Technology Acceptance Modelling of Bring Your Own Device (BYOD): A Confirmatory Factor Analysis

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ABSTRACT

This research explores students' acceptance of the Bring Your Own Device (BYOD) model adaptation in tertiary institutions. This model requires that students or Lecturers will use their own mobile computing devices during any academic activity. In tertiary institutions globally, the BYOD model has been investigated for the attitude and acceptability perceptions of students and Teachers/Lecturers to this method of learning. In Nigeria, however, there is acutely limited research in this area. To fill this gap, a 20-item questionnaire with a 5-point Likert scale was administered to university students using a random (online) sampling technique. The 241 responses obtained were from students familiar with lectures requiring them to bring individual devices for class activities. With Cronbach's alpha of 0.902, the construct showed high reliability for the internal consistency of the measurement instrument. Data analysis of students' perceptions indicates that most of them are willing to accept the BYOD model of learning. Confirmatory Factor Analysis (CFA) results showed that there were strong relationships between the factors. Results from this study show consistency with those from previous research and confirm the suitability of the technology acceptance model (TAM) for investigating computer users' behavioural intentions. Future studies may consider sampling the opinion of academic staff about accepting BYOD for lecturing or general work and also examine the actual use of the system.

Keywords: Technology Acceptance Model (TAM), Bring Your Own Device (BYOD), Mobile Devices, Confirmatory Factory Analysis (CFA), Perceived Ease of Use (PEOU), Models, University.

1. INTRODUCTION

In the last few decades, the use of mobile devices has become an integral part of almost every aspect of our academic, personal, business and professional life. Over the years, educational institutions and businesses have been providing computing devices for their staff and students to carry out their daily duties. This requires a significant cost of acquiring these devices which could be reduced when everyone is allowed to come along with their electronic devices for academic activities (Livson et al, 2021). Their productivity also increases as they can continue working remotely after office/lecture hours (Al-Said, 2023). This method of allowing staff and students to bring personal computing devices into the work and/or learning/teaching environments is known as Bring Your Own Devices (BYOD). The technology acceptance model **(**TAM), introduced by Davis (1986), is a model that presumes a mediating role of two variables called perceived ease of use (PEOU) and perceived usefulness (PU) in a complex relationship between system characteristics (external variables) and potential system usage.

Derived from the psychology-based Theory of Reasonable Action (TRA) and Theory of Planned Behaviour (TPB), TAM has been extensively used in explaining users' behaviour toward computing technologies (Adesina *et al*, 2010; Aggarwal, 2018; Estriegana *et al*, 2019; Masrom, 2007). In this study, the TAM model is used to understand the attitude of students towards adopting the BYOD policy for academic activities.

The traditional TAM model as shown in Figure 1, includes two basic factors of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). PU is the degree to which a prospective user believes that using a certain technology would enhance his or her job performance. On the other hand, PEOU indicates the degree to which a prospective user believes that learning and adapting to the use of a new technology would be easy.

The theoretical model of TAM is built on the assumption that when the users are presented with a new technology the major factors that influence their decision to accept it are PU, PEOU and their attitude towards using the technology. The users' decisions may also be affected by various other factors such as the teacher/lecturer influence (TI) and peer group influence (PI), as well as the availability of facilitating conditions (FC); these are considered the external variables of TAM.
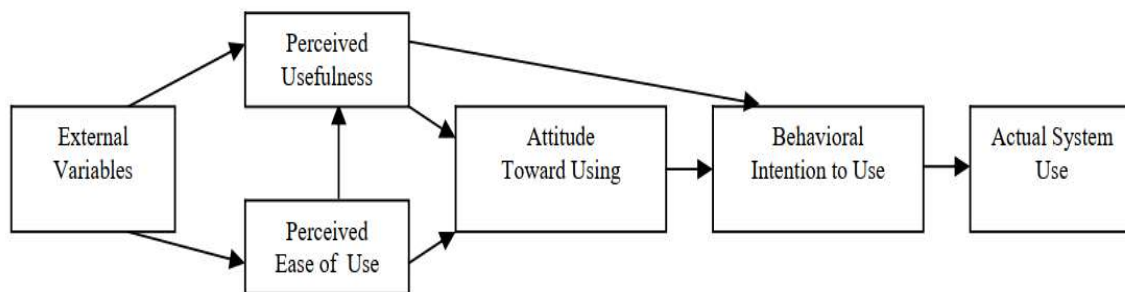
Figure 1: Original TAM Model
Source: Davis *et al,* 1989; Masrom, 2007

This study is guided by these hypotheses:

H_1: PEOU positively affects PU of BYOD.
H_2: PEOU positively affects the ATU.
H_3: PU positively affects the ATU
H_4: PU positively affects the BIU
H_5: ATU positively affects the BIU BYOD method.

This study aims to conduct a confirmatory factor analysis (CFA) to understand students' behavioural intentions to accept the BYOD method of learning. The sampled population were students of Admiralty University of Nigeria (ADUN) Ibusa, Oshimili-North Local Government Area of Delta State, Nigeria. Only Faculty of Science students who participated in receiving lectures under the concept of BYOD were surveyed. Also, the students were required to have basic knowledge of computer devices.

This article is arranged in sections. Section 2 reviews related literature, while the materials and methodology used in this study are presented in section 3. Results are discussed in section 4 and the conclusion is in section 5.

2. RELATED WORKS

Al-Said (2023) investigated the effect of BYOD on the learning behaviour of university students. The advantages of BYOD policies were affirmed in the study, but females were more likely to get distracted by their digital devices during academic activities. than males. Issabayeva *et al* (2023) also emphasised the merits of adopting BYOD, despite its limitations. The study reported that most students expressed a desire to use personal devices during academic activities.

The perceptions about the BYOD model were examined among 217 business students and 200 full-time working professionals by Zhang *et al* (2019). Job flexibility control, technology empowerment, and enjoyment were discovered to positively influence the perceived value of BYOD. The researcher posits that the rate of staff retention could increase due to the satisfaction employees enjoy with BYOD.

Adetayo (2021) explored the practical applications of BYOD principles and strategies to the mobility of library reference services in Nigeria. It explored mobile phones' role in Nigerian libraries, identifies likely challenges in implementing BYOD strategies, and recommends its adoption for reference librarians to remain relevant. Livson *et al* (2021) analysed the effect and efficiency of BYOD on the academic performance of undergraduate students in terms of their test scores and final course marks, as well as on the quality of work on selected course projects and level of satisfaction with the BYOD course, were also experimentally studied.

Sánchez *et al* (2020) study evaluated inverted learning with and without the BYOD program to analyse the possibilities of an inverted learning training plan. Higher education students (*n*=118) were used as a sample in a quantitative research methodology using a quasi-experimental approach, where the questionnaire instrument was used to collect relevant data. The study discovered that there are no significant differences in the method of teaching adopted.

The security risks for companies were of concern to Degirmenci *et al* (2019). To determine whether employees share works councils' concerns about privacy invasion into employees' lives through BYOD, a survey was conducted with 542 employees from three countries: the United States, Germany, and South Korea. Results of a structural equation modelling show that American employees place greater emphasis on BYOD risks associated with privacy, as evidenced by the two multinational case companies where works councils have expressed their concerns.

Aggarwal (2018) advocated that researchers believe that the inclusion of technology must be supported by user acceptance and that the most popular framework used to predict user acceptance of technology is the TAM. The study was conducted to predict the acceptance and utilization of BYOD by college students based on TAM variables which include PEOU, PU, ATU, and BIU. Other variables, including TI, FC and PI were adopted to study the user acceptance of BYOD. A questionnaire based on TAM variables was designed and used to gather information from students of a postgraduate course in information technology at an Indian university. The results obtained from the analysis show that the considered variables have an impact on the overall behavioural intention to use BYOD and it also supports the original findings of TAM.

De Kock and Futcher (2016) reported an explanatory case study involving a higher education institution in South Africa to determine typical mobile device usage in an academic context. From the study, the authors conclude that there is a high demand for the use of BYOD in higher education institutions in South Africa and that BYOD is vital to the academic success of its students.

Santos (2013) reviewed facilitating conditions that are associated with the BYOD programmes, including network infrastructure, network security, IT support, and equity issues. Based on the review, the author proposed potential strategies to help minimize these challenges. Another FC, besides security and network vulnerability, investigated by Saa *et al* (2017) was work efficiency as well as awareness and preferences of the BYOD trend among students in the higher education system.

Furthermore, Masilo *et al* (2021) identified technical problems, balancing learning and personal activities, as well as the lack of familiarity with BYOD for learning as limiting factors to its adoption. Masilo *et al* (2021) reported on the behavioural intention and challenges encountered by students with the BYOD strategy at a University of Technology in South Africa, and the impact of COVID-19 on this approach. A TAM questionnaire was administered to 210 Agricultural Mechanisation students. The results showed that 79.6% of students plan to continue using BYOD in the future.

3. MATERIALS AND METHODS

In investigating the perception of undergraduate students of the BYOD model of learning, this study was largely influenced by Aggarwal (2018) in the coinage of an instrument to obtain required information from the students. Figure 2 shows the external factors and the modified questionnaire constructs are presented in Table 1. Each construct is assigned a code for easy identification in the dataset.
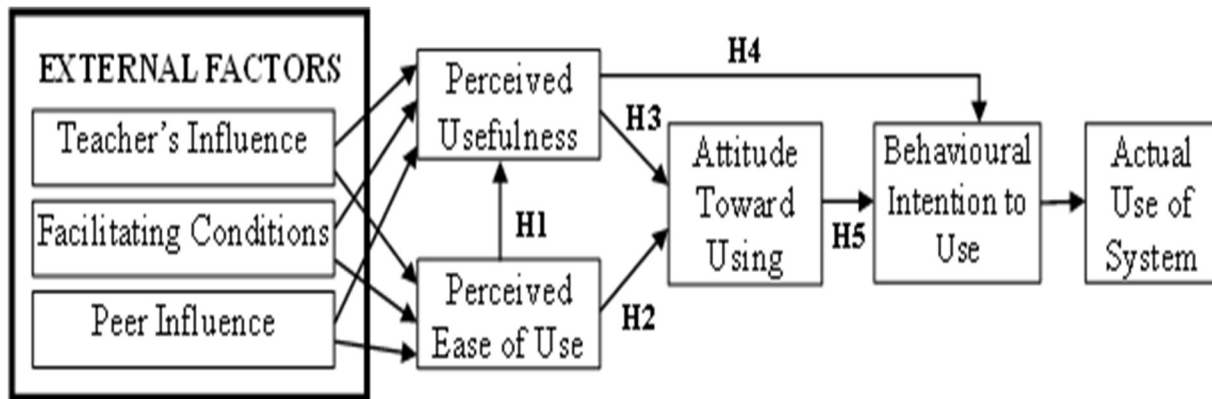

Figure 2: Proposed TAM-based Model

Table 1: TAM construct for BYOD acceptance

S/N	FACTOR	CONSTRUCT	CODE
1	Teacher's Influence	My teacher/lecturer encourages me to bring my own devices to class.	TI1
		The teaching method of my teacher/lecturer supports using electronic devices in the process of learning	TI2
		The usage of personal devices by my teacher/lecturer motivates me to take my own devices to class	TI3
2	Facilitating Conditions	Wi-Fi connectivity available on the campus encourages me to use my own devices	FC1
		Power supply availability in the classrooms and campus facilitates using my own devices	FC2
		I need to be confident about the security of my university network in order to use my own devices on campus	FC3
3	Peer Influence	Usage of personal devices in the classroom by my friends encourages me to bring my own devices	PI1
		Using my own devices makes me feel more confident among my coursemates	PI2
		I desire to bring my own devices because my coursemates are doing so	PI3
4	Perceived Usefulness	Using my own devices helps me get a better grade	PU1
		Using my own devices makes me accomplish tasks quickly	PU2
		Using my own devices makes my work easier	PU3
5	Perceived Ease of Use	It is easier to use my own devices	PEOU1
		It is easy to complete my projects and assignments on my own devices.	PEOU2
		I will have the flexibility of working at my own pace if I bring my own devices to class	PEOU3
6	Attitude Toward Using BYOD	It is a good idea to bring my own devices to the classroom	ATU1
		My learning will be more enjoyable if I use my own devices in the classroom	ATU2
		Using my own devices will have a positive impact on my education	ATU3
7	Behavioural Intension to Use BYOD	I plan to bring my own devices to class	BIU1
		If I am allowed to use my own devices in class, I will bring my own devices	BIU2

Teacher's influence on the students was considered a factor that may affect perceived usefulness and perceived ease of use (Aggarwal, 2018). Also affecting them, are the conditions that facilitate the use of BYOD, as well as the influence peers may have on a particular student. In like manner, the perceived usefulness and perceived ease of use influence the attitude towards using BYOD. Furthermore, the behavioural intention to accept BYOD may be determined by the attitude of the students (Davis *et al,* 1989).

3.2 Design of the Study Instrument

The questionnaire was divided into two (2) sections. Section A contained items to obtain demographic information about the respondent such as their gender, age range, academic level, and declaration that they are students. Section B contains 20 items using a five-point Likert scale to measure students' perception of BYOD. In this case, a respondent compulsorily chooses from options such as 'Strongly Agree', 'Agree', 'Undecided/Neutral', 'Disagree', and 'Strongly Disagree'. Scores on this scale ranged from 1 ('Strongly Disagree') to 5 ('Strongly Agree') and the respondents checked the box that best reflected their view on the items stated. Notably, the respondents were assured that the instrument would be treated confidentially; hence names or private information was not requested.

3.3 Sample Size and Sampling Techniques

The random (online) sampling method was used to obtain responses from students. A Google form was designed and a link was distributed via various students' social media (WhatsApp) groups. A total of 241 valid responses were received. Notably, all responses were accepted, since no incomplete or incorrect data entry. This was because the online questionnaire required respondents to react to each construct before proceeding to the next. Hence, each successful submission had complete responses. Also, all respondents had previously participated in lectures, practicals, and tests within 6 months. They had basic knowledge of computers and smartphones which were used for academic activities.

3.4 Validity of Instrument

The validity of a questionnaire refers to the extent to which the questionnaire measures what it claims to measure. In other words, it is the degree to which results obtained from the analysis of the data represent the phenomena under the study. For this research, face validity and content validity of the instruments were carried out by some experts in education who are lecturers. Their contributions were considered in restructuring the questionnaire.

To determine the suitability of the dataset for factor analysis, Bartlett and Kaiser-Meyer-Olkin (KMO) tests are conducted. Bartlett's test value of significance below 0.05 and KMO above 0.5 suggests a substantial correlation between the variables (Hair *et al*., 2010). In this study, the KMO measure of sampling adequacy was 0.897, indicating it is highly suitable for examining students' acceptance of the BYOD learning method. Also, Bartlett's test of sphericity was significant with $p<0.005$, chi-square of 2276.593 and degrees of freedom (df) at 190.

3.6 Reliability of Instrument

The study ascertained the measurement instrument reliability by applying Cronbach's Alpha method (Cronbach, 1951). The reliability coefficient as shown in Figure 3.4 was established as 0.902, indicating very high reliability. The generally agreed-upon lower limit for Cronbach's Alpha is 0.7, although 0.6 in exploratory research is acceptable (Hair *et al*., 2010). Nunnally (1967) suggested that the score for each construct should be greater than 0.6 for it to be reliable. Hence, with 0.902 obtained in this study, the instrument used is suitable for measuring the attitude of students towards the BYOD policy.

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.902	.912	20

Figure 3: Reliability Test

4. RESULT AND ANALYSIS

Statistical Package for the Social Sciences (SPSS) version 27 software tool was used to manipulate the data for analysis. Also, the Analysis of a Moment Structures (AMOS) module for SPSS was used for path analysis and confirmatory factor analysis. The tools helped generate correlations and regressions which are analysed to answer the research questions.

First, the dataset containing the responses from students about BYOD is uploaded to AMOS. Then rectangular icons are drawn to represent observed variables as shown in figure 4. For example, Teacher's Influence and Perceived Ease of use are observed variables. A circle represents unobserved variables such as errors. Furthermore, a forward arrow is used to represent a cause-effect relationship between observed and unobserved variables. A double-headed arrow is used to represent the covariance between the observed variables. Also, all variables are given unique names, including the error terms. This ensures the unique identity of every item during the modelling process.

4.1 Respondents' Demographics Analysis

The respondents were 170 males (70.5%) as against 71 females (29.5%). This is reflective of the study population which is dominated by the male gender. Previous studies by Ayo *et al* (2012) suggested that gender influences the PEOU and PU. Their ages were mainly in three age categories; most (n =130, 53.9%) of the students were between 18 and 29years, while 108 (44.8%) of the students were below 18 years old and only 3 (1.2%) of the respondents were between 30 to 44 years. None of the students who responded were above 44 years. This shows that the sample population are young people who are likely to be savvy with new technologies and ideas.

4.2 Confirmatory Factor Analysis

There are originally 20 constructs in the data from respondents. However, 7 factors are extracted that explain the variance in the responses by 73.894%. The various percentage variances, as shown in Table 2, are explained by each factor. Also, Table 3 shows the result from the extraction of factors using principal component analysis (PCA) and the varimax rotation method with Kaiser Normalization. The rotation converged after 9 iterations. Factor loadings lower than 0.50 were suppressed and only those above that threshold are shown in Table 3.

Table 2: Total Variance Explained

Component	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.606	38.031	38.031	2.553	12.763	12.763
2	2.128	10.638	48.669	2.377	11.884	24.647
3	1.428	7.141	55.810	2.185	10.927	35.574
4	1.101	5.504	61.314	2.089	10.447	46.021
5	.989	4.947	66.261	2.069	10.345	56.366
6	.790	3.952	70.213	2.054	10.271	66.637
7	.736	3.681	73.894	1.451	7.257	73.894

Table 3: Rotated Component Matrix

			Components				
	PI	**PEOU**	**ATU**	**FC**	**TI**	**PU**	**BIU**
ATU1			.710				
ATU2			.687				
ATU3			.757				
PEOU1		.727					
PEOU2		.813					
PEOU3		.644					
PU1						.733	
PU2						.661	
PU3						.689	
TI1					.749		
TI2					.851		
TI3					.591		
FC1				.834			
FC2				.786			
FC3				.697			
PI1	.766						
PI2	.803						
PI3	.761						
BIU1							.665
BIU2							.769

4.3 Implementation of BYOD and Hypothesis Testing

The proposed model for BYOD as represented in Figure 2 is implemented as shown in Figure 4 using AMOS software. The relationships between the various variables and the weights generated are also indicated. These regression weights show the strength of relationships between the variables and they are used to decide on the hypotheses. Table 4 shows the regression values for evaluating hypotheses – H1 to H5 – extracted from the positions in Figure 4 as indicated in Figure 2. Hypotheses H1 and H2 show regression between PEOU and PU is 0.73, while PEOU and ATU are 0.56, indicating a positive relationship between the pairs of variables. Hence, hypotheses H1 and H2 are supported.

It can also be observed that hypotheses H3 and H4 show regression between PU and ATU is 0.24, while between PU and BIU is 0.45, indicating a positive relationship between the pairs of variables. Hence, both hypotheses are also supported. Furthermore, the regression between ATU and BIU is 0.49. It can be observed that there is a positive relationship between the two variables. Hence, the hypothesis that ATU positively affects students' BIU concerning BYOD is supported.
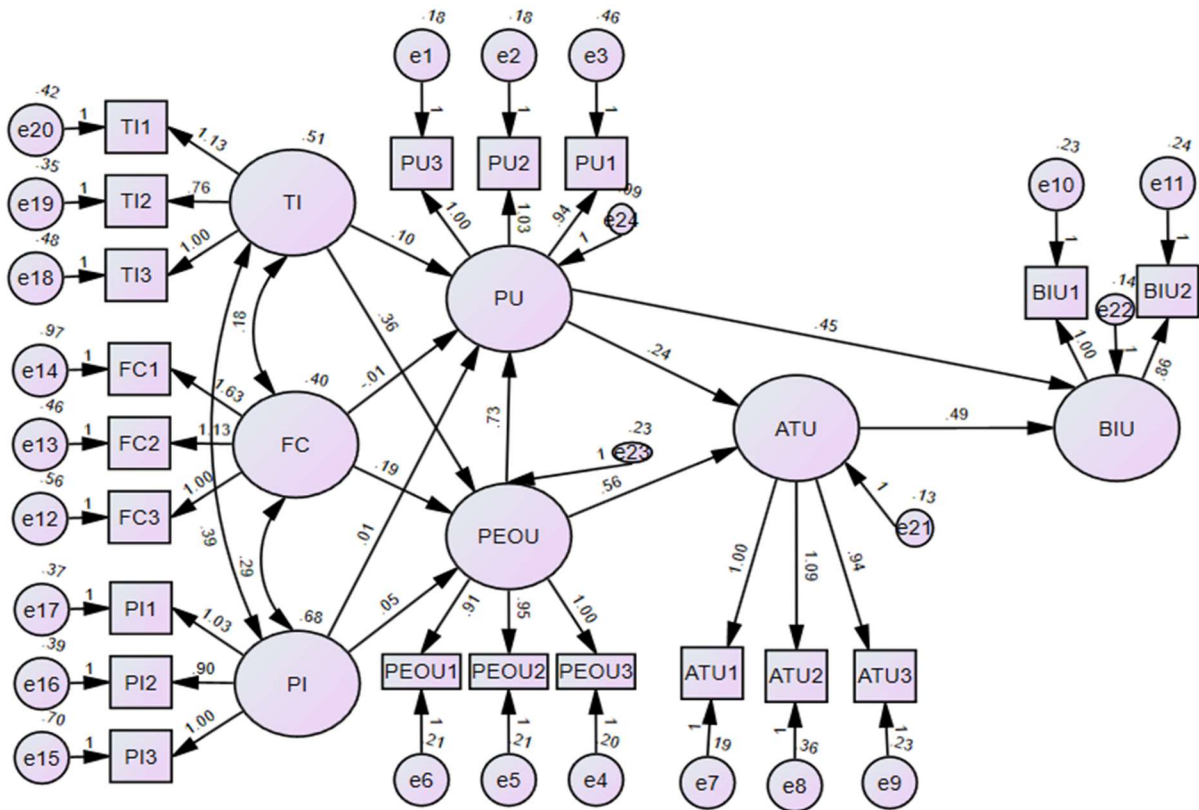
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Figure 4: Technology Acceptance Modelling of BYOD Using AMOS software

Table 4: Hypotheses results

Hypothesis	Factors	Regression Weights	Results
HI	PEOU → PU	0.73	Supported
H2	PEOU → ATU	0.56	Supported
H3	PU → ATU	0.24	Supported
H4	PU → BIU	0.45	Supported
H5	ATU → BIU	0.49	Supported

The tested hypotheses were consistent with previous research (Adesina *et al*, 2010; Aggarwal, 2018; Estriegana *et al*, 2019; Masrom, 2007). However, Masrom (2007) differed in reporting the effect of ATU on BIU, stating that the relationship was insignificant and was not supported. In contrast, this study finds a positive relationship between ATU and BIU.

5. CONCLUSION

BYOD is a method of allowing staff and students to bring personal computing devices into the work and/or learning/teaching environments. During classroom teaching or test/examination, students are allowed to use their devices. This helps employers to reduce the cost of acquiring computing equipment while allowing staff/students freedom to continue working outside the workplace with the same device. This study has used the TAM to predict the acceptance of this BYOD policy by students of a university in Nigeria. The statistical analysis conducted using regression analyses indicates that the results of the current study are consistent with the original TAM model. External variables – TI, FC and PI – are added to the original TAM to measure students' behavioural intention to accept BYOD. A five-point Likert scale was used in constructing a questionnaire with 20 items.

Out of the 241 respondents, 70.5% were males and 29.5% were females and all were below 44 years old. CFA was carried out resulting in 7 factors accounting for 73.894% variances. PCA and varimax rotation method with Kaiser Normalization was applied and converged after 9 iterations. Research hypotheses were tested using regression weights indicating the strength of relationships between the factors. Results showed that there was a strong relationship between PEOU and PU, PEOU and ATU, PU and ATU, PU and BIU, as well as ATU and BIU. The CFA results are consistent with previous research and show the suitability of TAM for technology acceptance investigation. University administrators will find the results from this study resourceful in policy formation and encouraging the adoption of BYOD in academic activities. Future studies may consider sampling the opinion of academic staff to accept BYOD for lecturing or general work and also examine the actual use of the system.

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