EDUCATIONAL TOOLS AND CURRICULUM DEVELOPMENT FOR THE ADVANCEMENT OF ENGINEERING EDUCATION IN AFRICA

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ABOUT AEEA

The main aims of the African Engineering Education Association (AEEA) are to:

- promote excellent quality education in various engineering disciplines in Africa .
- Provide a mutual support network of engineering educators, through the established African Regional Conference on Engineering Education (ARCEE).
- Encourage involvement of the Africans in diaspora to participate in the development of engineering education in Africa.
- Strengthen collaboration with other institutions with similar objectives.
- Improve teaching and learning in educational institutions, through workshops for engineering educators.
- Promote technological careers for women, so as to increase the proportion of women in the engineering workforce.

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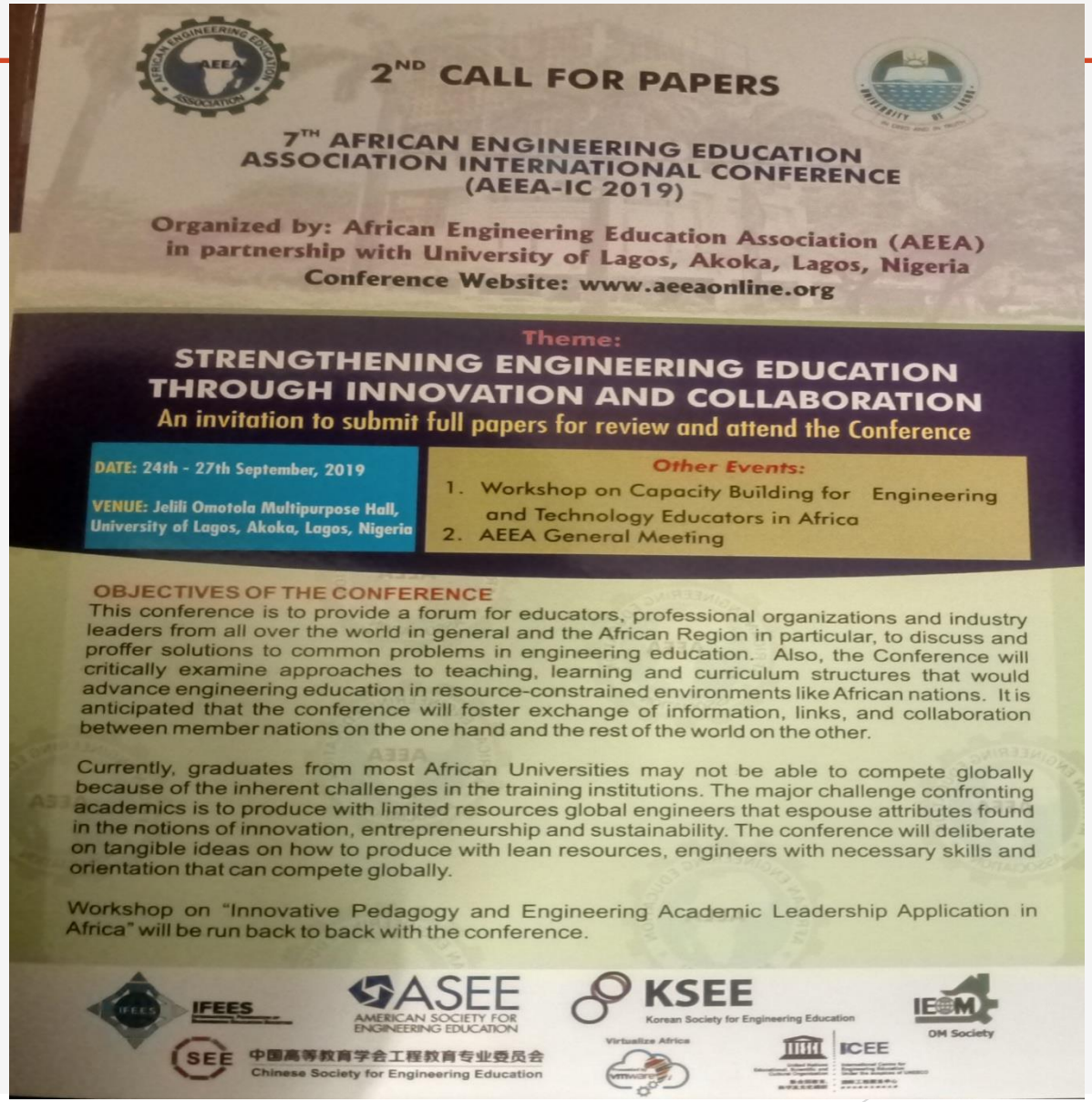

SUMMARY

- Educational tools are those instruments that are used for the pedagogical purposes to facilitate learning by students.
- These tools are either for teaching or learning.
- Teaching tools are used by teachers to deliver instruction materials to the learners while learning tools are something that a student uses to work through ideas or concepts or processes while demonstrating his/her thinking planning and/or decision making on ways to creating or responding to an art.

- In tertiary institutions there are two basic approaches to teaching and learnings: traditional and Innovative methods.

- The traditional method of teaching consists of teachers reading out while students sit submissively taking notes.
- The method is passive and does not focus on practical industry application.
- The innovative teaching methods are active and more impartful. Some of the active pedagogical methods are:

✓ Team-Based learning

✓ Problem-Based Learning

✓ Project-Based Learning

✓ Outcome-Based Learning

✓ Co-operative Learning

✓ Technological Enhanced Learning

- A teacher must identify the peculiarity of his class and select an educational tool that takes into cognizance the learning style of the majority of students in his/her class.

Active learning

- Active learning is about students doing meaningful learning activities and thinking about what they are doing during class session.
- It involves engaging students in the lecture rooms, in the laboratory, during design or project work.
- In active learning, teachers bring excitements into the classrooms and create a lively atmosphere to keep students on without necessarily allowing distraction into the classrooms.
- The need to use appropriate teaching method cannot be overemphasized.
- This need is succinctly captured in the study by Singhal et al. (1). Figure 1 shows that the most effective way to teach engineering courses is to practice by doing and teaching others.

- Students' learning styles have been categorized into (i) deep learning and (ii) surface learning.
- Deep learning refers to the in-depth understanding of information and theories taught (Atherton, 2).
- Deep learners take full notes in class, and afterwards go through them to check on uncertain information.
- They regularly work through given problem sheets to test if they could apply theories covered during lectures. Surface learners are mainly concerned with the ability to remember important facts and theories given during lectures.
- They only memorize to pass examinations and do not care about its application.

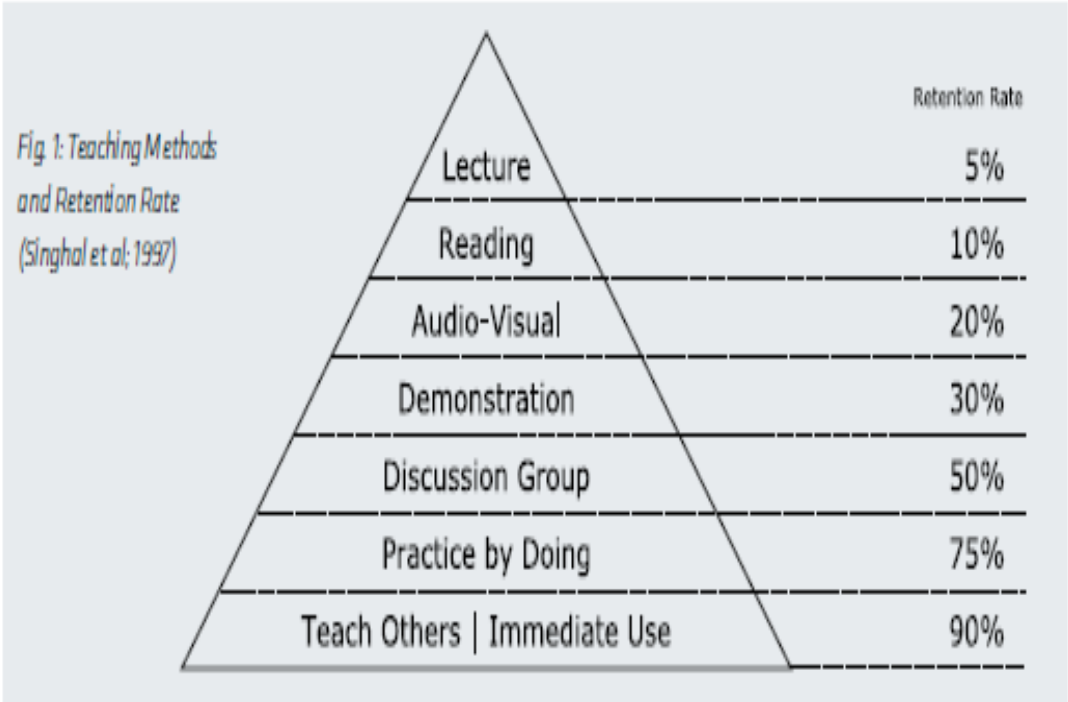

Fig. 1: Teaching Methods and Retention Rate (Singhal et al; 1997)

Curriculum development for the advancement of Engineering Education

- Generally engineering curricula are developed to solved societal problems in a sustainable way using engineering concepts and principles learnt in the university.
- The main features of the existing curricula are:

✓ common foundation years at 100 and 200 levels for all engineering disciplines

✓ workshop practice, laboratory work and tutorials

✓ design project with bias towards local applications

✓ broad-based engineering and interaction between students and professionals

✓ final year project in which the students work alone under supervision

✓ special skills and in-depth study in a particular area of the programme through optional courses or electives and

✓ knowledge in the area of engineering management, economics and law.

- In the curriculum the maximum stipulated duration of Industrial attachment is 40 weeks (National Universities Commission, 3) comprising the following modules:

  - ✓ students' work experience programme scheme I- 8 weeks (long vacation at the end of 200 level),
  - ✓ students' industrial work experience - 8 weeks (long vacation after 300 level)
  - ✓ students' industrial work experience scheme II – 24 weeks (2nd semester of 400 level plus long vacation).

- The curriculum of a subject with practical content is generally organized into an average of 67% for the theoretical classes and 33% for laboratory. Students also use the laboratory to develop case examples on their own time.

- The problems associated with the current curricula are:

- they are based on a foreign model which has evolved under ideal conditions (staff, equipment, infrastructure, training opportunities, etc) that are not easily duplicated in developing countries;
- there is usually a shortage of highly competent indigenous teaching and support staff with sufficiently wide practical experience of engineering;
- most of the available textbooks are often illustrated with examples from outside the local environment and which are irrelevant to the particular country;
- the curricula are adjoined to be too academic and overloaded with intellectual content in pure science and mathematics at the expense of basic engineering and technology
- inadequate provision for humanities, social sciences, business management concepts and entrepreneurship skills development.

New curriculum for engineering programmes

- The current curricula do not teach graduates to be self-employed. Because the infrastructures are run down, the informal sector is also down-trodden thus making the environment difficult for any start-up small businesses by graduates who, though were not trained in the trade, are naturally gifted.
- Therefore, there is need to develop new curriculum for engineering education programmes.
- The new engineering curricula should be outcome-based and have innovation and entrepreneurship skills acquisition embedded in them.
- The new breed engineer or engineer entrepreneur will possess an adequate knowledge of core engineering and demonstrable technical competence.
- The engineer-entrepreneur would have acquired appropriate intellectual foundation resulting from the development of personal attributes or skills.
- The engineer-entrepreneur would be motivated to apply engineering knowledge and technical skills in the context of local environment, leading to the creation of culture relevant and people oriented technologies.

- The fulcrum of the strategy is the collaboration between academia, industry (seasoned practitioner entrepreneurship and financial institution) and government and Non-governmental organisations (NGOs).
- The students will be given orientation to generate venture ideas with ability to write good proposals to enable them benefit from small and medium industries equity investment schemes (SMIEIS) as a source of venture capital to start small scale projects.
- The small and medium scale businesses are reputed for tackling unemployment situations in advanced countries.
- The development of new engineering curricula may not necessarily translate to the production of ready-made graduates for the industry which will result in rapid industrialisation or growth in the economy of the continent except solutions are proffered to some constraints that may militate against good delivery of engineering curricula by the facilitator and promote quality learning by the students.

Constraints to quality engineering education

- Some of the constraints that could affect the implementation of quality engineering curricula are:

- ✓ Poor Funding
- ✓ Inadequate Facilities
- ✓ Lack of Capacity Building Programme
- ✓ Weak University-Industry Partnership
- ✓ Lack of political will by the government

Prospects

- Despite all the constraints listed above, there are indications that the low human capacity development will be improved considering the following positive steps being taken by the stakeholders:

- ✓ Pedagogy – Innovation
- ✓ Funding – Identification of other sources of funding
- ✓ Facilities – Qualitative and quantitative improvement
- ✓ Establishment of Technological Entrepreneurship and Innovation Centres
- ✓ Promotion of Linkage between Universities, Research Institutes and Technology Incubation Centres.
- ✓ Reform in the Industrial Sector
- ✓ Reform in Government Policy
- ✓ University/Industry Government Roundtable
- ✓ Information and Communication Technology

Conclusions

- From the foregoing the following conclusions are made:
- ✓ The current educational tool (traditional pedagogy) in the universities is passive and ineffective way of imparting knowledge.
- ✓ There is need to change from the passive to active mode of pedagogy.
- ✓ The development of engineering curricula should be in consultation with the stakeholders, namely, Members of academic community, industry leaders (Users), Professional bodies (Regulators) Employers' Association, Major Employers associated with specific programme to make the effort a worthwhile exercise.
- ✓ The restructuring of curriculum cannot be considered in isolation without considering those factors that will ensure positive outcomes.
- ✓ Both university and industry have problems that hinder their abilities to meet up with challenges posed by the requirements for development.
- ✓ Reform is required in both sectors (university and industry) to make them work together with a view to formulating appropriate strategies for national development. Effective collaboration between the duo will translate to quality training of engineering graduates and they will be better prepared for the future challenges.
- ✓ The relationship between university and industry could only be sustained if government creates an enabling environment.

Thank you