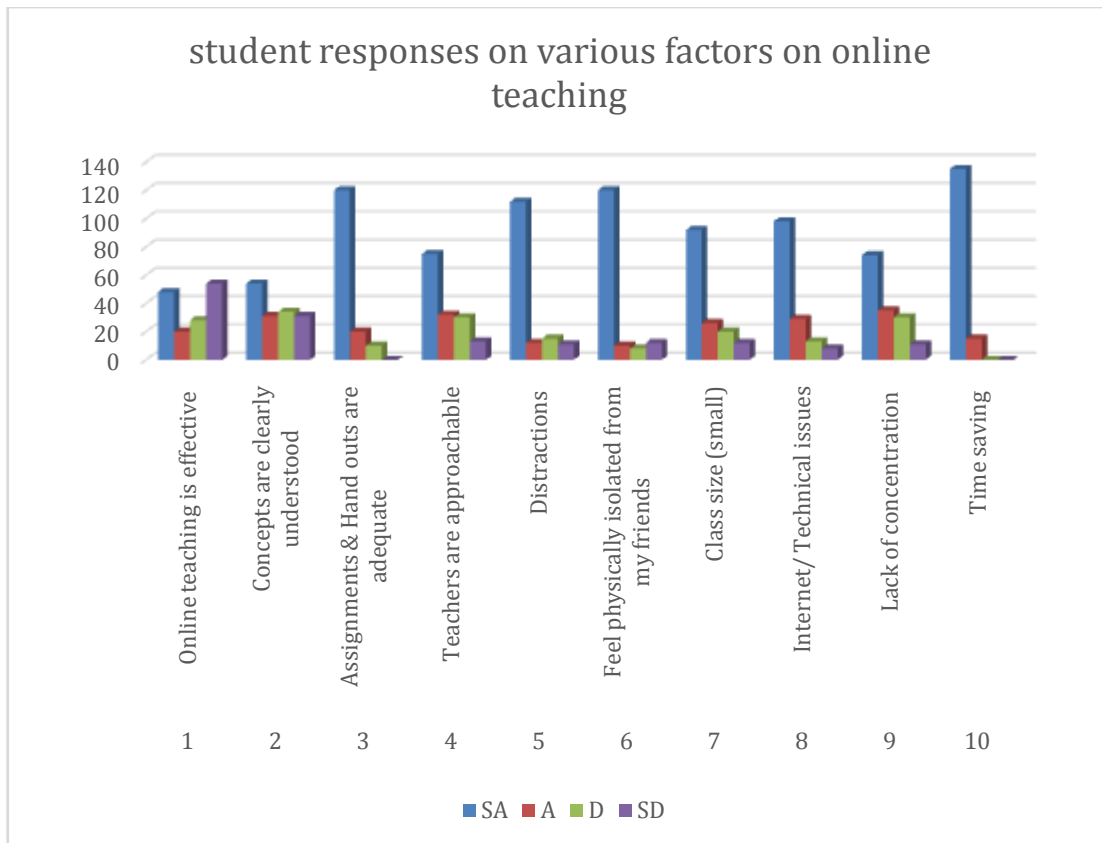
Table 2: Calculation of Bayesian Probability on - Effectiveness of Online Teaching

Parameters	Prior Probability P(A1)	Conditional probability P(B/A1)	Joint probability P (A1& B/A1)	Posterior probability P (A1/B)
Strongly Agree/Agree(A1)	0.45	0.01	0.0045	0.09
Strongly Disagree/ Disagree (A2)	0.55	0.08	0.044	0.91
			P(B) 0.0485	

Based on the condition that all students are computer friendly:
A1 = students agree online teaching is effective
A2= Students disagree online teaching is effective
P(B/A1) = 1 % of students not computer friendly
P(B/A2) = 8% of students not computer friendly

Hence, we may be inclined to say that the students who are not computer friendly feel online teaching is not effective.

Table -3   Conceptual understanding of the students

Parameters	Prior Probability P(A1)	Conditional probability P(B/A1)	Joint probability P (A1& B/A1)	Posterior probability P (A1/B)
Strongly Agree/Agree(A1)	0.56	0.10	0.056	0.41
Strongly Disagree/ Disagree (A2)	0.44	0.18	0.0792	0.59
			P(B) 0.1352	

Based on the condition that all students have good audio & video clarity:
A1 = students agree concepts are clearly understood
A2= Students disagree concepts are clearly understood
P(B/A1) = 10% of students lack clarity in audio
P(B/A2) = 18% of students lack clarity in audio

Above findings indicate that students find difficulty in understanding concepts clearly on online platforms.

Table -4   Distractions during online sessions

Parameters	Prior Probability P(A1)	Conditional probability P(B/A1)	Joint probability P (A1& B/A1)	Posterior probability P (A1/B)
Strongly Agree/Agree(A1)	0.83	0.16	0.1328	0.76
Strongly Disagree/ Disagree (A2)	0.17	0.24	0.0408	0.24
			P(B) =0.1736	

Based on the condition that study environment is not convenient:
A1 = students agree they get easily distracted
A2= Students disagree they get easily distracted
P(B/A1) = 16% feel that study environment is convenient for online sessions
P(B/A2) = 24% feel that study environment is convenient for online sessions
Hence, we may be inclined to say that students get easily distracted during online sessions

Table -5   Small class size impact online learning

Parameters	Prior Probability P(A1)	Conditional probability P(B/A1)	Joint probability P (A1& B/A1)	Posterior probability P (A1/B)
Strongly Agree/Agree(A1)	0.79	0.14	0.111	0.65
Strongly Disagree/ Disagree (A2)	0.21	0.28	0.059	0.35
			P(B) =0.17	

Based on the condition of a large class size:
A1 = students agree class size impacts online learning is effective
A2= Students disagree class size impacts online learning is effective
P(B/A1) = 14 % of students feel class size should be small
P(B/A2) = 28% of students feel class size should be small

Above findings indicate that online learning is effective when class size is small

Table-6   Impact of Concentration

Parameters	Prior Probability P(A1)	Conditional probability P(B/A1)	Joint probability P (A1& B/A1)	Posterior probability P (A1/B)
Strongly Agree/Agree(A1)	0.73	0.43	0.3139	0.78
Strongly Disagree/ Disagree (A2)	0.27	0.33	0.0891	0.22
			P(B) =0.403	

Based on the condition of good attention span:
A1 = students agree concentration has an impact on online learning
A2= Students disagree concentration has an impact on online learning
P(B/A1) = 43% of students feel attention span is limited

P(B/A2) = 33% of students feel attention span is limited

Above calculated results indicate that student's attention span is limited on online learning platform

VI) DATA ANALYSIS:

- Statistical relationships of a system's variables and casual interactions are possible with a graphic interpretation which is easy to study and interpret with the help of Bayesian networks. Using such a model and having evidence about one or many of performance indicators of students, it is possible to investigate the status of other indicators in the model. This Bayes theorem can be applied to predict the intervention impact on one or more parameters on the other parameters of the network This activity performance model will allow teachers to manage various activity performances in Web learning models to achieve high learning effectiveness.

- Although it boasts several advantages over traditional education, online instruction still has its drawbacks. Online and traditional education share many similarities such as students are still required to attend class, learn the indicators, and course content expectations, return completed assignments, and involve and accomplish group projects. While teachers, still must design curriculums, maximize instructional quality, answer class questions, motivate students to learn, and grade assignments. Despite these basic similarities, there are many differences between the two modalities. Traditionally, classroom instruction is known to be teacher-centred and requires passive learning by the student, while online instruction is often student-centred and requires active learning.

- In teacher-centred, or passive learning, the teacher usually controls classroom dynamics. While, the teacher lectures and comments, students listen, take notes, and ask questions during their academic learning process. In student-centred, or active learning, the students usually determine classroom dynamics as they independently analyse the information, construct questions, and ask the instructor for Clarification. In this scenario, the teacher, not the student, is listening, formulating, and responding (Saledom 2010).

- Tianlin (2017) presented an online Bayesian Passive-Aggressive (BayesPA) learning, a generic online learning framework for hierarchical Bayesian models with max-margin posterior regularization. They have demonstrated that BayesPA subsumes the standard online Passive-Aggressive (PA) learning and extends naturally to incorporate latent variables for both parametric and nonparametric Bayesian inference, therefore providing great flexibility for explorative analysis.

- More screen-time and concentration issues have low SD of 0.83 and most students stated that their concentration levels were quite low during the lesson time after attending 2 hr of lecture. This could result in their lower learning abilities. Some students may also

develop health issues due to over exposure of themselves to the computers. The larger the screen time the more is the lack of concentration in online class. Lack of physical contact as is applicable in offline teaching mode, paves way for monotony and hence lack of ability to concentrate well in online class.

- Non enthusiastic responses were recorded when the students were asked if they have faced self-discipline issues during online class. Students lack self-motivation too as they did not feel comfortable with idea of returning online assignments. The reason may be methods like role plays, technical and management games, case studies research analysis can be better applied in traditional classroom setting rather than online sessions.

- An overwhelming majority felt that they faced technical glitches during online sessions which has distracted their attention and increased lack of concentration and has a mean of 3.2. Although even in traditional classroom also, concentration issues can be faced by the students, but an immediate teacher intervention can solve that issue.

- Skill building activities like project works, lab experiments were completely missed by students which go hand in hand with the theoretical knowledge. This creates a learning and application gap in the student's ability. Majority of students also felt that the overall development of the students got hindered due to online lessons. In regular setting of school,schools allot a dedicated time for building mental and physical abilities of students by organising various programs.

VII) CONCLUSION:

Although online education has advantages but fades away over traditional education in various aspects. Our study concludes that a vast majority of students were not in favour of complete online lessons due to various factors. Online teaching and learning have its own merits and demerits. In very much unavoidable circumstances these can be a simple substitution to traditional classroom settings. A combination of online and regular classroom session would also offer a suitable alternative in the troubled times for a successful run of online lessons. The schools will have to regularly conduct training session for the teachers and may have to adopt an online testing platform for better efficiency. This involves a lot of expenditures in terms of finance and as well manpower. Majority of the students felt that these learning gaps would affect their understanding at

higher levels of education. The traditional classroom setting will help in better competence, knowledge progress and peer interaction.

VIII) LIMITATIONS OF THIS STUDY:

This study gives an overall perspective of the students randomly selected through convenience sampling, and can be treated as a general view but not may be applicable to all schools in all countries and settings. Also, the age range selected for this sample is 16- 18 year and hence cannot be extended to all age ranges and all educational backgrounds and all grades of study.

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