Building a Course Portfolio with Industry-Institute Collaboration

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***Abstract*— The effective integration strategies of blended learning with traditional, designed a decade ago and proven effective, scalable, and flexible, now put forth several other challenges with delivery and evaluation. Especially for the elective courses, they demand assessments that add value to the course and the student's resume. The principles of elective design, the delivery tools, and techniques, the number of students, the significance of the course, etc., are some of the major evaluation parameters to be considered for the design of assessment strategies. This paper presents one such evaluation methodology, portfolio design, for the courses delivered in a blended learning model, which can also be adapted to the offline learning model. The model involved problem analysis, concept relation, design thinking, solution approaches, implementation, and presentation in the form of a portfolio. The portfolios were created online using various open source tools. The paper presents the model and design goals in detail. The first offering of the course had course projects, and the second offering had portfolio creation. The grades and attainment have improved in the second offering compared to the first one. There is also improvement in the course attainment where course learning objectives have remained the same. Portfolios are an effective strategy to evaluate one's course understanding. Portfolios can be an effective way to present the course realizations to the community as justified through the t-test analysis.**

***Keywords*— assessment, blended-learning, elective design, portfolio**

***JEET Category*—Practice**

I. INTRODUCTION

FROM Gurukul systems to contemporary universities, the education system has evolved with complex structural changes. The diversity and growth have led to the interplay of numerous multifaceted dimensions (Guri-Rosenblit et al., 2007). Degree programs, curriculum design, teaching pedagogy, and evaluation methodologies have been adapted to modern needs and trends. The education systems have progressed, tightly coupled with economic, political, and social forces (Arnove, 1980). Technological advancements have provided the education systems with enhanced means and measures. Though online education was a distant vision (Larreamendy-Joerns & Leinhardt, 2006), with the advent of the 2020 Coronavirus pandemic, the online learning model has closed the gaps and is a reality sooner than it was predicted.

The effective integration strategies of blended learning with traditionally designed a decade ago (Hameed et al., 2008), proven effective, scalable, and flexible, but today put forth several other challenges with delivery and evaluation. The culture of Indian learning systems, our demography, and large class strength add additional trials to be gratified. The confronts of blended learning have been systematically reviewed, and students' self-regulation is recognized as one of the major challenges (Rasheed et al., 2020). Self-regulation, a challenge, also calls for suitably designed interventions for assessments and probes to continuously monitor course delivery effectiveness. This parameter directly connects to the course delivery and indirectly also connects to the assessment strategies.

After nearly two years of implementing the blending learning model due to the pandemic, the education institutes have realized numerous methods as per the course demands. While certain core courses demand chalk-and-talk methods, and a few others with flipped classroom modes (Strelan et al., 2020), there are also courses that demand a mix of both learning models and more. The nature of the course, syllabus structure, and the depth of understanding required can be guiding criteria for designing and delivering a course.

When course objectives and learning outcomes are formulated, evaluation strategies are the significant contributors to measuring the extent and realization of the learning outcomes achieved. Especially for the elective courses, they demand assessments that add value to the course and the student's resume. In the design of an elective course, some of the major evaluation parameters to be considered for the assessment strategies are the principles of elective design, the delivery tools and techniques, the number of students, the significance of the course, etc. This paper presents one such evaluation methodology, portfolio design, for the courses delivered in a blended learning model, which can also be adapted to offline learning. However, the key motivation was derived considering the present scenario of course delivery. For the course, a portfolio is defined as a compilation of design and research by applying the course knowledge and solving a real-time problem systematically with semantic emphasis.

The paper further presents the details of the paper in 5 sections. Section 2 presents the literature survey; section 3 presents the course scheme and portfolio assignment design as an evaluation strategy for the blended learning model of the course delivery; Results and discussion with effectiveness are presented in section 4, and section 5 concludes the paper with future scope.

II. Literature Survey

Recent studies confirm that the blended learning model outperforms pure online learning in improving students' attention, self-confidence, and satisfaction perceptions (Ma & Lee, 2021). Over time, blended learning models have been deliberated with global perspectives. Considering the global perspectives, they have been proposed with local implementable solutions (Bonk & Graham, 2012). It has been proven that the blended learning model brings the best of both worlds – online and offline class modes (Picciano et al., 2021). In this regard, building effective blended learning programs has been discussed for the contemporary challenges as well as their solution approaches (Singh, 2021).

Blended learning models have been evaluated with respect to pedagogy, reading materials usage, and learning environment usability (Precel et. al., 2009). They have been explored with collaborative learning, independent learning, and problem-based learning techniques to make the process effective (Hoic-Bozic et al., 2008). Various technology and media usage laterally with instructional design challenges have been discussed for the blended learning models (Kaur, 2013). Procter (Procter, 2003) defines blended learning to be an effective combination of diverse styles of delivery techniques, models of training, and different styles of education means. There is a need for an effective evaluation strategy design to evaluate all the mentioned constructs of blended learning.

Portfolio creations have been studied over time (Elliott, 2003). Assessment of E-portfolio in higher education has been studied (Syzdykova et. al., 2021). A view on using portfolios in teacher education has been studied (Imhof & Picard, 2009). Portfolios and assessments in teacher education have been discussed (Campbell et. al., 1999). Reflections on using student portfolios have been deliberated (Harris et al., 2001). Portfolios have been used as developmental assessment tools (Tillema, 2001). The usage of portfolios has been questioned (Gronlund, 1998). The impact of using several available models has been discussed (Endacott et. al., 2004). The literature on portfolio usage has been reviewed (McMullan et. al., 2003). Usage of it as an assessment tool has been conferred (Mokhtaria, 2015). Portfolios have also been studied as a tool in engineering instruction (Christy & Lima, 1998).

Several methods have been attempted for portfolio creation, and there still exist gaps in achieving the desired objectives and outcomes of the course. This paper proposes one for an industry-collaborated elective course keeping the course design principles and gaps in the literature survey as a major focus.

III. Course and Portfolio Design

A portfolio is a collection of works on an area with a better visual presentation (Paulson, 1991). The portfolio assignment was designed for the course semantic web; an elective offered for the sixth semester.

A. Elective Description

Elective courses play a major role in a degree program. Various programs introduce the electives at different years, considering the structure of the program. Various schools at KLE Technological University offering the Engineering degree program offer elective from the sixth semester. So does the School of Computer Science and Engineering. The elective subjects are considered and designed from various domains such as systems engineering, data science engineering, high-performance computing, network engineering, etc., essentially also being the research clusters. The school's Board of Studies reviews these electives, and changes are accommodated as per suggestions. The school restructures the courses after review to maintain the industry standards and state-of-art. The Board of Studies has members from Industry and Academics, Alumni, etc. When students are presented with elective options, they can choose the ones they are interested in. This gives students the autonomy to discover their area of curiosity and select a relevant course from more than one research cluster.

'Semantic Web' elective was premeditated in partnership with Knit Arena Private Limited and KLE Technological University. It is a three-credit elective offered for VI semesters. The course falls under the classification of Data Science. The syllabus of the course is of forty hours divided into three units. The course was selected by 200+ students in the year of study, whereas the course is relatively graded.

B. Course Objectives

When the machine learning and artificial learning streams took over, giving novel discernment, the semantic web was announced to be dead. There are many articles on the web stating and announcing that. But in reality, it's only the decade-old definitions and meanings have become obsolete. The semantics of the web is still a significant challenge and needs a newer perspective. The present theoretical understanding is outdated, but as we know, the web undoubtedly needs semantic operations. The semantics and the web need a new lens to provide a newer and more holistic definition.

Bringing out the ideologies of web 3.0 (semantic), discussing what did not work, and motivating to build prototypes for the state-of-art web challenges was the major objective of designing this elective course. The syllabus had three units of 40 hours of engagement and was structured to impart principles, state-of-art, and applications. Delivering the required web principles was one of the intents of the course. The stakeholders of the semantic web and the elective design identified were the researchers of web 3.0, faculty teaching web-related courses like web technologies, and the application developers contributing to the area. The further idea was to create an assignment that would align with the discussed objectives of the course (Hegade et al., 2021).

C. Research Question

Considering the above discussions in the literature survey, a research question was formulated with dependent and independent variables. The research question was - 'What is an effective assignment and evaluation methodology to realize the course effectiveness and learning outcomes for an elective course?' As the course had industry collaboration and interaction, it was jointly decided by the industry and the course faculty to create a portfolio assignment to achieve the

said objectives in support of the literature review carried out. The course objectives are discussed further in the next subsection.

D. Course Objectives

The Course Learning Outcomes (CLO) can be seen in Table I below. All CLOs mentioned in the table are mapped to the program outcomes mentioned by the school of Computer Science and Engineering.

TABLE I
CLOs FOR THE COURSE

CLO id	CLO
S_CLO1	For the semantic web, examine and analyze data and its properties
S_CLO2	Explain the necessity to comprehend the information, analyze, represent and apply it for web 3.0 operations
S_CLO3	Examine the models and technologies for semantic records and logic
S_CLO4	Compare, analyze and realize the web 3.0 philosophies with state-of-art practices, methods, and ideologies
S_CLO5	Apprehend the models for web 3.0 principles.

For each CLO mentioned above, in order to measure the attainment at the end of the course, a number for the threshold and a number for the target were assigned. These numbers, being the measures, were set based on the complexity and activity designed for each of the learning objectives. Table II presents them.

TABLE II
CLO TARGET AND THRESHOLD

CLO	Threshold	Target
S_CLO1	60%	65%
S_CLO2	65%	65%
S_CLO3	65%	65%
S_CLO4	65%	65%
S_CLO5	60%	65%

The target is a measure that indicates the percentage of students. The target is the same across all the CLOs. The threshold is indicated for each of the outcomes mentioned. The percentages are inferred as, say, for S_CLO1, 65% of the undergraduates have to get marks of 60% and more than that. Following are the grading criteria used for evaluation: A score of 3 is graded if a set threshold is achieved. If it is 10% lesser, then a score of 2 is awarded, and 20% lesser, then a score of 1 is awarded. Below that is scored zero. So each CLO attained is calculated and scored between 0 to 3, where 3 is the highest attainment, and 0 is the least.

E. Portfolio Design

This section discusses the key points of portfolio design. Ten hours of industry sessions were organized on how to build effective portfolios. The sessions were delivered by an Industry expert from the company Knit Space Software Research and Services Private Limited. Students in teams of four were guided to select a problem statement for which they would be building a portfolio. The portfolio problem selection was based on four key points (Brandt, 2010). The key points can be seen in Figure 1.

The selection was based on

- The Passion: the kind of problems students were passionate about and wanted to solve
- The Trend: Selecting the problems from state-of-art and prevalent to current challenges. Problems that need immediate attention.
- The Perspective: to provide a new vision and scope to the problem
- The Challenges: identify and solve the challenges in the area of the semantic web, making contributions to the area.

Fig. 1. Key points for problem selection

The model of the portfolio consisted of correlating the course concepts on building a data store, query logic, business logic, meta-data, and then the presentation. The details can be seen in Figure 2. Each of them is built on top of the other in the layers. For each layer, a guiding question was provided to understand the context. The context was designed based on the course and the principles (Hegade et. al., 2021). The layers were derived from the semantic web technology stack.

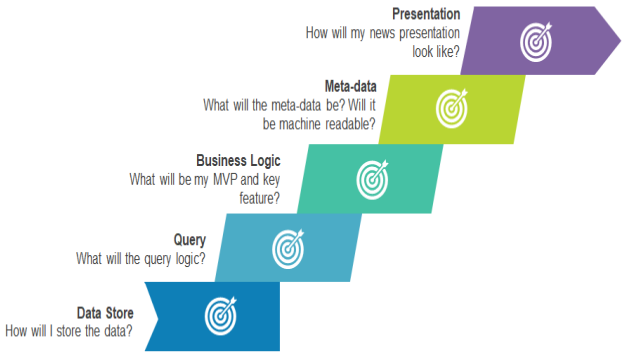

Fig. 2. Key points for problem selection

Each team had to select a problem and build on each of the layers. Each of the key points came with a question to provide a perspective to it. Students had to select a problem based on passion, perspective, trend, and challenge. Students were then guided on how to bring the course concepts into the portfolio with examples effectively. Several key concepts in the course were given as examples—students were then guided on how to

build design models on the considered case studies (Udo-Imeh et. al., 2012). A sample model design can be seen in Figure 3.

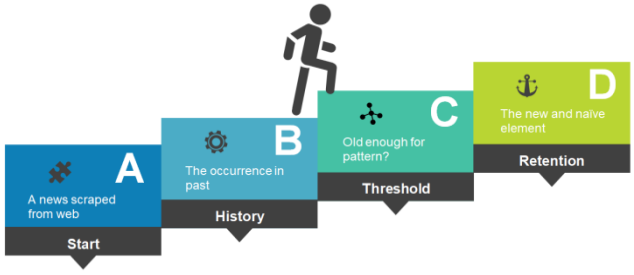

Fig. 3. Model Design

The example was demonstrated using a case example of validating a news information example. Another example can be seen in Figure 4, specific to the news case study.

Fig. 4. News case study model

The news case study was discussed in detail, along with a sample portfolio design created on WordPress. Each team was asked to select any free platform to create a portfolio. The sessions involved discussing the social semantics in a larger and deeper context to provide a viewpoint for the portfolio design (Bhattacharya & Hartnett, 2007).

IV. Results and Discussion

A. Attainment Analysis

The grades obtained for the course are presented below in Table III as compared to two years of course offering. Because of relative grading, the number of students in the grade range is the same for both years. Though there is a decrease in the number of S grades, which is not relatively graded, the overall course attainment has increased.

TABLE III
Course Letter Grades

Letter Grade	Number of Students 2018-19	Number of Students 2019-20
S	20	6
A	38	63
B	36	52
C	21	52
D	3	8
E	7	10

Table IV presents the overall attainment of the outcomes calculated as indicated. Though the portfolio was directly related to CLO5, as the teams had to realize the different course concepts, it had an indirect effect on the remaining CLOs. Portfolio design was the realization of the entire syllabus.

TABLE IV
CLOs Attainment

CLO id	Attainment Score
S_CLO1	2.49
S_CLO2	2.03
S_CLO3	3.0
S_CLO4	3.0
S_CLO5	3.0

The attainment values were compared to last year's offering, and it is summarized in Table V.

TABLE V
CLOs Attainment – Year Wise

CLO id	Attainment for the Year 2018-19	Attainment for the Year 2019-20
S_CLO1	2.07	2.49
S_CLO2	2.36	2.03
S_CLO3	2.11	3.0
S_CLO4	2.29	3.0
S_CLO5	1.87	3.0

As seen in Table V, the attainment for 3 CLOs has significantly increased as compared to the last offering. The mean attainment for the year 2018-19 was 2.362, and for the year 2019-20 was 2.704. There is an increase of 0.342 in the average attainment.

Top portfolios were awarded from the industry, and the list can be seen below in Table VI.

TABLE VI
TOp Portfolios

Title	Link
Meaningful Search	http://meaningful-search.unaux.com/
Fake News	https://filter833976042.wordpress.com/
Movie Recommendation	https://watchmovie939727668.wordpress.com/

B. Feedback Analysis

Feedback was collected from students and can be seen in the figures below, numbered 5 to 7. Students were asked to rate how satisfying was the portfolio creation experience. The response was completed by 134 students. Students had to rate using the likert scale of one to five, where one is least satisfying, and five is most satisfying. As seen in Figure 5, 92% of the class said that creating a portfolio was a satisfying experience. The percentage is lower for the other numbers, almost tending to zero.

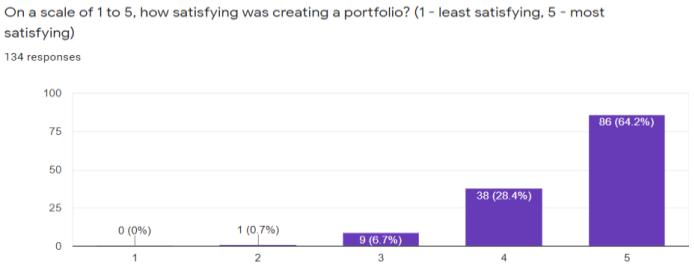

Fig. 5. *Portfolio Satisfaction*

As seen in Figure 6, 89% of students agreed that a portfolio helped them to understand the course concepts better.

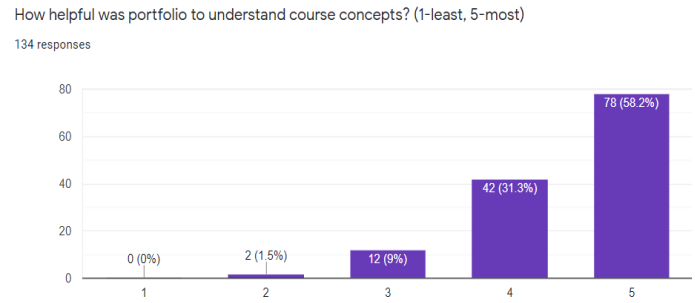

Fig. 6. Portfolio concept co-relation

As seen in figure 7, 89% of students agreed that a portfolio helped to appreciate the semantics and apply them to the applications.

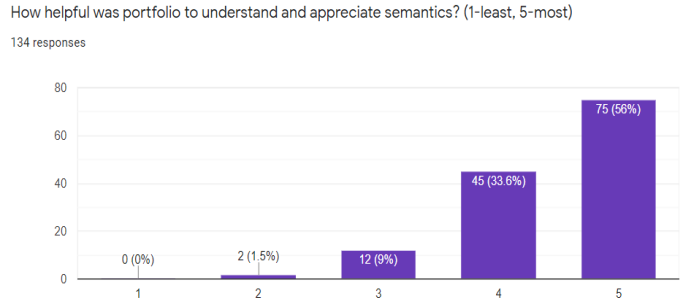

Fig. 7. Portfolio and Semantics

C. t-test Analysis

In order to test the hypothesis that if the portfolios helped in the learning process, a t-test analysis was performed with the attainment scores of the reported two years as presented in Table V (Kim, 2015). Both methods were compared for effectivnesss and attainment scores were used as it quantifies the designed course learning objective.

As the data is directional we used the 1-tailed test. As the data was coming from different samples analyzed over two years, we used type 2 analysis. The data was tested with ttest() in excel sheet with values as testified in Table V. The p value was reported to be 0.04178 and as the value is below 0.05, we reject the null hypothesis and conclude that the portfolio activity positively benefitted in the learning process.

V. CONCLUSION

Portfolios are an effective strategy to evaluate one's course understanding. They also help students create a learning base where they can showcase it in their resumes and present their takeaways from the course to the world. As it is a team activity, the strength of the class would not be a major concern in implementing the activity. Portfolios are effective when applied in higher semesters, and students must be guided through each creation step. The next offering of the course is planned to provide an enhanced discussion and involvement for the improved learning experience. While most students are yet to appreciate the creation, the results can be validated with placement and job perspective for future improvements once when the batch graduates and the industry implications can be analyzed.

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