Epistemological Access to Technology Blended with Pedagogy as a Congruent Component for Students' Achievements

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ABSTRACT

This article examines how epistemological access to technology blended with pedagogy performs a congruent role for students' accomplishments at the higher education level in Pakistan. Students, at this level, come with varied linguistic backgrounds showing horrendous differences of skills and limited cognizance of interacting with advanced technologies. In the context of Pakistan, pedagogues likewise are the propagators of conventional apparatuses with regard to teaching English as a foreign language. Research in the domain of epistemological integration of technology with pedagogy is scarce at the university level in Pakistan. Therefore, the motivation behind this exploration is to comprehend how and to what extent epistemological access to technology enhances the pedagogical access for purposeful learning and can affect the learning outcomes of the students. The study used quantitative and experimental research methods, employing the data apparatuses of low assessments (pre-test, assessments and a post-test). SPSS version 21 was used to analyze the data and it was further deciphered and reported by using descriptive and inferential statistical apparatuses, and the differences were spotlighted amongst the varied assessments. Research findings contributed scholarly to the existing literature to promote epistemological access to technology at higher education level to meet the demands of the post-modern world.

The present study confers that solely physical access to the provided resources at education institutions does not validate the achievements of the students, rather epistemological access – i.e. purposeful access – to the physical and intellectual resources shall be provided to guarantee personal and professional accomplishments of the students.[1] Consequently, access is more than getting a place for education; it shall provide purposeful learning to extend academic experiences of students into successful professional practices.[2] This purposeful learning does not entail insignificant enrollment by paying the fee and attending classes rather post-enrollment experiences are needed to be addressed if real learning is to take place. This remodeling of the framework likewise demands an ontological turn in our thinking which focuses on how students can persist in the education system rather than why do understudies fail. In the current era of technology, a shift from conventional to progressive pedagogies is required to meet the complexities, cultural diversities and individualities of the students at higher education institutions. Pakistan is certifiably not a different case in this chaotic situation and we need to reconsider the traditional way to deal with pedagogy. This paper suggests the use of mixed pedagogies with the Technological Pedagogical Content Knowledge (TPACK) framework for the successful teaching-learning process.

The study would develop an insight into the epistemological access to technology and pedagogy for effective integration of technology with the pedagogical practices to validate purposeful access to the provided resources, to secure in turn academic and professional success and students. The study will accentuate to renovate the existing practices of pedagogues and work on their training programs to make it a part of the planning process for deeper reformation of the education system in Pakistan.

The purpose of the study was to explore the interactive effect of Epistemological Access to Technology (EAT) and Pedagogical Access (PA) on Student Achievements (SA). The study also examined the effect of teachers' training program on the enhancement of pedagogical access to improve students' learning outcomes.

This study was focused on following questions:

a) What is the effect of teachers' training on epistemological access to technology at higher education level?

b) How can epistemological access to technology improve pedagogical access for meaningful learning?

c) How much and to what extent epistemological access to technology combined with pedagogical access can influence the learning outcomes of the students at the university level?

To find the conclusion two hypothesis were adopted. Firstly that there will be no statistically significant difference in the learning outcomes of students due to teachers' epistemological access to technology combined with pedagogical access.

Second, that there will be a statistically significant difference in the learning outcomes of students due to teachers' epistemological access to technology combined with pedagogical access.

Epistemological access technology is a generic trait of pedagogy in the Western countries; however, it is in the process of being introduced in Pakistan.[3] Higher education has been investing in widening the arena for the access to knowledge[4] as it is directly related to student accomplishments. In the procedure of blending pedagogy with technology, the significance of epistemological access to technology should be stressed in order to make it more effective. Epistemological access implicates 'learning how to become an active participant in academic practice'.[5] The Information and Communication Technologies (ICTs) are gradually assimilating with the teaching-learning processes and are adding to its value.[6] Current practices bolster the evidence that isolated pedagogical apparatuses whether conventional practices or the progressive practices are not effective, and complexities, uncertainties and individualities of the postmodern era demand the dissolution of these dichotomies and progression towards "future three"[7] which advocates the mixed pedagogical modalities. To ensure the personal and professional success of students, we need to have epistemic access to the provided resources and methodologies because the process of teaching and learning is more complex than the mere application of technology.[8]

To secure purposeful access to technology the first order barriers (lack of resources, institution, subject culture, assessment) are not challenging. It is rather the second order barriers (attitudes and beliefs, knowledge and skills) that are a real threat to re-culturing and the change process.[9] To control the second order barriers, it is pertinent to reshape the beliefs and values of the teachers[10] who keep the difference in the espoused beliefs and enacted beliefs in their

daily classroom practices. It is the difference in the theory and practice, which moulds the neutral nature of technology for purpose of ease only. Unfortunately, teachers have limited the use of technology to reduce their workload only as they use portals, LMS accounts and assessments just to prepare the result sheets, to mark attendance and to evaluate students on the objective type assessments,[11] which leaves various other dimensions of the technology unexplored. Hedegaard and Chaiklin have developed the concept of teaching and learning as a 'double move' between situated activity and subject matter concepts[12] which emphasize on the complex and multidimensional use of the technology for teaching as well as learning practices. The classroom press – "press for immediacy and concreteness, press for multidimensionality and simultaneity, press to ever-changing conditions or unpredictability, press for personal involvement with students"[13] faced by teachers accentuates the gap between re-culturing and restructuring, whereby restructuring is mostly done through the provision of resources to bring change but re-culturing is the missing ingredient to design a change strategy at educational institutes for effective results. This restructuring without re-culturing brings just episodic reform rather than meaningful reform[14] and it will bring change only at the surface level and may increase the risk of appraising non-events. The understanding that the access to knowledge should be more inclusive indicates that access to resources is associated with upward mobility, social cohesiveness and human rights.[15] Therefore, to bring in deep reforms it is mandatory to be more inclusive and to work on the missing factor of re-culturing as well.

Moreover, it requires teacher training to integrate technology into teaching methodologies for effective outcomes to ensure maximum utilization of physical and intellectual resources. TPACK framework – which involves a blend of integrated technological knowledge (TK), content knowledge (CK) and pedagogical knowledge (PK) – shall be used to refine the existing knowledge of teachers and to aid the construction of new epistemologies which in turn influence pedagogical decisions of teachers at the time of designing a course.[16] This transformative nature of TPACK will not only help to repurpose technology through teacher's design effort but also to completely adopt and utilize the framework for successful teaching-learning practices in the classroom setup.

Technology-based teaching methodologies may cursor a breakthrough in the prime educational objective of self-actualization of the students. The first and foremost step towards self-actualization is self-awareness that may be expedited by the use of

technology-based teaching practices that are in confirmation of the age of the student rather that of the teacher. Self-awareness is crucial for self-regulated learning and the more a student is aware of his strength and weaknesses the more he is conscious of his learning path. This self-consciousness turns learning into transformative learning which is necessary for the sustainability of the learning process to ensure the success of students for lifelong learning.[17]

Learning exists under the feedback provided by formative assessments and summative assessments. Current evidence[18] spotlights the absence of quick feedback provided to the students, which kill their motivation and engagement for learning. Informing students about their performance empowers the students to take precautionary steps for improving their learning, so the assessment system should be responsive enough to provide flexibility to individualized learning path: making learning challenging for capable students and facilitating those who are at-risk.

As existing epistemologies, values and beliefs of teachers affect their pedagogy; similarly, the personal epistemology of students affects their learning.[19] So, teachers shall not only know the beliefs and values of students but also attempt to mould and reshape their beliefs and values because the students' interpretation of the instruction depends on their personal epistemology. If they value technology and believe that they can use it to improve their learning, they may better respond to the pedagogical strategy, and their personal epistemology will positively affect the learning process.

Existing teaching practices not only reflect myopic thinking with which we deal with educational technology in fragmentation but also constrain our vision of what and how much might be accomplished with computer technology in our classrooms. Furthermore, a design experiment approach is used not just to honour the complexity of the detailed implementation of intervention yet, in addition, to lessen the gap between theory and practice.

The researchers argue that the suggested model offers an insight into technology integration at theoretical, pedagogical and methodological levels. Contrary to the pedestrian view of technology, our framework highlights affordances and connections between pedagogy and technology keeping in mind epistemological underpinning for valued access. The triad in Figure 1 articulates the specificity of the connection between pedagogy, technology and epistemology instead of taking every segment in segregation.

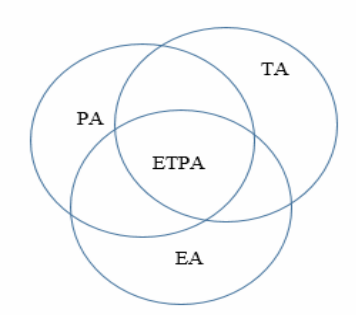

Figure: 1. Epistemological Technological Pedagogical Access (ETPA). The Three Circles: Pedagogical Access (PA), Technological Access (TA), and Epistemological Access (EA) converge to lead to ETPA.

The experiment was conducted at the University of Central Punjab, which is a large private sector university in Lahore, Pakistan. The university intakes 650 students in the fall semester and 200 students in the spring semester, every year under the Bachelor of Computer Science (BSCS) program.

A total of 650 students were enrolled into the program and all the students were taken as the subject of the study. The whole intake was randomly grouped into thirteen (13) sections titled as A to M, and each section comprised of fifty (50) students. The participant studied Functional English in their first semester and took part in the experiment in the fall semester 2017.

The course duration was four months (16 weeks) consisting of 30 lectures of 90 minutes each. The purpose of the course was to reduce most occurred grammatical errors in English language students usually made at the faculty using multiple language learning software i.e. Transparent Language Online (TLO) and Hypermedia Learning System (HL). Moreover, the Learning Management System (LMS), built on the same structure as Moodle, was used to conduct the assessments whereby each test and assessment contained 40 queries to be attempted in 40 minutes and automated feedback was shared in the form of students' scores and graphs with both teachers and students.

All the classes were conducted in the language labs where each student was provided with a separate computer and the students could access their course content using individual login and password provided by the university. The study took place in three steps and the first step started with the conduction of pre-test in the first week and the results were shared with all the teachers and students that not only unfolded the prior knowledge of the students

as a whole but also detailed the strengths and weaknesses of each student to self-regulate their learning. Students' scores on the pre-test enabled the teachers to readjust the content in the pre-defined course outline as per requirement of each class and each student.

The second step proceeded with the conduction of 4-Assessments in the duration of four months following one assessment by the end of each month. A quick feedback after each assessment provided the opportunity to each instructor and student for in-depth analysis of their learning path.

In the third step, a post-test was conducted in the last week and the results were compared with the pre-test to record students' progress and academic achievement. The findings of the study helped the planners to further redefine the course contents and pedagogy to meet the needs of the students.

The study used a quantitative design to collect, analyze, interpret and report data. Descriptive analysis and inferential statistics were used to find differences in the assessments (1-4) scores and pre-test/ post-test scores.

The phae of findings consisted of a methodical exploration and discussion of the data attained from the pre-test, four assessments, and a post-test, which gauged respondents' retrospective investigation of all the sessions. The findings were equated in the midst of all assessments including pre-test, and post-test. All of the tests were administered in fall 2017 and were computer-based. The tests were adapted from Educational Testing Service's The Test of English for International Communication exam and encompassed 40 items to be attempted in 40 minutes, which were uploaded on the Learning Management System (LMS). The scholarly accomplishment of the respondents was measured through computerized checking. In addition, the tests allocations were then subjected to diverse statistical apparatuses.

The current study utilized a non-parametric statistical test for investigation, as the data were evaluated on an ordinal scale. As non-parametric assessments are usually intended for the enquiry of nominal or ordinal data, they are preferably befitted for the effective utilization in social science and humanities research.

In spite of the fact that the ethics of non-parametric tests have been abundantly faced off regarding the individuals who support utilizing non-parametric tests contend that they have the majority of the excellencies of customary parametric tests, without the conceivable distortions that might emerge if presuppositions are disrupted.

Nonetheless, one drawback is that the non-parametric apparatus tend to center utterly on null hypothesis testing. The null hypothesis for this investigation is that there is no progression among the respondents' pre-test, four assessments, and post-test marks. On the contrary, the alternative hypothesis is that there is a considerable advancement among the respondents' pre-test, four assessments, and post-test results.

Five hundred and seventy-three respondents successfully completed the pre-test, four assessments, and a post-test experiment. 4-Assessments were spread over a period of four months whereby each assessment was conducted by the end of one month to check the progress of the students' learning. The advancement from pre-test to post-test and all 4-assessments for the distinctive test items was figured out for each learner, section and instructor. The data were statistically tabulated into the subsequent categories:

1. Error-wise Comparative Analysis
    i. Error-wise Comparative Analysis of Pre-test and Post-test
    ii. Error-wise Comparative Analysis of 4-Assessments
2. Assessment-wise Comparative Analysis
3. Instructor-wise Comparative Analysis
4. Question-wise Comparative Analysis

1. Error-wise Comparative Analysis

Analysis of Pre-test and Post-test

Figure 2 demonstrates the aggregate percentage of lexical and grammatical errors made by the respondents in the pre-test, and the post-test. The graph illustrates that occurrence of grammatical and lexical errors disseminated disproportionately among all the error-types. The maximum errors made by the participants were in the use of the conjunction, which primarily had 32% of the errors in the pre-test, expanded to 51% of the errors in the post-test. Correspondently, in the use of pronouns, the number of errors increased from 15% to 31% of the errors.

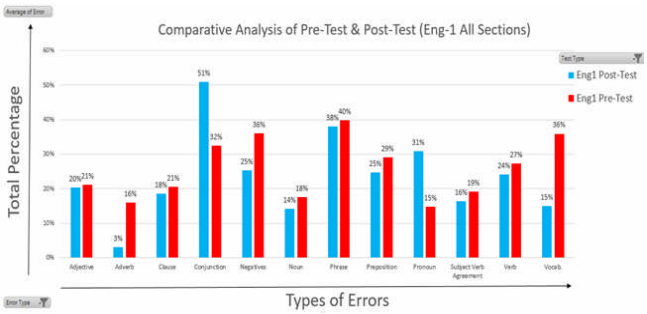

Figure 2: Error-wise comparative analysis of Pre-test and Post-test.

Analysis of 4-Assessments

Figure 3 shows the error-wise analysis of the four assessments administered over the course of the study. Simultaneously, the maximum errors produced by the learners were again in the use of conjunction which was recorded as 37%. It goes parallel with the findings of pre-test (i.e. 51%), the minimum errors made by the learners were in the use of adverb/ qualifier with 9% of the errors which shows a constant decrease in the learning process of the said error-type, similarly

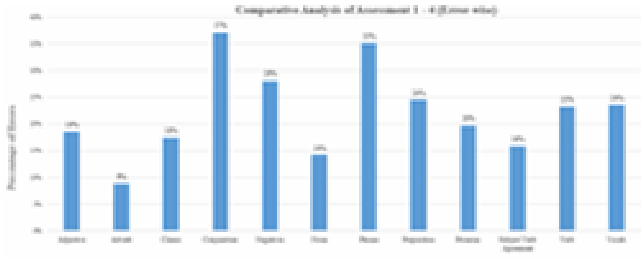

Figure 3: Error-wise comparative analysis of four assessments.

2. Assessment-wise Comparative Analysis

The graphic representation delineated in Figure 4 demonstrates a noteworthy difference in the number of error-types by the students. The greatest numbers of errors (39%) were plotted in assessment – 1 among all of the four assessments. A significant improvement was shown among the respondents during the course of training from assessment – 1 to assessment – 2 (the errors reduced from 39% to 26%), and assessment – 3 to assessment – 4 (the errors decreased from 23% to 11%) respectively. However, a reasonable improvement was reflected in the total percentage of errors from assessment – 2 to assessment – 3 (the errors diminished from 26% to 23%).

Moreover, error-wise comparative analysis of all the 4-Assessments, and post-test shows progressive sequencing of the learning curve i.e. adjectives (19% – 20%), adverb (9% – 3%), clause (18% – 18%), negatives (28% – 25%), noun (14% – 14%), phrase (35% – 38%), preposition (24% – 25%), subject verb agreement (16% – 16%), verb (23% – 24%), and vocabulary (24% – 15%).

Figure 4: Assessment-wise Comparative Analysis.

3. Instructor-wise Comparative Analysis

The graph in Figure 5 illustrates the performance of eight (08) instructors. The findings delineate a comparative analysis of instructor-wise errors dispersed disproportionately among all thirteen (13) sections entitled from A to M, taught by various instructors i.e. AS, AM, AZ, NN took one section each; NM, SH, SM took two sections each; HN took three sections.

The significant performance among all the instructors was reflected by AS and HN who deviated by producing least number of errors in their sections i.e. 21% and 22% respectively.

Moreover, NN and SH deviated at the second place showing with 25% of the error each; similarly, AZ and NM deviated in the third place with 29% of the errors each. On the contrary, SM and AM could not perform well as the maximum number of errors was plotted in their sections i.e. 30% and 33%.

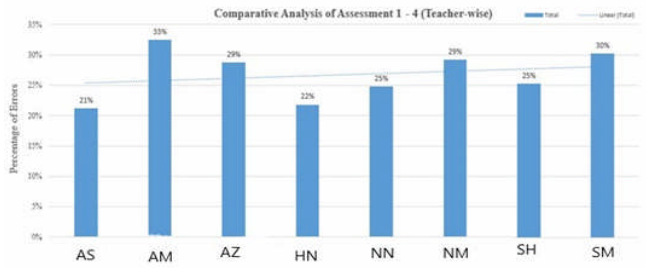

Figure 5: Instructor-wise Comparative Analysis of 4-Assessments

4. Question-wise Comparative Analysis

Figure 6 highlights the question-wise investigation of the errors in varied assessments. There were forty (40) test items (questions) in each assessment to be attempted in forty (40) minutes. The percentage of errors fluctuates and indicates disseminated results.

Notwithstanding, most of the students produced the maximum errors in items 10 and 35 (conjunction i.e. 40% each), item 26 (phrase i.e. 39% of the errors), item 02 (negatives i.e. 38%) and item 04 (vocabulary i.e. 35% of the errors).

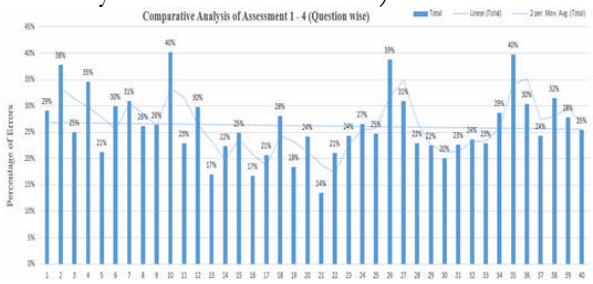

Figure 6: Question-wise Comparative Analysis of 4-Assessments

The findings exemplified in the preceding part go parallel with the assertion by reference[20] that integration of technology into pedagogy shall be purposeful to meet individual diversities of learners. The research question-1 aimed to examine the effect of teachers' training on epistemological access in higher education. The results highlight the significance of the training workshop attended by all the English language instructors. Figure 5 accentuates that there is no drastic high and low performance by any of the instructor rather the graphics visualisation presents a somewhat parallel performance of the instructors for the training that have acquired. The shared-consensus developed at the training workshop did not end as an episodic event rather technological knowledge acquired by the instructors persisted throughout the semester finally affecting the decisions on instructional design for the next semester. This sustained learning and deeper questioning of the instructors well responded to the dynamic conservatism that prevailed prior to the training. For purposeful access to technology, all the instructors not only learnt "how to do it" but also learnt "why they were doing what they were doing" which resulted in re-culturing along with restructuring. The significant change in the beliefs and values of instructors regarding purposeful access to technology emphasizes that teachers' training had a positive effect on epistemological access to technology.

The results are also in tandem with[21] the view that incorporates TPACK framework in teachers' training program with complete follow-up will help in avoiding fragmented workshop and risk-averse approach towards the transition to ensure satisfaction and consistency of the current practices. The consistency in instructors' commitment to practice what they learnt in the training workshop mirrors up the fact that the teachers did not adopt superficial reform

rather their engagement resulted in a high sense of efficacy and sustained learning.

The research question-2 pointed towards improvement in pedagogical access with epistemological access to technology. The findings reinvigorate[22] the notion that complexities, uncertainties, and diversities of post-modernism demand flexibility in the instructional design and structure. The flexibility to rearrange the contents of the course was offered to all the instructors that facilitated them to overcome the gaps in the predesigned course outline. This freedom of flexibility allowed each instructor to attend each learner individually to cover the breaches in the learning process. The results demonstrated increased pedagogical access both individually and collectively to all students for meaningful learning. Error-wise comparative analysis of four assessments illustrated in Figure 3 disclosed to each instructor for the error-wise deficiency level for each of their learner which made the respective instructor uncap pedagogical access to at-risk students for better learning. This added endeavours of all the pedagogues improved pedagogical access for purposeful learning.

The research question-3 inquired how much and to what extent epistemological access to technology combined with pedagogical access can influence the learning outcomes of the students at the university level. Error-wise comparative analysis of Pre-test and Post-test exhibited in Figure 2 expounds that there is a significant improvement in the scores of all error-types of pre-test and post-test. The pre-test scores revealed prior knowledge of not only at-risk students but also the advantaged ones to initiate each student's progress from their desired level. This illustration of the students' performance at the pre-test and post-test was shared with the teachers and students through visual graphics which enabled them to start learning from their proficiency level. Simultaneously, assessment-wise comparative analysis depicted in Figure 4 explicates step-wise feedback provided to the students which demonstrates a significant decrease in the aggregate percentage of lexical and grammatical errors produced by the students. Results of post-test were also tabulated as an extension which answered the research question-3 posed by the researchers. The result proved the alternative hypothesis (H1) and found a statistically significant difference in the learning outcomes of students due to teachers' epistemological access to technology combined with pedagogical access.

The focal point of the present study was to investigate how much and to what degree epistemological access to technology combined

with pedagogical access can influence the learning outcomes of the students at the university level. The results of the research indicates that integration of technology with pedagogy shall be purposeful to meet with the individualities of the learners and accentuates on the flexibility in the instructional design as well as structure to meet with the emerging challenges of the time. Furthermore, the integration of these two factors will eliminate the risk of the superficial effect of teachers' training; resultantly, it will develop the sense of effectiveness and continuous learning among pedagogues. This investigation was conducted specifically at the university level in Pakistan to increase the learning competence and efficacy of the students; however, comparative studies could likewise be conducted at the elementary and secondary levels to gauge its effectiveness and appropriateness.

This topic has further implications for future research. The crucial role of epistemological access to technology in the teaching-learning process of the English language, and for those who are studying other subjects, cannot be overlooked due to its paramount role in their respective domains. Moreover, this exploration studied and elucidated the part of epistemological access at the University of Central Punjab, Lahore, Pakistan. However, this can be extended to other public and private universities across the country. Finally, a meticulous analysis of epistemological access to technology amalgamated with pedagogical access for meaningful learning could widen the horizon of pedagogues and the understudies simultaneously.

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