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The present case study illustrates an example of how universities can develop initiatives that enhance the learning effectiveness of their students and, at the same time, help them become more innovative and generate knowledge that improves research outcomes and contributes to scientific advancement. Research & Innovation in Science and Engineering (RISE) constitutes an initiative implemented by an Indian comprehensive university, through which multidisciplinary teams of students present their project ideas and, if selected, they get the institutional support to develop them: some funds, the university facilities and equipment and, more than anything, the guidance of a dedicated faculty mentor, and the involvement of the industry. The students' learning experience is totally collaborative, interdisciplinary, applied and experiential, in good alignment with the needs of the present and future labor market. Additionally, the outcomes of the program include research papers, patents and industry partnerships that clearly benefit the institution and all its stakeholders.

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# Enhancing students' engagement, learning and knowledge generation: the RISE case study

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## Abstract

*The present case study illustrates an example of how universities can develop initiatives that enhance the learning effectiveness of their students and, at the same time, help them become more innovative and generate knowledge that improves research outcomes and contributes to scientific advancement. Research & Innovation in Science and Engineering (RISE) constitutes an initiative implemented by an Indian comprehensive university, through which multidisciplinary teams of students present their project ideas and, if selected, they get the institutional support to develop them: some funds, the university facilities and equipment and, more than anything, the guidance of a dedicated faculty mentor, and the involvement of the industry. The students' learning experience is totally collaborative, interdisciplinary, applied and experiential, in good alignment with the needs of the present and future labor market. Additionally, the outcomes of the program include research papers, patents and industry partnerships that clearly benefit the institution and all its stakeholders.*

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## 1. Urgent changes are required in Higher Education

Headlines concerning the lack of preparedness of college graduates for the workforce are nothing new. Nearly one decade ago, the article titled "Grave New World? Workplace Skills or Today's College Graduates" (Eisner, 2010) described how university graduates are facing evolving skill needs and increasing competition, and identifies through the voice of employers what are the key competencies for a successful career in the 21<sup>st</sup> century. The report by Hart Associates (2015) constitutes one of many examples where employers give students very low grades on competencies, some of which they consider absolutely relevant for career success. One more example can be found in a 2015 article in the Chronicle of Higher Education titled "College Graduates Aren't Ready for the Real World" the author manifests how employers are not satisfied with their novice employees, in particular when it comes to

delaying gratification and thinking long term (Levine, 2015). Despite this disconnection and low appreciation levels of the university outcomes, one of the Gallup studies for Inside Higher Ed finds that 96% of chief academic officers at higher education institutions say their institution is very or somewhat effective at preparing students for the world of work (Gallup, 2014), which clearly contradicts the perceptions of business leaders.

Taking a more positive view, there are numerous instances where very interesting efforts to reduce this gap can be found, like the work carried out by the Laurate network of universities, to define the key competencies for recent graduates to be successful in the labor market today, which involved more than 5000 professionals and employers from around the globe, and identified the following competencies as essential for a new professional entering the workplace: Communication, Analyzing and Solving Problems, Working well with others, Achieving objectives, Working well with others, Learning and self-development and Adapting to change (Laurate, 2016).

Even further, recent reports like *Skill Shift: Automation and the future of Workforce* elaborated by McKinsey Global Institute (Bughin et al, 2018) present the need of instilling a culture of life-long learning, defining more agile corporate structures with less hierarchy and more collaborative team works or the expected rise in the use of independent contractors and freelancers.

The voice of employers results loud and clear and, in essence, seems to require a very different approach to Higher Education than the traditional models. It is time to effectively transform the traditional, passive 'Talk and Chalk' approaches into new educational models, that provide students with more engaging learning experiences whose outcomes, measured in terms of the profile of the future graduates, will constitute a more effective response to the needs of the global labor market and to each one of its specific industries.

## 2. New learning needs

The development of the competencies that the market place requires in university graduates cannot effectively occur if only the old traditional teaching methods are utilized. Fortunately, there is an increasing number of innovative practices that take place in numerous Higher Education institutions, which incorporate active learning, and result in much more engaging, satisfactory and effective experiences.

If we think about the future professional world, we can probably agree that it would be good to make our university graduates apply their knowledge effectively, to be able to find solutions to complex, interdisciplinary problems, to be able to collaborate with others and learn from their own experience to continue to develop and grow. Under this assumption, we believe that collaborative, interdisciplinary, applied and experiential learning could be interesting pedagogical approaches that can contribute very positively to the enhancement of the learning experience, and to the improvement of the final outcomes reflected in the profile of university graduates.

- The benefits of collaborative learning are well addressed in the Education literature. Laal and Ghodsi (2012) conclude that collaborative learning can be much more beneficial than competitive and individualistic learning activities, generally resulting in not only better academic outcomes, but also enhanced social skills and personal confidence.
- According to Holley (2017), interdisciplinarity explores questions and problems that do not exist within disciplines. The same author highlights how the diversity of views related to a particular topic promotes the inclusion of a range of perspectives while cultivating the skills needed for collaboration and integration.
- Applied Learning is also widely accepted as an effective educational method. Rabidoux and Rottmann (2017) believe that it is a practical approach for which research demonstrates that student motivation increases, which fosters student centered instruction and provides real world applications. For these authors, it is also an opportunity for high impact learning where students explore content and directly apply new knowledge.
- The valuable benefits of Experiential Learning are nothing new either. So many references and historical maxims: *I hear and I forget, when I see and I remember, if I do and I understand; Tell me and I will forget, Teach me and I will remember, Involve me and I will learn*, attributed respectively to Confucius in year 450 BC and to Benjamin Franklin, in 1750. Experiential learning is also referred to as learning by doing, or learning through action, even though all these names might be unconsciously inviting teachers and learners to neglect the thinking component that an effective learning process requires, the reflection that needs to go hand in hand with the action itself. Based on the abundant research and personal experiences, it is our assumption that through experiential learning, “direct experience and focused reflection”, students can effectively develop the knowledge, competencies, and values that the present and future labor market will require. The solid pedagogical foundations of the theory of experiential learning, which Kolb proposed decades ago are broadly accepted and recognized. According to Kolb (2014): *‘Experiential learning theory has been widely accepted as a useful framework for learning-centered educational innovation, including instructional design, curriculum development, and life-long learning’*.

The initiative presented in this paper constitutes an example of integration of the pedagogical methods described above, and illustrates how universities can provide students with highly effective learning experiences, positively appreciated by employers too.

### **3. Making the most of a learning community**

It is amazing to think how much talent a Higher Education institution can contain! And it is not only the knowledge and experience of professors, but the untapped ideas and solutions to complex problems that our students can provide. One could think that the role of the University is basically to provide students with the right conditions for them to learn, grow and get ready for a successful career. Conditions that will always be related to the curriculum we offer them in their programs of study, and to the essential

contribution of faculty. Furthermore, the role of the learning resources, the spaces and opportunities universities create for students to experience deeper learning and fully live the academic spirit are also key. Additionally, the creation of a real learning community implies an active role of the students, and requires peer interactions to a much greater extent than we would normally see in many universities today.

Research & Innovation in Science and Engineering (RISE), the initiative that we describe in the following sections is an intentional attempt to create the kind of learning community described, where the learning outcomes and even the scientific production reaches levels of extraordinary achievement.

#### **4. Enhancing innovation through the introduction of RISE**

Youth of today is very talented and full of ideas. They often come up with interesting concepts, but probably due to lack of funds and proper guidance, they find it difficult to develop and execute them practically. Keeping this need in view, an India based university launched a specific program in 2015, called 'Research & Innovation in Science and Engineering' (RISE), with a goal to encourage research activities amongst all the undergraduate and postgraduate students of Engineering, Design and Planning. The main objectives of RISE included:

- To create a research and learning environment for the students, where interdisciplinarity and collaboration were basic principles.
- To foster a culture of scientific inquiry, effort and rigor by promoting research skills and competencies within the student community.
- To enhance the publication of quality research in peer reviewed, highly respected, academic journals.
- To stimulate innovation, and an active role in local and global problem solving
- To promote association with the relevant industries to bring up the research work to the consumers.

RISE serves as guidepost for the university students to reach its full potential in research and scholarly activity, acting as a catalyst to promote and improve research activities amongst the participating students. After going through the selection process, students are facilitated with financial support (approx. \$ 3,000), infrastructural support (in terms of lab facilities) and intellectual support (in terms of faculty guidance) to work upon their ideas and shape them up.

A holistic approach is adopted while short-listing, awarding and executing the projects to the students, which helps them to learn more and guides them to complete their projects towards the expected outcome. The complete process is shown in the flow chart given in the figure below:

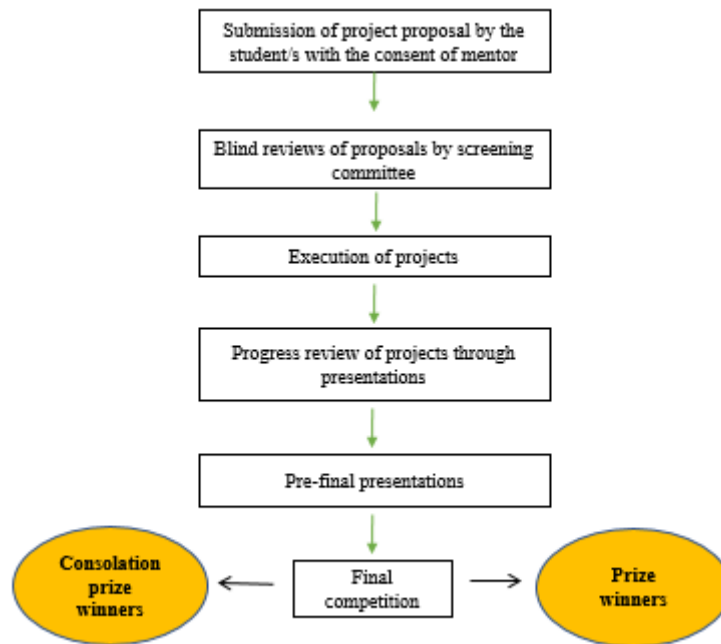


Figure 1.

Process flow for execution of RISE

Since 2015, the program has evolved considerably, always incorporating a continuous improvement approach that makes it more effective and aligned with the needs of students. For instance, since 2017 two theme based categories of RISE have been launched, Category-I for the students who are submitting their fresh idea to work upon, and Category-II for the students who have already developed some prototype or have come up with some potential results in a previous cycle of RISE and want to upgrade it in terms of components, precision, or performance. External competitions and awards have had a national focus until 2018, but the institution will provide additional support towards international recognition starting in 2019.

## 5. Student response and outcomes

Benefitted by this initiative, students explore all the possible areas of research, such as chemical industry, automobile industry, renewable energy, polymer industry, petroleum industry, electronics & communication, IT/IOT based devices, automation and others. It is noteworthy that most of teams mainly work on the application part of the research, focusing on particular problems or challenges of our daily life. To mention a few, some of the projects include railway crack detection system, quadcopter for studying environmental patterns in disaster affected areas, image processing devices for various applications, auto-gear vehicle, OBDAS for capturing data, or a language converter for visually impaired people, some of them shown in figure 2.

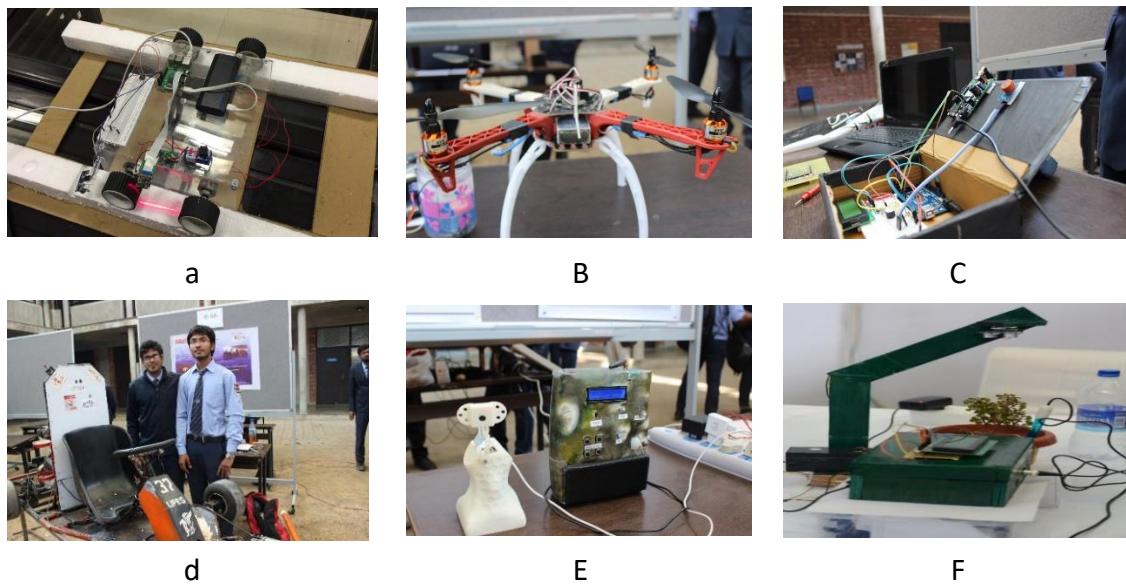


Figure 2.

(a) Railway Crack Detection System, (b) Quadcopter, (c) Image Processing for fruit/vegetable quality, (d) Auto-gear Vehicle, (e) On Board Data Analysis System (OB DAS), (f) Language converter for visually disabled people

It is a matter of pride to share that the RISE projects have resulted in wonderful outcomes, in the form of working prototypes developed by students, patents, publications and various awards won by them at various prestigious platforms outside the university. During last 3 cycles of RISE, a total 14 patents have been filed and 23 research publications have been produced as the outcome of these projects. And even some projects have moved forward towards commercialization with the support of the institutional R&D and incubation centers of the university. Along with this, several awards have been won by the students outside the institution, like the very prestigious *Gandhian Young Technological Innovation (GYTI) Award* at President's House, New Delhi, in March 2018.

Additionally, promotion of association with the relevant industries has also been a direct benefit of this initiative. Through RISE, industrial relations have been built up for preparing students to the next level. Some industries, such as Mahindra & Mahindra (automobile), Aircel (mobile), Leanapps (software), etc. have been at the panel of RISE for providing qualitative inputs to the students to make their products ready for commercialization. Students are in touch with them for upgrading their products and launching them with the help of the university incubation center.

Regarding students' impressions, their feedback about RISE is expressed by complementing a survey at the end of the process. The following figure captures the information regarding a total number of 79 students that have completed the survey since RISE was launched. Students' feedback could be excellent, very good, average or poor. And, as it can be appreciated in the figure below, the majority rated the experience as excellent followed by numerous very good impressions. No students have ever rated the experience as poor.

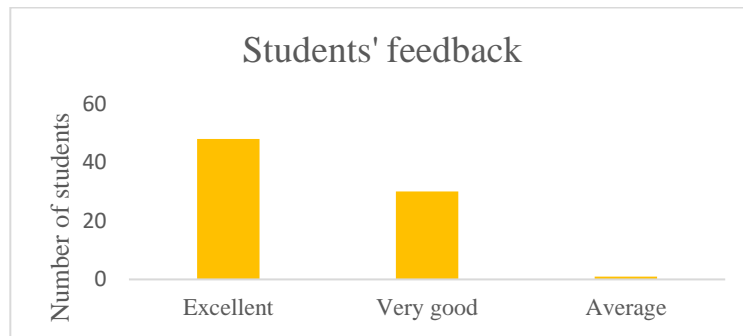


Figure 3.

Results of student survey

To complement the quantitative information, students were invited to participate in a focus group, where a semi-structured conversation took place with 17 participants. The conversation was extremely positive and all the students manifested high levels of satisfaction with the experience. The last two questions were a) if they would recommend their university that this program is continued and b) if they would recommend other universities in the country to do the same. In both cases, 100% of the students answered affirmatively. The participating students used the words shown on Figure 4 to describe RISE:



Figure 4.

Words utilized by the students to describe RISE during the focus group

The conversation that took place during the focus group was recorded and analyzed, with the following concepts emerging from the discourse:

Table 1.

Topics addressed	Emerging ideas
<b>Experience</b>	<i>Very positive; opportunity for students; opportunity for the country; rigor; scientific method; available resources</i>
<b>Mentors</b>	<i>Guiding; supportive; enhance creativity</i>
<b>Learning</b>	<i>Practical; applied; interdisciplinary; effective; helps with other academic subjects</i>
<b>Job</b>	<i>Helps discover career interests; connection with real professional world; very valuable in internships</i>
<b>Key competencies</b>	<i>Communication; team work; problem solving; creativity; resilience</i>



Table1: Discourse analysis of focus group with students (16/11/2018)

## 6. Conclusions and recommendations

The development of this initiative has proved itself as a successful instrument to achieve the goals that were established, having not only resulted in very interesting research production, but in the enhancement of students' engagement and initiative, and in a very positive institutional contribution to address a few of the challenges the world of today.

The economic growth of a nation depends upon its capacity to educate & nurture its young population. It also needs inculcation of seeds of learning and exploring the opportunities to innovate in them. Trusting new generation is a bliss and they are indeed making their organizations, societies and countries to be proud of them by experimenting wonderfully and finding out the solutions of the standing problems of the day. Just, the need of the hour is to recognize and provide them with the proper required support and prospect. RISE has come up as a successful platform for university students to achieve their aspirations and a chance to convert their dreams into reality, and its results speak of the success of the idea. The enthusiasm of the students and outcomes of RISE have been a driving force for bringing it at national level, and then at international platforms too. Considering the achievements through RISE, it is recommended to invest on R&D activities in academic organizations, trusting the skills of youth and promoting young scientist to win the problems through their innovations across the world.

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