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Trends and challenges in engineering and technology innovation in Kenya: An analysis of students' projects

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Abstract

Use of projects in teaching and learning is one of the strategies that promote deeper learning. It prepares students with the 21st century skills for career and life in general. Deeper Learning methods not only embed strong academic learning, but also embody the ability to solve complex problems, work collaboratively, communicate effectively and learn how to learn. Use of projects encompasses many educational methodologies that are student-centred. This paper analyses a range of technology education students' projects for a period of two academic years with a view of outlining the major trends and challenges in technology and innovation in Kenya. A total of ninety one (91) projects were considered for desktop analysis. Data was collected by critically reviewing the objectives of the project with a view to establishing the technological aim, and the challenge being addressed by the project. From the topic the area of innovation pointed at was established. Both the outlined and inferred technological challenge within the statement of the problem and the objectives of the projects are outlined with a view to proposing the main trends and challenges in technology and innovation. Ten key areas of technological innovations were established namely technology and Security and safety at work and at home; Work facilitation and simplification; engineering in Agriculture; business management and controls; correctional services; facilitation of the differently abled members of the society, Energy provision and convenience; facilitating education and training; industrial manufacturing; and environmental sustainability. This paper recommends that the leads offered within the projects are indicators of the trends, direction and challenges in technology and innovation that Kenya and the rest of the world may focus on to solve the real life problems encountered by humanity.

Keywords: Technology and Innovation; Science and Technology; Engineering and Technology; Project Learning; Technology Learning; Problem Solving, Deep Learning

1. Introduction

The twenty-first century demonstrates a radical shift from industrial societies to information or knowledge societies, where advances in information and communication technologies (ICTs) are rapid and shape economic and social development. Globalization has changed the economic structures and the world of work. The teaching and programs in Technical Vocational education and training (TVET) thus must work towards dealing with and actualizing these realities. Technical Vocational Education and Training has to consider the new demands and must provide appropriate and constantly updated training concepts.

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2. Projects in Teaching

Use of projects in teaching and learning is a powerful method that has extensive benefits for students, ranging from critical thinking to project management and to self-confidence. Project learning is linked to significant improvements in student performance, attendance and classroom engagement. It also gives teachers the opportunity to build stronger relationships with their students by acting as their hands-on learning facilitator. In essence, project is an instructional method where students collaborate with others and learn by doing. The skills learned through project are also mainly the skills sought for by employers.

There are ten benefits of project-based teaching and learning and how it can better prepare learners with life skills that set them up for future success. The benefits are:-

- Collaboration: Relationships formed during collaboration is a huge part of projects teaching and learning. Not only do students learn how to work better in groups—providing their own input, listening to others, and resolving conflicts when they arise—they build positive relationships with teachers, which reinforces how great learning is. Students also form relationships with community members when working on projects, gaining insight for careers and beyond.
- Problem Solving: Students learn how to solve problems that are important to them, including real community issues, more effectively—even learning from failure and possibly starting over.
- Creativity: Students apply creative thinking skills to innovate new product designs and possibilities for projects.
- In-Depth Understanding: Students build on their research skills and deepen their learning of applied content beyond facts or memorization.
- Self-Confidence: Students find their voice and learn to take pride in their work, boosting their agency and purpose.
- Critical Thinking: Students learn to look at problems with a critical thinking lens, asking questions and coming up with possible solutions for their project.
- Perseverance: When working on a project, students learn to manage obstacles more effectively, often learning from failure and making adjustments until they're satisfied with their work.
- Project Management: Students learn how to manage projects and assignments more efficiently.
- Curiosity: Students get to explore their curiosities, ask questions and form a new love for learning.
- Empowerment: Students take ownership over their projects, reflecting on and celebrating their progress and accomplishments (10)

Objectives of the study

This study was guided by the following objectives:

- To evaluate the main areas of technology focus for the final year projects in technology education
- To analyse the trends and challenges in Technology and engineering in the technology education final year projects

2.1. Data collection

It is a requirement that each year four student technology education must undertake a project. Data was collected from year four final year projects. Ninety one (91) final year projects were analysed.

3. Research methodology

The research methodology is the strategy, plan of action, process or design lying behind the choice and use of particular methods and linking the choice and use of particular methods to the desired outcomes (4). A methodology justifies the authenticity of the research. It is a philosophical inclination towards which the research is weighted. For this study, a heuristic methodology is adopted. This is a derivative of phenomenology that brings to the fore the personal experience and insights of the researcher. The question that this kind of enquiry seeks to answer is, "What are my experiences of the phenomenon and the essential experience of others who also experience this phenomenon intensely?" This is a methodology in which the experience of the researcher is taken into consideration. This kind of methodology is based on two premises. First, that the researcher must have a personal experience with and intense interest in the phenomenon under study. Second, is that all others involved in the study must have the experience and interest in the phenomenon. Thus heuristic methodology focuses on intense human experiences and is a combination of personal

experience and intensity that yields understanding of the essence of the phenomenon (8). The researcher are concerned with meanings not measurements, with essence not appearance, with quality not quantity and with experience not behaviour (8).

Heuristic research can be summarised in the following four points: First it emphasises connectedness and relationship; second it leads to depictions of essential meanings and portrayal of the intrigue and personal significance that imbue the search to know; third, it concludes with creative synthesis that includes the researcher's intuition and tacit understanding; and lastly the research participants are not lost in the descriptive process of data analysis since they continue being displayed as whole persons. Thus, the essence of the person is retained in the heuristic research (8). It was felt that heuristic research suits this study because the researcher is a practitioner in TVET training which the research is focused.

3.1. Theoretical framework of the study

Theoretical perspective is the philosophical stance informing the methodology and thus providing a context for the process and grounding its logic and criteria (4). The main theory for the study was Kolb's theory of experiential learning. Experiential learning is the process of making meaning from direct experience. Aristotle once said, "For the things we have to learn before we can do them, we learn by doing them." It involves learning by doing. In this learning set up, Learners taking part in planned real-life activities that are often community based. Learning is facilitated through a combination of planning and preparation, experience, reflection and review. Experiential learning involves a, 'direct encounter with the phenomena being studied rather than merely thinking about the encounter, or only considering the possibility of doing something about it.'

3.2. Epistemology of the study

Epistemology is a branch of philosophy concerned with theory and knowledge. It deals with the nature of and derivation of knowledge, the scope of the knowledge and the reliability of the claims of knowledge (4). The study is inclined towards the constructivist's school of thought. Constructivism is philosophy founded on the premise that by reflecting on our own experiences, we construct our understanding of the world that we live in. It is a phenomenological orientation to inquiry in which 'meaning' is the prime focus. Denzin and Lincoln (1998) suggest that constructivism is a viable paradigm for the study of human interaction, under which this study falls. In constructivism, there is no objective truth waiting for us to be discovered. The guiding principle for this school of thought is that truth and meaning come into existence from our engagement with the realities of our world (4).

3.3. Need for creativity in training

Intelligence comprises three basic abilities: analytic, practical and creative. School curricula in which teachers combine training for all three skills are quite effective. Creativity on the other hand has been understood as the ability to produce work that is both novel and appropriate (11). The creative process in human beings is organic, and contains emotional energy. In fact, the more passion and inspiration, the deeper and more coherent the creativity that emerges. If you intend to support the growth, creativity and awareness of those you serve, you facilitate from a more meaningful place than if focused only on the goal.

Creativity and innovation are becoming increasingly important for the development of the 21st century knowledge society. They contribute to economic prosperity as well as to social and individual wellbeing and are essential factors for a more competitive and dynamic world. Education is seen as central in fostering creative and innovative skills (7 p iii)

Innovation has been understood as the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations (1). Craft (2005) sees creativity as the ability to see possibilities that others haven't noticed, Esquivel (1995) sees it as the critical process involved in the generation of new ideas. Innovation has also been defined as the intentional introduction and application within a job, work team, or organization of ideas, processes, products, or procedures that are new to that job, work team or organisation and that are designed to benefit the job, work team or organisation (9). Craft (2005) sees innovation as the implementation of new ideas to create something of value, proven through its uptake in marketplace. An innovation can be seen as a new idea being launched on the market for the first time.

Developing creativity requires that an integrative whole-brain approach is taken. Creativity requires whole-brain thinking; right-brain imagination, artistry and intuition, plus left-brain logic and planning. The principles of art and

science as catalysts for transformation are used. Tapping into dormant talents help people feel more confident and unafraid of embracing the future. Exercises designed to effect shifts in perception, help people break out of traditional mind sets. This is the philosophy behind the use of projects in consolidating all the ideas learnt in the four year program.

3.4. Data presentation and analysis

A total of 91 projects were analysed with a view to identifying possible direction of the proposed innovation. The objectives of the projects were considered for the 91 cases. For each project the general direction of the innovation is indicated in the table below.

Table 1 Data Analysis and interpretation

Serial No	Project title	Main Objective	Challenges and trends in Technology and engineering Innovation	Implications to training and research- general direction of the innovation proposed
1	Hydraulic powered mechanical arms	To develop a hydraulic powered robotic arm which can help to lift and place objects at required locations with higher efficiency while minimizing risks	Bulk handling of heavy artifacts and equipment. Use of technology in mechanical situations to make work light. Due consideration of safety in all work areas be they industrial, construction, mechanical and farmland.	That there is a need to teach systems that make work easy and also facilitate. All science and technology teaching and training must find suitable areas of application in our day to day life. Examples must come from real life situations and have broad based applicability.
2	School management system	To come up with a system that can help administration to control human resources faster, easier, more efficient and effective	People and work interface. Making systems be responsive to the needs of personnel to make work systems more productive.	The need for transferable skills that are cross cutting in all situations and have wide applicability. Use of technology in the management of education and training facilities
3	Student notes management system	To come up with a student notes management system which can help to easy learning and enhance student performance	Technology for application in the teaching and learning practices and situation.	Science and technology in the provision of quality education and training.
4	Electronic electoral system	To develop an electoral system which can help save time, minimize errors in counting and enhance transparency when carrying out elections in the university of Eldoret	Technology in democracy and leadership processes	That technological innovations should facilitate life processes such as representation, leadership, stewardship and agency.
5	Online noticeboard	To develop a user-friendly interface for online sharing of information in institutions and beyond	Technology in communication and sharing of information	That innovation are required in the way information is developed, packaged, shared and preserved. These are areas in our day to day life experiences.
6	Car hire and parking management system	To provide a convenient operation by car hire management team by developing a computerised	Technology in facilitating day to day living and experiences.	Science and technology in business systems and appliances

		system that makes logistics/processes easier		
7	Proposed construction of green building	To construct a certain able (environmentally friendly building) in Chepkoilel in order to reduce the ecological footprints	Technology, environment and sustainability	Science and technology for ecological and environmental sustainability
8	Proposed construction of modern workshop	To design modern structurally sound durable aesthetically appealing workshop for the university of Eldoret for better quality training	Engineering and technology for better training facilitation.	All science and technology teaching and training must find suitable areas of application in our day to day life.
9	Proposed construction of modern female hostel	To design affordable aesthetic, structurally sound, comfortable and functional female hostel that can also accommodate the physically challenged	Engineering and technology for inclusivity and convenience.	That there is a need to teach systems that make work sustainable and easy and also should be environmentally facilitative.
10	Proposed construction of student centre	To design an aesthetic and comfortable student centre in effort of improving infrastructure in the university of Eldoret	Engineering and technology for all round education and training experiences. Life at the university is not about class experiences alone but also the whole being development.	All science and technology teaching and training must find suitable areas of application in our day to day life.
11	Proposed pavement construction	To construct an affordable, aesthetic and passable pavement from the forestry building to the new site and education complex	Engineering and technology for improving living conditions.	That there is a need to teach systems that make work sustainable and easy and also should be environmentally facilitative. All science and technology teaching and training must find suitable areas of application in our day to day life.
12	Relationship between awareness level and occurrence of accidents on sites	To investigate the relationships between the level of awareness among construction workers on health and safety measures and occurrence of injures in construction sites within Eldoret	Engineering, science and technology for safe work spaces through sharing of timely and relevant information.	Holistic approach to the workplace considering ergonomics and sustainability. Communication expectations and having workplace expectation well outlined.
13	Factors influencing delay of construction projects	To identify the major causes of delay, effects of delay and methods of minimizing delay in construction projects	Engineering and technology for work performance and completion of projects.	Making technology deliver expected outcomes and expectations. Setting goals and targets guided by the facilitation of Technological prowess.
14	Hydraulic service lift	To come up with an equipment that can help minimize injuries, save time and provide quality service at garages	Bulk handling of heavy artifacts and equipment. Use of technology in mechanical situations to make work light. Due	That there is a need to teach systems that make work easy and also facilitate. All science and technology teaching and training must find suitable

			consideration of safety in all work areas be they industrial, construction, mechanical and farmland.	areas of application in our day to day life. Examples must come from real life situations and have broad based applicability.
15	Steering control headlights	To come up with a steering control headlight and its mechanism that can help to avoid problems that cause road accidents at night.	Engineering and technology for safely and convenience	Applying Technology to solving practical situation encountered daily at home work and while on transit
16	A.C powered saw	To come up with a cheap, easy to fabricate and with low maintenance cost which can help in mass production of cutting materials	Engineering and technology for making work convenient, efficient and light	Applying Technology to solving practical situation encountered daily at home work
17	Automatic wiper	To come up with a cheap autonomous vehicle wiper so as to avert the issues associated with overtaking at night.	Engineering and technology for safely, comfort and convenience	Applying Technology to solving practical situation encountered daily at home work and while on transit
18	Manual cum motor driven cereal cleaner	To come up with a simple, hand-operated, durable and economical, environmentally friendly machine that saves on time and cleans cereals without wastage	Engineering and technology for daily chores. Facilitating life processes with convenience and safely.	Applying Technology to solving practical situation encountered daily at home work and while on transit
19	Four-wheel steering system	To come up with a four- wheel system (4WS) which can replace the current 2WS which has a number of deficiencies.	Engineering and technology for safely, comfort and convenience	Applying Technology to solving practical situation encountered daily at home work and while on transit
20	Hydraulic bearing puller	To come up with an equipment for safer and easier removal/installation of bearing	Facilitative machines and equipment. Use of technology in mechanical situations to make work light. Due consideration of safety in all work areas be they industrial, construction, mechanical and farmland.	That there is a need to teach systems that make work easy and also facilitative. All science and technology teaching and training must find suitable areas of application in our day to day life. Examples must come from real life situations and have broad based applicability.
21	Vehicle overload detector	To come up with a system that can detect vehicle overload to avert vehicle damage and road carnage.	Facilitative machines and equipment. Use of technology in mechanical situations to make work light. Due consideration of safety in all work areas be they industrial, construction, mechanical and farmland.	That there is a need to teach systems that make work easy and also facilitative. All science and technology teaching and training must find suitable areas of application in our day to day life. Examples must come from real life situations and have broad based applicability.

22	Headlight aiming board	To come up with an accurate and cheaper equipment used to focus lights for headlights.	Technology for training and facilitation of learning	Bringing technology to class. Applying science and technology in making teaching and learning interesting and realistic
23	Automatic street lighting control system	To design a street light control system which h is automatic, power saving and cost-effective co compared to the manually operated systems	Technology for real life. Making situations outside mainstream areas conducive for living. Having secure and safe spaces	Applying Technology to solving practical situation encountered daily at home work and while on transit
24	Hospedaje rental house management system	To provide user friendly electronic and effective programme that can help landlord man their property without much struggle	Technology for solving problems in the current economic activities for sustainability	Applying Technology to solving practical situation encountered daily at home work and while on transit
25	Microcontroller-based street lighting system	To design and construct a fully auto mated street light control to avoid wastage of electricity during the day and to consistently provide adequate brightness depending on the changing uses of roads	Technology for real life. Making situations outside mainstream areas conducive for living. Having secure and safe spaces	Applying Technology to solving practical situation encountered daily at home work and while on transit
26	Wireless mobile charger	To test design wireless power transmission mobile c charger circuit using inducting coupling that can help to quickly and efficiently charge phone without help of wires	Technology for convenience and day to day living	Technology systems for making day to day life activities are carried out in a sustainable way and with ease. Technology for facilitation of technology access in a reliable way. Sustainability of technology systems and facilities
27	Online event planning management system	To come up with a system of event planning and management which can help ensure safety of customer records and easy accounting for payments	Technology for management of resources and promotion of accountability.	Technology systems for making day to day life activities are carried out in a sustainable way and with ease.
28	Fridge door alarm	To come up with a device (fridge door alarm) which can indicate the fridge need to be closed to avoid power lose and unnecessary food spoilage	Technology for making systems efficient band convenient. Making life easy and saving energy resources.	Technology for home appliances. Making systems comply with energy saving strategies.
29	Remote control lighting circuit	To design and fabricate a remote-control lighting circuit which enables lights to turn on and off when the remote button is pressed	Technology for making systems efficient and convenient. Making life easy and saving energy resources.	Technology in making life convenient and efficient

30	School results processing system	To develop an online result processing and grading system for Chebukaka girls' secondary school	Technology for education and training. Reporting results of assessment and evaluation	Technology in training. Bring science, engineering and technology to the teaching and learning space
31	Optical smoke detector	To develop a circuit which is economical and reliable used to detect smoke and activate fire alarm in buildings	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
32	Voltage probe with tone and led output	To design and fabricate a device that can help in solving problems such as injuries and shock that electrical engineers face in their field of work	Technology for safe working spaces. Improves work outputs and minuses losses due to compensation.	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
33	Ultrasonic path finder	To create a device that will the visually impaired to move around with easy helping them to place walls, doorways and obstacles sooner than they would if they were using and ordinary walking stick	Technology for inclusivity and total access to all. Technology for life systems	Technology for life systems towards access by all members of society. Technology for promotion of equity and access
34	Automatic infrared security alarm	To design an infrared security alarm circuit which is automatic, labour saving and effective compared to manually operated mechanisms	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
35	Solar tracker	To design a system that tracks the solar UV light for solar panel	Technology for efficient functioning of Technology appliances and systems	Technology for optimization of systems appliances and convenience. Making life less challenging and also sustainable use of resources and facilities
36	Cell phone detector	To design and fabricate cell phone detection systems and do financial evaluation of the systems	Technology for efficient functioning of Technology appliances and systems	Technology for optimization of systems appliances and convenience. Making life less challenging and also sustainable use of resources and facilities
37	Simple audio amplifier	To design an amplifier circuit that take an input signal and produce an output signal that is higher than the input	Technology for inclusivity and total access to all. Technology for life systems	Technology for life systems towards access by all members of society. Technology for promotion of equity and access
38	Driving school complex	To design an aesthetic comfortable structurally sound and functionally driving school complex in the University of Eldoret in effort to ensure production of adoptable graduates	Technology for facilitation of required skills- Driving skills	Technology for optimization of systems appliances and convenience. Making life less challenging and also sustainable use of resources and facilities
39	Male hostel construction	To design a structurally sound reasonably cheap aesthetic,	Technology for facilitation of required skills- Support	Technology for optimization of system and convenience.

		comfortable and functional male hostel in the University of Eldoret	systems – Accommodation of learners	Making life less challenging and also sustainable use of resources and facilities
40	Modern male hostel	To design an affordable, aesthetic, comfortable and functional facility that meets the needs of male students of all types (physically challenged inclusive)	Technology for facilitation of required skills- Support systems – Accommodation of learners	Technology for optimization of system and convenience. Making life less challenging and also sustainable use of resources and facilities
41	Construction of teacher's quarters	To design an aesthetic high quality affordable functional structurally sound staff quarters in the University of Eldoret secondary school	Technology for facilitation of required skills- Support systems – Accommodation of teachers	Technology for optimization of system and convenience. Making life less challenging and also sustainable use of resources and facilities
42	Tourism management offices and tuition blocks	To design tourism and management department offices and tuition block that meet the needs of the student population in the department	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
43	Technology education complex	To a technology complex that will equip learners with a co-friendly skill that are essential in the building industry	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
44	CEO's residence	To design a modern robust serviceable specious and attracting structure to serve as a habitable house for the University don	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
45	University publication auditorium	To establish a functional auditoria for hosting educational events and recreational activities done within the University of Eldoret	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
46	Guest house	To design and construct an affordable environmentally friendly guest house that can solve the crisis of insufficient guest house facilities in Busia town	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
47	Business centre	To come up with aesthetic affordable comfortable structurally sound functional business centre in the University of Eldoret which can help in to enhance trade, accommodation and access to essential services	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
48	Four-storey residential building	To design a structurally sound four-storey residential building in the University of Eldoret	Science, engineering and technology for safety and protection of investment.	Technology for safety and convenience. Making life less challenging and also

			Improving comfort and responsiveness of systems	sustainable use of resources and facilities
49	Female hostel construction	To design a unique, specious, accessible aesthetic accommodation facility for female students (including the physically challenged) in the University of Eldoret	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
50	Design of mortuary	To design a functional and user-friendly mortuary with required attachments which can help provide better mortuary services in Nairobi metropolis	Science, engineering and technology for safety and protection of investment. Cares of life and Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
51	Chepkoilel health centre	To ease congestion in the school dispensary by designing all -purpose health centre	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
52	Glass crushing machine	To design and fabricate simple effective and affordable glass crushing machine which can be used in glass industries to reduce production cost	Technology for industrial application aimed at making life artefacts in a sustainable manner	Technology for industrial processes - Manufacturing and disposal of waste products
53	Design of angle vice	To design and fabricate a simple tool for clumping works in engineering field	Technology for industrial application aimed at making life artefacts in a sustainable manner	Technology for industrial processes - Manufacturing of products
54	Hydraulic tyre changer	To design and fabricate a simpler tool that is cheap, easy to use and maintain which can be used to change vehicle tyres	Technology for improvement of services and transport facilities	Technology for making work easier and convenient.
55	Hydraulic coil spring compressor	To develop hydraulic coil compressor which can be used to squeeze all types of strut springs of modern vehicles such as BMW etc	Technology for improvement of services and transport facilities	Technology for making work easier and convenient.
56	Smoke sensor	To come up with a device which when installed in buildings can detect fire outbreak through sensing smoke and alert the occupancy of the room to vacate in good time	Technology for safety and sustainability of resources	Technology for enhancing safety at home and work place.
57	Illuminating sensing lighting system	To design and construct a lighting solution whose working is purely dependent on the ambient natural light	Technology for suitable utilisation of resources in a sustainable manner	Sustainable utilisation of available natural resources
58	Online hostel management system	To come up with a programme that can ease the process of controlling hostels and also enable easier	Science, engineering and technology for safety and protection of investment. Cares of life and	Technology for safety and convenience. Making life less challenging and also

		booking and allocation of students for hostels	Improving comfort and responsiveness of systems	sustainable use of resources and facilities
59	Microcontroller-based bidirectional people counter	To design a system that can count the number of people entering and exiting a premise	Science, engineering and technology for safety and protection of investment. Cares of life and Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
60	GSM controlled switching system	To design construct and test a GSM based appliance which can help in controlling the operations of electrical appliances	Science, engineering and technology for safety and protection of investment. Cares of life and Improving comfort and responsiveness of systems	Science, engineering and technology for safety and protection of investment. Cares of life and Improving comfort and responsiveness of systems
61	GSM based prepaid water meter	To come up with a smart water metre that can measure water consumption accurately, display real time account balance and cut off water when there is zero credit on the account	Science, engineering and technology for safety and protection of investment. Cares of life and Improving comfort and responsiveness of systems	Science, engineering and technology for safety and protection of investment. Cares of life and Improving comfort and responsiveness of systems
62	Chicken project management system	To come up with an effective chicken project management software that will be user-friendly and able to eradicate the problem of data redundancy in chicken production business	Science, engineering and technology for safety and protection of investment. Cares of life and Improving comfort and responsiveness of systems	Science, engineering and technology for safety and protection of investment. Cares of life and Improving comfort and responsiveness of systems
63	Construction of male hostel	To design and come up with a model of a structurally sound, robust, serviceable building to accommodate male students	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
64	Construction of men's hostel	To provide a specious affordable aesthetic structurally sound functional and easily maintainable facility that can accommodate male students of all kinds in the University of Eldoret	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
65	Social hall	To design a structurally sound, robust and serviceable building that will provide a platform for recreational activities	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
66	Mini-shopping mall	To design a comfortable accommodation for the shoppers	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
67	Pedal powered reciprocating water pump	To design and come up with a device that will enable all people to draw water for	Science, engineering and technology for the	Technology for improved life and better access to basic

		irrigating gardens and domestic production with ease	provision of basic human needs	needs. Provision of clean water
68	Automatic headlight dimmer	To come up with a device that dims the headlight automatically when automobile approach each other at night	Technology convenience and safely while on the road.	Technology in the day to day life activities. Safety of the user of technology appliances and others.
69	Automatic transmission fluid gear pump	To design and fabricate an ATF pump in effort to improve accuracy and quality of oil delivered as well as access of oil to the awkward position of transmission	Technology convenience and safely while on the road.	Technology in the day to day life activities. Safety of the user of technology appliances and others.
70	Foot-driven dough mixer machine	To fabricate a foot-driven dough mixer machine that is hygienic less involving economical and faster in dough mixing	Science, engineering and technology for the provision of basic human needs- Food	Technology for improved life and better access to basic needs- services in food production in easy ways.
71	Library indoor light control system	To design an intelligent that saves energy and maintains the light intensity in the library at the desired level	Technology for basic living systems and utilisation of resources	Technology for provision of controlled light in special places such as the library.
72	Automatic emergency power system	To design a home-made emergency power system which turns on when the main supply fails and off when the main supply is available	Technology for convenience and solving current challenges of unstable power supply.	Science and technology for provision of sustainable safe home and working spaces
73	Hotel management system	To come up a programme that ease delivery and ensure safety of the records of the clients in hotel setup for the purpose of stock taking and accounting	Science, engineering and technology for safety and protection of investment. Improving comfort and responsiveness of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
74	University website system	To design a website that can help to improve interactions between students and administration by developing a user interface	Technology for communication in international platforms	Technology for provision of information to clients and customers in internally acceptable and adaptable methods.
75	Digital classroom	To come with a digital classroom system that can help to enable learning in the contemporary world	Technology for application in the teaching and learning practices and situation.	Technology is not only for application in the world of work but also in the preparation for the world of work. Technology must find sustainable applicability in the teaching and learning space. Learning should also find dominance in the work space in the name of learning at work
76	Water level indicator	To come up with a most commercial and reliable water	Engineering and technology in the	Technology for optimal operation of appliances to manage resources. Life

		level controller using as less resources as possible	Technology in making control of appliances	requirements are availed according to plan.
77	Sober Kenya rehabilitation system	To design a website that can detect drug abuse and thus help in fighting drug abuse through online registration and reporting of drug abuse	Technology and science for health and better living	Technology for application in correctional and adjustment services
78	Online management and booking system	To come up with a software that can serve as an online management and booking system for Paradise Palace business	Technology and engineering for business systems.	Technology is not only for application in the world of work but also in the preparation for the world of work. Technology must find sustainable applicability in the teaching and learning space. Learning should also find dominance in the work space in the name of learning at work
79	Automatic street light control system	To design a street control system which is power saving and cost effective as compared to manually operated system	Engineering and technology in the control of appliances	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
80	Online spare parts shop	To create a programme that can automate the process of purchasing and payment of automobile spare parts	Technology and engineering for business systems.	Technology for business application in specific industry- spare parts.
81	SCR controlled battery charger	To come up with a device that can help to overcome the challenge of development of malfunction by batteries due to over charging	Technology and engineering for life appliances	Technology in the power industry. Charging of batteries for provision of power to systems and appliances in life
82	Hotel management system	To come up with a programme that can enable automated management of day-to-day activities of a hotel through on line booking and entry of data for services offered	Technology and engineering for business systems.	Technology in business controls, applications and monitoring. Service industry is quite elastic and is able to accommodate many practitioners
83	Cell phone detector	To design and fabricate cell phone detecting system that can help to combat cheating in exams using phone and usage of phones in unauthorised places	Science and Technology for increasing credibility in provision of education and training	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
84	Automated electric fence	To design and build an automated electric fence which have the shock and alarm system generated by a micro-controller	Science and technology for safety and security in homes and workplaces	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
85	Light security switch	To design and construct an affordable economical and	Science and technology for safety and security in homes and workplaces	Technology for safety and convenience. Making life less challenging and also

		relatively cheap light triggered switch		sustainable use of resources and facilities
86	Automatic room light control	To design a device that can be used in hostel rooms to monitor the number of persons entering and going out of the room	Science and technology for safety and security in homes and workplaces	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
87	Online food market	To come up with an online platform for selling and buying food staffs without delay and rejects	Science and technology for business processes	Food market technologies. Enabling access to needs and services accordingly
88	Automatic solar powered irrigation system	To design a simple automatic solar powered irrigation system that will provide efficiency in irrigation by sustainable use of water and energy in irrigation farming	Science and technology for sustainable food provision and production. Science for applications in agriculture	Technology in business controls, applications and monitoring. Science in food production
89	Timetabling management system	To develop a software that can help timetable makers to come up with a timetable faster easier and in a more effective and efficient manner	Science and technology for training facilitation through efficient planning and offering of training.	Technology of the organisation and management of training provision
90	Intruder alarm circuit	To design an intruder alarm circuit which is automatic, labour saving and cost effective compared to manually operated mechanism	Science and Technology in safety and security. Information management of systems	Technology for safety and convenience. Making life less challenging and also sustainable use of resources and facilities
91	Agricultural farm products and services marketing system	To develop a platform that can help in solving problems that most farmers face in the current agricultural market through enhancing use of internet as a marketing tool for farmers	Science and technology for sustainable food provision and production. Science for applications in agriculture. Technology in business.	Use of technology in matching needs and provisions of agricultural produce through internet marking platforms

4. Conclusion

Analysis of the ninety one (91) projects reveal ten major directions that innovations in Kenya should be guided towards.

- Security and safety at work and at home
- Work facilitation and simplification
- Technology and engineering in Agriculture
- Technology in business management and controls
- Technology for correctional services
- Technology for facilitation the differently abled members of the society
- Energy provision and convenience.
- Technology for facilitating education and training
- Technology for industrial manufacturing
- Technology and environmental sustainability.

Recommendation

Teaching through projects at the university of Eldoret should expose learners to real life situations so that the solutions they device from the projects are based on making life better and more productive. In addition, the pointers by the innovations proposed should guide the next phase of projects so that in the final end, tangible artifacts are generated that solve real life problems. Besides, the projects that have been attempted by the students should be taken through deeper analysis to establish the best and optimal solutions to the problem explained. Relatedly postgraduate students may take over some of the ideas being advanced in the with a view to advancing them so that crucial analysis and evaluation is achieved.

Compliance with ethical standards

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No conflict declared since this paper is written by a single author.

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