An automated on-line portfolio for engineers: Planning and Tracking student activity – A tool for job interviews

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An automated On-line Portfolio for Engineers:

Planning and Tracking Student Success

Abstract:

Engineering programs across the country are increasingly offering outside-the-classroom programs and opportunities that strengthen and increase the value of an engineering education. Such opportunities support students in practicing their knowledge, further developing their ideas, better understanding contemporary world challenges, becoming more engaged with their communities, and experiencing first-hand the potential impact of engineering solutions for which they have the opportunity to participate while pursuing their undergraduate degree. Many of these activities are extracurricular or co-curricular and while engineering students look forward to participating and taking full advantage of all what is offered, demanding engineering curricula make the individual student planning of enrichment activities, and the tracking of overall student success, a project of its own.

To complement and support academic and college-level enrichment program for engineering students at the Illinois Institute of Technology (IIT), we implemented a new approach for following and recording student participation and performance in curricular and non-curricular activities that are relevant to their engineering education. We developed and implemented an automated on-line portfolio for engineering students that is personalized to each student and contains a full record of all courses, activities, and achievements throughout their undergraduate years. The IIT engineering portfolio is prepopulated with general information on curriculum requirements and enrichment programs and opportunities. As a student completes a specific requirement or participates in an enrichment activity, the individual student portfolio information is automatically updated. Each event or activity is fully described in the portfolio with relevant background information and accompanied with visual aid (photos or videos as appropriate) displaying the event and student work. Students are encouraged to further personalize their portfolios by adding all activities and projects that are relevant to their education, including those not facilitated by our institution.

The IIT engineering portfolio provides students with a platform to plan, document and quantify their undergraduate experience. Students are able to track their progress, design their own academic path to graduation, and develop their own enrichment activity plan that best fits their specific interest. The engineering portfolio also assists students to prepare their resume for job interviews and, when used as a tool for interviewing, the portfolio highlights tangible experiences outside what is normally found in transcripts and conventional resumes.

Our approach focuses on capturing the entire breath of each student's educational experience, while setting the foundation for students to build an open-ended self-guided career plan that draws from their skills, experiences, and achievements that comprise their engineering portfolio.

A key feature of our portfolio project for engineering students is its impact on student career planning and success after graduation. Engineering students who had participated in the portfolio project at our institution are expected to continue to use the electronic portfolio as a planning tool to seek continued career improvement and creatively adapt to changing professional demands towards remaining competitive in the market place.

At IIT, all incoming engineering undergraduate students are automatically registered with the online engineering portfolio. At graduation, engineering students receive, in addition to their diploma, a fully populated personalized portfolio of their work and accomplishments. We believe that access and use of an on-line portfolio is effective in assisting engineering students to have a better undergraduate experience, to be most effective in displaying their accomplishments when competing for career opportunities upon graduation, and to continue to plan for professional success. In this paper we describe the attributes of the IIT engineering portfolio and the student's use of the portfolio as a supporting tool while pursuing their engineering degree and upon graduation. The benefits of the portfolio used as an assessment and advising tool to educators and as an extended resume (of a student's accomplishments) to employers are also discussed.

Introduction

The current undergraduate engineering education at IIT encourages participation of students in activities that go beyond the ordinary classroom, and exercise and extend students' experience in contemporary areas that are recognized to be critical and challenging to the engineering profession. To gain this experience, students engage in a variety of curricular and non-curricular activities that are organized as part of our distinctive engineering education initiative. One of the novelties of this initiative is the opportunity offered to students to compile the examples of their work in the form of portfolios. A portfolio is prepared electronically through an online process and compiles the record of a student's accomplishments as he/she participates in various activities within thematic areas that are identified within our distinctive engineering education initiative as having societal, technical, and scientific relevance, and deserving of consideration as areas of enrichment of the educational experience of our students. Currently we had built on four themes or focus areas: health, energy, water, and security. We originally conceptualized and planned the development of a portfolio as a means of helping our students to design their path to graduation through an enriched curriculum, and, as such, to have a better success rate in job interview and placement. As the IIT engineering portfolio was further developed and implemented, we recognized its potential value for planning and building career strategies after graduation, and its potential benefit to educators and employers. To educators, it was apparent that the portfolio could also be utilized as a means of student outcome assessment, especially for specific "targeted" learning outcomes that are often difficult to include in regular courses. Also, the portfolio could become an effective tool for student advising and mentoring. The IIT engineering portfolio is a step beyond a regular advising tracking system and offers the faculty with a better perspective of a student's program of study that includes a host of other activities to help enrich the student's curriculum. To the employer, a portfolio is an extended resume

providing in-depth information on the student's accomplishments and college experiences that go well beyond taking ordinary courses and completing course assignments and projects. The information regarding student experiences in contemporary engineering areas (as compiled in the IIT engineering portfolio) is expected to help potential employers to better match their needs with students' capabilities and thus optimize their resources when training new employees.

This paper provides an overview of the engineering portfolio initiative at the Arnour College of Engineering at IIT. The current framework of a portfolio is explained. The significance of the portfolio and its benefits to various stakeholders (students, employers and educators) are discussed. The paper also describes the future direction in this initiative and the ongoing strategies being implemented to measure the success of the portfolio project.

Objectives

The objectives of the engineering portfolio at IIT are to:

(1) Offer opportunities to students to compile a record of their accomplishments within the engineering distinctive education thematic activities, design their path to graduation with an enriched curriculum, and build on an open-ended self-guided career plan based on mastered skills and demonstrated achievements;

(2) Provide potential employers with an extended resume with a more comprehensive record of professional background of a new engineering graduate; and

(3) Provide educators with an assessment tool for student learning outcome in certain key areas that cannot be easily embedded in ordinary undergraduate courses, and as a powerful tracking system for student advising.

In regard to Objective 1, the IIT engineering portfolio is expected to help students track their progress, design their own academic path to graduation, develop their own enrichment activity plan that best fits their specific interests, and plan for career success. This is considered as the "fundamental" objective of the portfolio. On the "application" side, the objective is also to help students with a better job interview and more successful placement. In regard to Objective 2, the portfolio is expected to become instrumental in helping employers to better focus their selection process by matching the experiences of a student with the company's mission and current manpower needs. Objective 3 is intended to target assessment of specific learning outcomes that are often difficult to include in regular courses within the undergraduate curriculum. Examples of these areas include leadership, knowledge of contemporary issues facing the engineering profession and the elements of multidisciplinary cooperation among students. Furthermore, the portfolio is envisioned as a more comprehensive advising tracking system that offers an educator a broader perspective of a student's capabilities in achieving an enriched experience during his/her undergraduate engineering education.

Portfolio Framework

The IIT engineering portfolio is designed to compile records of a student's participation in activities organized by the Armour College of Engineering in several target areas within the distinctive engineering education initiative. These areas focus on critical issues facing the engineering profession. Currently, four thematic areas are emphasized: health, energy, water, and security. The process of targeting specific areas for distinctive education is dynamic and will include additional themes if identified by the profession as challenging issues facing various engineering disciplines. The current framework for the IIT engineering portfolio is designed to take a full advantage of electronic transfer of information and filing, and presenting the incoming materials in a format that is considered the "accepted practice" by the profession. With the current framework, three types of materials and/or data enter each portfolio when a student starts creating it. While students have flexibility in creating their individual portfolio, in general all portfolios will include: (1) examples of the student's work; (2) records of the student's activities (these include courses and other curricular and non-curricular activities of educational and/or scholarly value); and (3) any critique or commendation received for undergraduate research experience, and any publications, awards, or recognitions cited for the student's achievements (see Fig. 1). The examples of the student's work, which allows to customize for individual career focus, include final reports on competitions entered and projects completed, narratives prepared after attending a seminar or a roundtable, and papers or posters published upon completing participation in the Armour R&D program, IIT's Program for Undergraduate Research in Engineering (PURE) and Mentored INnovation Development (MIND) program. The records of the student's activities are electronically entered into the portfolio when he/she attends seminars, roundtables, discussion groups, field trips, etc. The records of critiques by a faculty mentor, and any awards and recognitions received by the students are also compiled in the portfolio. These documents specifically are in connection with the student's activities within the distinctive education thematic areas (as described earlier).
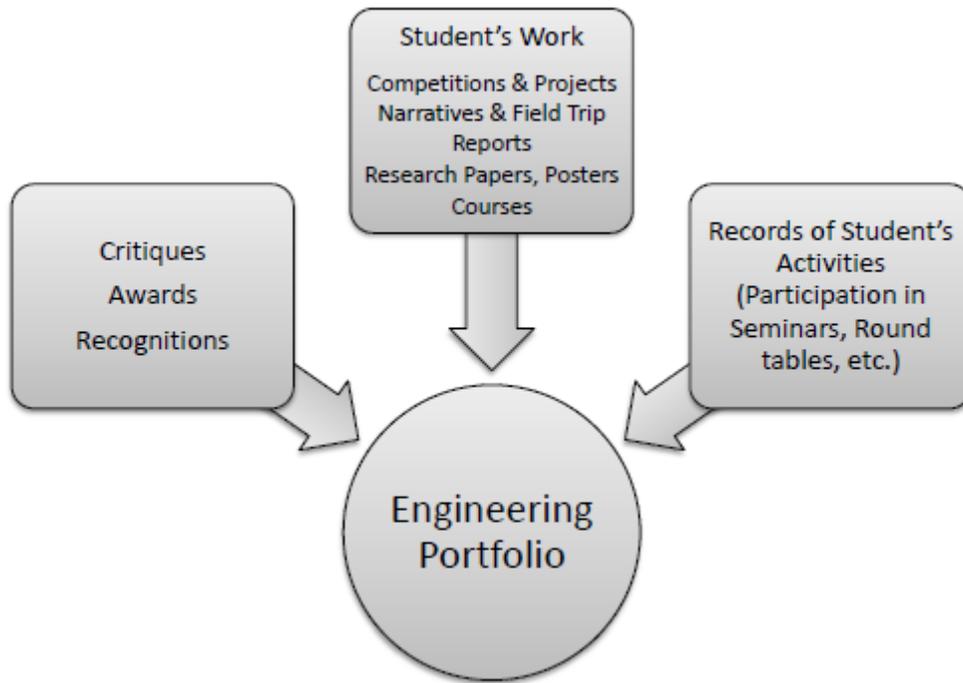
Fig. 1 The framework of our institution's portfolio

Significance

The importance of portfolios in engineering education is increasingly being recognized by educators and the profession. However, published papers on the actual experiences are rather limited. Reported cases of portfolio applications include systems to record students' projects in courses[3], and using the portfolio as a means for assessment[10] and students' learning experiences[4]. Outside of the engineering application, and focusing on using electronics means to develop portfolios (i.e., e-portfolios), one can find more published work, especially on using the e-portfolio concept as a means of assessment[2,5,9]. The significance of a portfolio in job interview and success has also been reported in the literature[8]. The development of an engineering portfolio within our distinctive education initiative in the Armour College was planned to learn from the success of portfolios as published, while expanding into new content and areas of application. And as such, a multi-objective portfolio was designed to offer benefits to not only the students but also to faculty and potential employers. The IIT engineering portfolio was intended to offer a tool that would present a student's curricular and non-curricular accomplishments and his/her experience and competency in addressing contemporary issues and challenges facing the engineering profession. It is also envisioned to provide a foundation to build on open-ended self-guided career plans based on mastered skills and demonstrated achievement. The tracking of skills, experiences, and achievements in a portfolio is expected to facilitate the planning of shifting of goals to adapt to new challenges and market circumstances

to remain competitive in changing econonies[11]. With its multi-objective nature, the portfolio will still be used as an assessment tool and offer the benefits inherent to any discipline portfolio in helping students for a better chance of success in the job market. The significance of the IIT engineering portfolio can be recognized within the context of the three objectives cited earlier, and as it relates to three main stakeholders benefiting from it: namely students themselves, employers, and educators (Fig. 2).
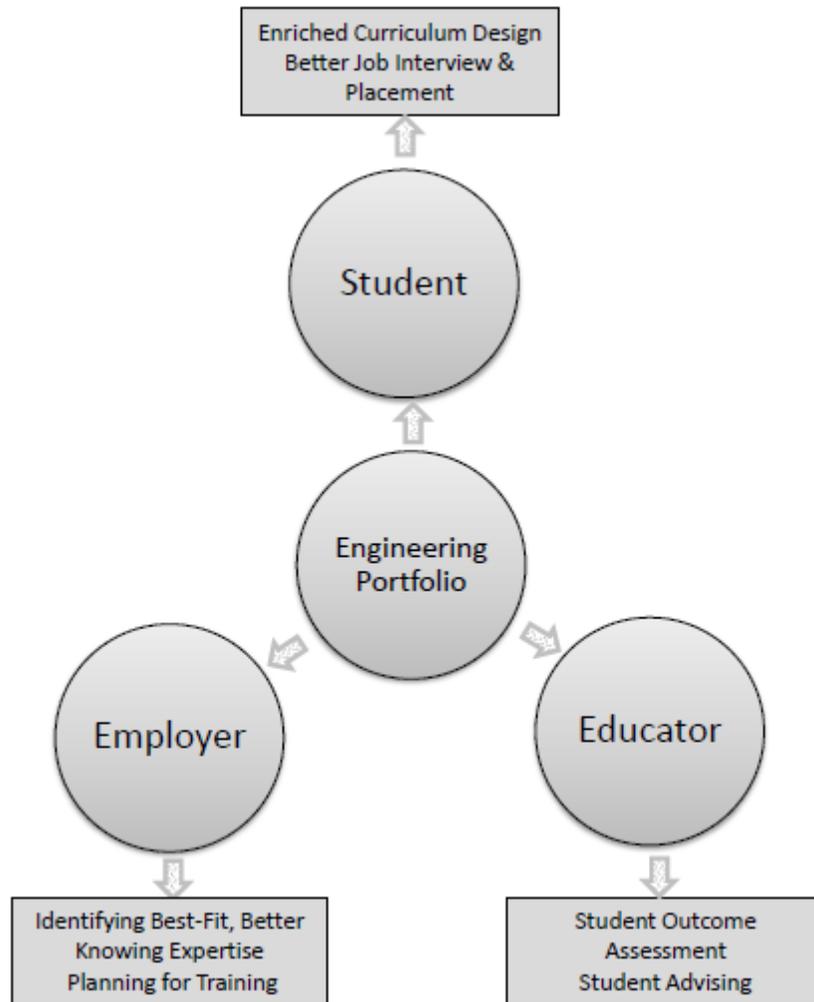

Fig. 2 Stakeholders benefiting from engineering portfolio

1. Students: The fundamental value of a portfolio to students is the opportunity offered to them to design an enriched curriculum and path to graduation. On the application side, the value of the portfolio is in employment opportunities, which has long been well understood in many disciplines outside of engineering (such as in art and architecture). As a collection of work and achievements continues during the student's undergraduate education, the portfolio offers a

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means by which the student will be able to promote his/her expertise and experience in areas that are well beyond what is considered to be the usual and ordinary. This is expected to have an impact on the success of students in the job market. More specifically, the IIT engineering student's portfolios focus on compiling the results of their accomplishments in projects, competitions and other activities that stretch well beyond the usual classroom exercises. These accomplishments reflect more on students' abilities and talents in solving issues that are contemporary and within areas that are recognized by the profession as critical and challenging to today's engineering design and practice. The records of these accomplishments in performing unique and timely activities are expected to place our graduates a step ahead of the "usual crowd" in the job market and especially during the interview process.

2. Employers: The IIT engineering portfolio helps a potential employer to better understand a student's aptitude and preparedness for the position (he/she is applying for) and to identify any specific areas where the student will need to be further trained. In addition, the portfolio offers a valuable screening tool to the employer when interviewing future employees in identifying candidates that are considered the "best-fit" to the organization and its needs. These benefits will help employers to use their training resources more efficiently and effectively.

3. Educators: The value of a portfolio to an educator is primarily in the student learning outcome assessment process and in advising. The materials compiled in a student's portfolio offer valuable information that can be used as an "evidence-based" data for assessment. For the portfolio to be effective for assessment, the students' activities will need to be targeted and focused on a few specific items for which the assessment can be achieved as a group, for example, portfolios are used in targeting students' writing and communication capabilities[5]. In the context of student outcome assessment, the Accreditation Board for Engineering and Technology (ABET) emphasizes what is now known as a-k outcomes[1]. As indicated earlier, the IIT engineering portfolio contains project summaries, narratives on seminars or field trips attended, various products such as paper and posters published upon participating in the undergraduate research experience, description of projects after entering competitions, etc. Such a collection provides enough means to target specific a-k outcomes and compile assessment data within a series of specific performance indicators. Figure 3 provides an example of a targeted assessment using the IIT engineering portfolio. The example included in Fig. 3 specifically addresses the issue related to competency in understanding contemporary topics within an engineering discipline (student outcome k). The assessment for example can be achieved by reviewing student's narrative prepared after attending a roundtable on issues concerning the urban systems and infrastructures in large cities (these roundtables are organized every semester as part of our distinctive engineering education activities). In terms of advising, as indicated earlier, the significance of the portfolio is to offer the educators with a better perspective of a student's capabilities and thus advising them to design a more enriched education program that is well superior to an ordinary curriculum.
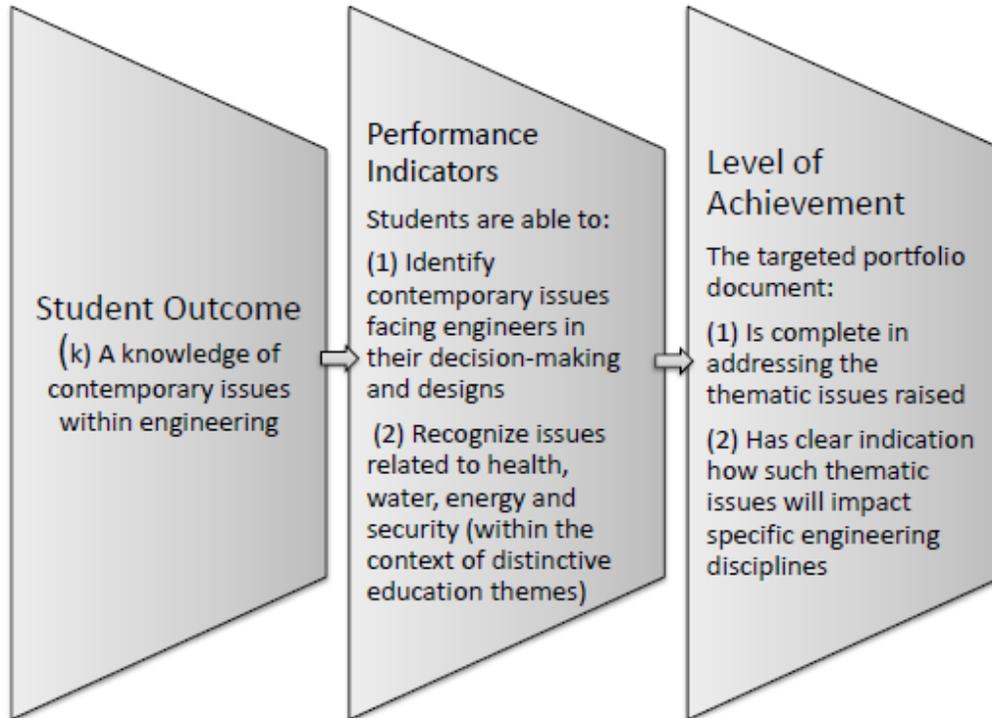
Fig. 3 Portfolio used as an assessment tool

Future Directions in Portfolio Applications

Moving forward, the next phase in the IIT engineering portfolio application involves (1) measuring the impact of portfolio in job interviews and placement; (2) using an automatic feedback process for portfolio development and implementing faculty's input for the contents and (3) developing training sessions and workshops for faculty in helping students with the design of their portfolios and education programs.

One of the primary goals of the distinctive education in engineering at IIT is to measure the effectiveness of the portfolio in student success for job interview and placement. The IIT engineering portfolio initiative started in 2012; and students participating in the distinctive education with complete portfolios will enter the job market within a year. A limited amount of data on the effectiveness of the portfolio in helping students to better position themselves in achieving a distinctive engineering education was obtained. A student survey was conducted, and although the sample was not large enough to establish statistically significant results, specific trends were identified resulting in valuable information. The preliminary data indicated an overwhelming agreement by students that the portfolio will be an effective tool that would enhance their education experience and learning. However, we recognized that a more rigorous data collection and analysis on the effectiveness of the portfolio in several areas (education, assessment and job opportunities) will need to be conducted. Accordingly, the Armour College of Engineering at IIT is currently working closely with IIT's Career Management Center in

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developing a plan to monitor students' success in the job market and assess the role of the portfolio in the success rate. The assessment will utilize several metrics including: (1) the rate of job placement for students with and without portfolios; (2) Students' perception of the significance of portfolios in their success during the interview; and (3) the employers' perception in regard to students' preparedness, self-presentation at the time of interview and fit to the company's needs. Preparation of an assessment tool for this phase of our distinctive education theme is currently in progress. Furthermore, the faculty will also be involved in the evaluation of the effectiveness of the portfolio in advising, student outcome assessment and other curricular activities.

Additional improvement in the next phase of the IIT engineering portfolio applications includes an automatic feedback for implementing faculty's input in the design of the portfolios and students' education programs and offering the opportunity to the faculty to review a student's portfolio with suggestions on the contents. Training sessions and workshops are also in plan to guide faculty in portfolio design and using it as an advising and assessment tool.

Other academic programs and initiatives within our home institution had recognized the value and potential impact that our engineering portfolio (developed and implemented in the past two years) may have on their own programs and had, most recently, expressed interest in using similar methods and joining our effort. Similar campus-wide applications of portfolio have demonstrated success in helping students with their education[6]. We are currently engaged in exploring the expansion of our engineering portfolio to support a larger community of students and interest areas. The next generation of our portfolio is planned to add flexibility allowing customized applications beyond engineering education aimed to have a broader impact at our institution.

Summary and Conclusions

This paper reports on a new initiative by the Armour College of Engineering at IIT in tracking and recording student participation and performance in curricular and non-curricular activities that are relevant to their engineering education. The collection of a student's accomplishments is achieved through an electronic online engineering portfolio system. The IIT engineering portfolio project was originally pursued as a means of helping our students to design their path to graduation through an enriched curriculum, and, as such, to have a better success rate in job interview and placement. However, as the portfolio concept was further developed, its significance in other areas, especially for assessment and advising and as a means of helping potential employers to match students' background with their needs, was also recognized.

The following are the main conclusions of this paper:

(1) The IIT engineering portfolio offers our students with an opportunity to design an enriched curriculum as a path to their graduation. The portfolio is also expected to offer students with advantage during job interviews and with a higher rate of success in job placement.

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(2) The significance of the IIT engineering portfolio is also recognized in applications related to student outcome assessment and advising and as a way of helping employers to better match their needs with students' expertise and experiences.

Acknowledgements:

Bibliography

1. ABET (2014). Criteria for accrediting engineering programs. Engineering Accreditation Commission, Accreditation Board for Engineering and Technology (ABET), Baltimore, MD, p 3.
2. Barret, H. (2006). "Using electronic portfolios for formative/classroom-based assessment," Classroom Connect Connected Newsletter 13, No. 2.
3. Campbell, M.I., and More, C. (2003). "Web-based engineering portfolio system," Proc. American Society of Engineering Education Annual Conference and Exposition, Session 1520.
4. Christy, A. D., and Lima, M. (1998). "The use of student portfolios in engineering instruction," *Journal of Engineering Education*, Vol. 87, No. 2,p. 143-148.
5. Mason, R., Pegler, C., and Weller, M. (2004). "E-portfolios: An assessment tool for online courses," British Journal of Education Technology, Vol. 35, Issue 6, p. 717-727.
6. McCowan, C., Harper, W., and Hauville, K. (2005). "Student e-portfolio: The successful implementation of an e-portfolio across a major Australian university," *Australian Journal of Career Development*, Vol. 14, No. 2, p. 40-51.
7. Ostheimer, M. W., and White, E. M. (2005). "Portfolio assessment in an American engineering college," *Assessing writing*, Vol. 10, No. 1, p. 61-73.
8. Powell, K. S., and Jankovich, J. L. (1998). "Student portfolios: A tool to enhance the traditional job search," *Business Communication Quarterly*, Vol 61, No. 4, p. 72-82.
9. Reis, N. K., and Villaume, S. K. (2002). "The benefits, tensions, and visions of portfolios as a wide-scale assessment for teacher education," *Action in Teacher Education*, Vol. 23, No. 4, 10-17.
10. Williams, J. (2002). The Engineering Portfolio: "Communication, reflection, and student learning outcomes assessment," Int. J. Engng Ed. Vol. 18, No. 2, p. 199-207.
11. Gee, J. P.(2004). "Shape-shifting portfolio people", In Situated Language and Learning: A critique of Traditional Schooling, Psychology Press, Ch 7, p.95-110.