Learning Outcomes of African Engineering Students in a Chinese Context: A Qualitative Study

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Abstract:
China's 'One Belt, One Road' national strategy has brought about both opportunities and challenges to its higher education system and that of neighbouring countries. Increased internationalisation of higher education has resulted in Chinese universities attracting a large number of international students, including those from Africa. However, few studies have been conducted to assess the learning outcomes of African students in a Chinese context. This article provides insight into African engineering students' self-reported learning outcomes and experiences after studying in China. The findings reveal that academic and cultural knowledge, cross-cultural communication skills, teamwork skills and changes in personalities and professional vision are common areas of development. The article concludes with recommendations for the design of effective learning experiences.

Key words: Internationalisation, African students, Learning outcomes, KSA (Knowledge, Skill and Attitude), Chinese higher education

La stratégie nationale chinoise "une ceinture, une route" a généré des opportunités et des défis pour son système d'enseignement supérieur et celui des pays voisins. Avec l'internationalisation croissante de l'enseignement supérieur, les universités chinoises attirent un grand nombre d'étudiants internationaux, y compris des étudiants en provenance d'Afrique. Cepen-

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dant, peu d'études ont tenté d'évaluer les acquis de l'apprentissage des étudiants africains dans le contexte chinois. Cet article offre un aperçu des acquis autodéclarés des étudiants ingénieurs africains et de leur expérience des études en Chine. Les résultats de ce projet exposent plusieurs domaines communs de développement : les connaissances académiques et culturelles, les compétences de communication interculturelle, la capacité à travailler en équipe et des changements de visions professionnelle et académique. Cet article conclut par des recommandations visant à créer des expériences d'apprentissage efficaces.

Introduction

Africa, particularly sub-Saharan Africa, has experienced robust economic growth against the backdrop of global recovery and has attracted substantial foreign investment. However, the World Bank (2013) forecast deceleration in growth and the economic outlook is subject to many risks. Internal factors include the acute shortage of domestic human capital, especially in the areas of engineering and technology, reflected in imported foreign skilled labour. External factors relate to the global economy and monetary policies. For African countries to keep up to economic growth speed, it is essential to focus on human capital development, particularly in Science, Technology, Engineering and Mathematics (STEM).

Infrastructure development is a key driver of the African development agenda and a critical enabler of sustainable economic growth and the achievement of the Sustainable Development Goals (SDGs). To this end, it is of great importance to address the infrastructure gap in order to facilitate industrial development and integrate sub-Saharan African countries into global value chains. On January 27, 2015, China and the African Union (AU) signed an MOU on infrastructure cooperation which included modern highways, airports, and high speed railways (Xinhuanet). It not only seeks to accelerate regional integration but also to benefit African youth through further education and job opportunities.

In terms of cooperation between China and African nations, in his "Ten Key Cooperative Plans" proposed in December 2015, President Xi emphasised the Sino-African Industrialization Cooperative Plan (Xinhuanet). In terms of the Plan, 40,000 vacancies will be provided for Africans to receive industrial and technological training in China. Educational centres and capacity building institutes will be launched to educate 200,000 African technical professionals.

With enhanced cooperation between China and African nations, more African students have decided to study in China due to its high-quality education and opportunities for educational support via scholarships. Over the past decade or so, the number of African students in China has increased

thirty fold, from 1,384 (1999) to 41,677 (2014) (CAFSA, 2014). The introduction of the 'One Belt, One Road' policy is expected to further enhance exchange in higher education (Qu, 2015).

However, few studies have been conducted to assess the learning outcomes of African engineering students in a Chinese context. This article explores the learning outcomes of African engineering students in China through the Knowledge, Skill and Attitude (KSA) framework.

Literature Review

The literature on engineering students' learning outcomes has addressed the development of tools and strategies to evaluate the influence and quality of global engineering programmes (McNeill, 2010; Arzberger et al.; 2010, Jesiek et al., 2014). Based on a series of surveys, Jesiek and his colleagues (2012) designed global competency scenarios to assess engineering students' responses to different real-world cultural contexts. McNeill (2010) investigated the learning outcomes among engineering undergraduates in three study-abroad programmes in which students from US institutions participated in engineering projects in China and African countries. He found that students acquired varied learning outcomes through these experiences, including professional knowledge, intercultural skills and so on.

Some studies have focused on international students' learning experiences and outcomes in a Chinese context. Zhu et al. (2015) examined the major characteristics of international summer programmes in Mainland China and provided an overall assessment of the learning experiences and outcomes of international participants in these programmes. They found that apart from gaining professional knowledge, international students improved their communication skills, enhanced their teamwork spirit and changed their academic or career interests. However, there are few studies on African students' learning experiences and outcomes in a Chinese context.

In this study, the authors evaluated the learning outcomes of African students in China by applying Bloom's Taxonomy (1956). In Bloom's original taxonomy, the cognitive, affective, and psychomotor domains were defined separately to capture different learning objectives. The taxonomy has been widely adopted and refined by researchers, administrators and multiple stakeholders (Nichols and Nichols, 2000; Anderson and Krathwohl, 2001).

Many researchers have also applied this model to assess the outcomes of students' international learning experiences (McNeill, 2010; Altaf, Doerry, Shuman, and Collins, 2014). McNeill (2010) used it to assess the learning outcomes of engineering students. His findings show that participants acquired different kinds of knowledge and skills through the programmes,

such as technical knowledge, intercultural knowledge related to the host country, interpersonal skills, etc. He also described some attitudinal changes. For example, some students reported being more confident, flexible, and open-minded.

To apply the framework in this study, detailed definitions and sample learning outcomes were provided as follows:

Knowledge: Defined as factual knowledge, understanding, opinion or information. e.g., Technical knowledge; Intercultural knowledge;

Skills: Defined as abilities or skills to apply, analyse, summarise, evaluate or communicate information. e.g., Presentation skills; Ability to work with diverse team members;

Attitudes: Defined as values, interest, emotions, dispositions, characters or attributes. e.g., Open-mindedness; Social awareness.

Using this conceptual framework, the researchers asked the question "What are the knowledge/skills/attitudes acquired by the African students through their experiences of studying at University H, China?"

Context of the Study

This study was conducted at one of the National '985' Project universities in China – University H. With a focus on educational innovation, University H has adopted several initiatives to improve students' global competitiveness. These include dual degree programmes, research collaboration with overseas partner universities and so on. As a result, the University has attracted a large number of international students, with the proportion of African students increasing in recent years.

Methods

Qualitative interviews were conducted with participating students to explore their learning experiences and learning outcomes, as well as challenges relating to effective learning experiences. In order to assess the learning outcomes, an interview protocol consisting of 10 questions, was developed based on the KSA (Knowledge, Skills and Ability) framework (Altaf, Doerry, Shuman, and Collins, 2014; McNeill, 2010). Twelve African students majoring in five engineering disciplines (Mechanical Engineering, Software Engineering, Electrical Engineering, Communication and Information Engineering, and Power Engineering and Engineering Thermophysics) were recruited to participate in one-on-one semi-structured interviews. Each interview lasted from 40 minutes to an hour.

After the interviews, the transcripts were analysed. Three *a priori* codes, 'knowledge', 'skills', and 'attitudes' were designed as the first level codes. Within each first level code, open-coding was used to identify students' specific learning outcomes in these three categories. Phenomenology was

selected to understand the participants' educational outcomes and learning experiences. A phenomenological methodological approach focuses on understanding the essence of shared experiences and meaning of a phenomenon, such as a job, marriage, or programme (Patton, 2002).

Results

Learning Outcomes for African Students

The results from the qualitative data analysis revealed African students' learning outcomes in the three dimensions of knowledge, skills and attitudes. Within each dimension, direct quotes related to major themes are provided to elaborate on the influence of the experience of studying in China on the African students.

Knowledge

Academic Knowledge

The study participants reported that their learning experiences at University H had helped them gain more academic knowledge and conduct cross-disciplinary research. One stated:

> I have gained significant knowledge here, both direct and indirect knowledge. So from the perspectives of engineering, I have gained significant amount of knowledge after coming here....because I have been exposed to different fields and areas which I am not so familiar with before. So it has been a rich knowledge.

Some students reported that they were exposed to new research fields and acquired new academic knowledge after studying in China. Bob from the Mechanical Engineering programme said,

> Because during my study, I learned, studied some courses which are not available in my previous university study. So I could learn something from the program at University H, and it's important for me, I think.

Other students pointed out that they not only gained academic knowledge but also learnt its "real-life application". John from the Power Engineering and Engineering Thermophysics programme shared his experiences as follows,

> Professionally I can say that I have studied and I have learned a lot of things, especially when it comes to do with the real application of knowledge or information. The application of these principles, for example, I have been able to study software so that I can be able to use [it] to translate information from books into actual work.

However, a few students indicated that although they gained a great deal of academic knowledge, they lacked industry or practical experience. John said:

> During my study, I believe that I've gained more knowledge, more knowledge on what I am supposed to do.... but I think I didn't get much practical experience like I expected, maybe I expected to have more interactions with the industry or to go for internship, but that did not happen.

Cultural Knowledge

In addition to academic knowledge, most participants reported that they learned more about China and Chinese people during their studies at University H. Many were first-time visitors and reported learning Chinese. Bob stated:

> I think the first significant experience is without doubt the learning of Chinese. I think this experience is the most significant experience up until now, because in my country, Chinese is small language. It is not popular, compared with other international languages like English, French, and Spanish. So when I came here, I wondered about this language, the character and the culture of China.

Asked about the most helpful experiences in China, a student recounted his experience of studying Chinese as part of his Masters' programme.

> Because before I came to China, I did not imagine that I could study a foreign language like that, and when I came to China and study Chinese is also a must, a compulsory for me, and though it was very difficult, but I have to work hard, study hard, make sure that I can better command my major.

Thus, while learning Chinese was a big challenge to most students, they gained deeper understanding about Chinese culture and Chinese people through learning the language. Many showed increased knowledge of China, Chinese culture, and Chinese customs in general, especially in terms of Chinese history and food. One student noted:

> What I have seen are the (Chinese) cultures and customs. In this afternoon, we have ... classes about the Chinese culture. You know, the difference[s] of Chinese culture, about what was like in the past of China, and today, what the modern China is like...That's kind of history and then you know the Chinese food.

Some students also reported that they began to understand certain behaviours of Chinese people after living and studying in China for some time. One said,

> From my observation, the Chinese are sort of reserved. I think they are socially-reserved, unlike us we are so open-minded. I think these are some of the examples and some of the differences that I try to get to know.

Furthermore, some students appreciated the way the Chinese approach

people. For example, Luke from the Communication and Information Engineering programme said,

> I have been aware that the Chinese took a lot of care, not to offend people. They just accommodate you as you are, and I have found that to be very helpful. There is no rudeness in the Chinese people, even if someone has something they will not say it in a way that hurts you. And I found that to be helpful. That's part of the Chinese culture. The Keqi [courteous] aspect.

Thus, these students enhanced their understanding and appreciation of Chinese culture through daily communication with locals. They also learnt about diverse cultures by meeting peers from all over the world. Dave from the Power Engineering and Engineering Thermophysics programme said,

> ... it's a very diverse community. People from Pakistan, the way you relate to them is very different from people from Iran, people from Belgium, people from Congo, people from different communities. So that gives you attitude of being able to live with people with different backgrounds peacefully.

It appears that the students learnt to understand different cultures and developed cross-cultural communication skills while being immersed in an entirely new culture. In similar vein, Luke shared his experience of being involved in student organisations:

> One thing I like in this international university is that you meet people from all over the world. You get to hear first time the stories, especially the city like Shanghai, very cosmopolitan. You meet with people from everywhere, literally everywhere the world, Americans, Spanish, Italian, French, Japanese, Korean, and Australian.

Most participants reported that their experience of studying at University H was worth the cost, particularly in terms of broadening their cultural perspective and enriching their cultural knowledge. They noted that they became more aware of cultural differences and sensitivity, especially the difference between Chinese culture and African culture. One of the students reported,

> Another difference is between the cultures. For example, here in China you make friend with someone in less than a few minutes, and after that he could ask you something personally, for example, do you have a wife or do you have a child, some question like this. But in our country, we don't usually ask these questions, we consider it personal.

Skills
Cross-cultural Communication Skills
Many students talked about their experiences of meeting people from other cultures during their studies in China. Some reflected on their manner

of dealing with interpersonal relationships. John from Power Engineering and Engineering Thermophysics shared his experience:

> Well, the most helpful experience I can say while I am in University H is, first of all, the international exposure that I have been able to interact with people across the world. So at the moment I don't consider myself somebody with a lot of aspects, I can say that I have talked to people from different countries from different continents, interact with them. I have the opportunity to see to them in class, discuss with them about the assignment, so I can know how different people from different backgrounds communicate with one another.

Others reported that the experience added a significant cultural dimension. Tim from Mechanical Engineering said,

> Last semester I had a Brazilian roommate and this year I had a Pakistan roommate. So basically you know have multi-cultural experience not just the Chinese culture but even other culture around the world, so this significant experience brings me a cultural dimension to know how to interact with different people.

Research Skills

Moreover, many students reported that the experience of studying at University H had a positive impact on their research skills. A participant said:

> …I am able to give presentation. I don't think I am able to do such things before. I am now able to write different reports on seminars. I can exchange and talk with different professors and doctors. Maybe in the future I will be able to write papers or reports at high level, which might make me to get my PhD degree and go further.

Presentation Skills

More specifically, most of the students believed that they had improved their presentation skills through various research activities, some of which were required by supervisors. Tim from Mechanical Engineering talked about the challenge of doing a presentation to his classmates:

> Like giving presentation, it was a challenge; I didn't give any presentation before I came here. After I came here, I gave some presentations. Also I am able to join some research work in my lab and I am also going to attend a conference. It's good.

It seems that Tim strengthened his research capabilities after overcoming the challenge of giving presentations in front of his peers. Similarly, many students expressed positive perceptions of their presentation skills and the importance of face-to-face communication. For example, Mark from the Electrical Engineering programme said,

> I have developed abilities to present, to deliver a presentation. Because

in my country all the presentations you make are with your supervisor. And there was no face-to-face communication (in my previous study), so I learned a lot about how to communicate with others face-to-face, because here we need to do a presentation in a group discussion [setting] or lecture, this is a good thing.

Teamwork Skills

Most students contended that they enhanced their team spirit through both in-class and out-of-class team building activities in their programmes. Some talked about how they worked as a team when conducting group activities. One shared his experience of developing teamwork skills:

I remembered one thing I got here or improved here is team-working. Because I practiced every week sports with Chinese students so I learned how to work in a group. Besides, during our research, we work in groups, so we have small groups and we should work together. We share duties and experiment so to succeed in your research.

Others learnt more about the essence and impact of team spirit:

I have learnt how to work as a team. This has actually gives me the understanding that one person can go far, but a team can go really far. If the team is not united, you cannot go anywhere. So just like I have said, the house that is divided cannot stand, if the people within a team are not united, they cannot. It's something I have learned, it added to my knowledge to work as a team.

Attitudes
Personalities

In addition to acquiring new knowledge and skills, many students reported changes in their personalities. For example, Bob from Mechanical Engineering said,

As I have said, I was a shy man. When I was in my home country, I almost worked individually. I completed my duty by myself, not asking others for help. But here I think I could change this attitude, and from time to time, I could ask the Chinese students and teachers for help to solve problems and complete what I want to do. I think this is the value that have been changed.

Another student, Shane from Software Engineering, shared his observations on the influences of diverse cultures on his personality:

So it's an experience of meeting people from all those countries and learning about their cultures, their lives and also it's like the change in my personality. I think it has made me more open-minded, more willing for the life, for the work, for the experience.

It seems that intensive exposure to different cultures broadened Shane's

cultural horizons, and therefore encouraged him to be open to new cultures. He continued to talk about the impact of the overseas learning experience on his personality:

> It's just like be away from your country, your family, your loved ones and suddenly you be in China alone.... so this personally made me strong, made me more acceptable and made me feel more open to challenges and wanted to achieve the goals I am here for.

The experience of living and studying in China made Shane stronger and more open to new challenges. Similarly, John from the Software Engineering programme reported that he learnt to be wiser and more forbearing as a result of being far from family and friends:

> You are far away from your family and you cannot meet with people [in home country] [so often]. By having this experience, I accept these parts, I accept this life and changes to my personality. It made me wiser, more, you know, it has changed a lot in my personality. It made the person who I am today. I am much wiser, much more forgiving, much more accepting [to challenges].

Academic or Professional Vision and Perspectives

Several students believed that the learning experience of studying at University H influenced their academic or professional vision. Asked about the impact of the learning experience, Dave from Power Engineering and Engineering Thermophysics programme answered:

> It's changing my interest in research. Initially, I thought that research was like doing experiment in the lab. But after I have some contact with people, I realized that it's not all about the lab. You need to first have very solid understanding, its physical meaning of what you are doing, and you need to understand the syntax of the software you are using, and you need to apply in such a way that not exactly in the industry base, it has changed my way of thinking.

Some students also reported changes in their professional vision. For example, Shane contended that the experience had profoundly changed his professional goals, and that he hoped to make a positive contribution to his home country:

> Maybe before I was just thinking about how to work and get a real career and get a good money, but now I don't think like this, I really think of working or getting a good career but also think when I go back to my country, I will try to do my best for my country, I try to work to change things, to develop the country to do my efforts, my ability, my skills, the things that I've learned here, the things I saw here and the things I observed here in China, maybe I can try or apply or at least try to make difference in my home country when I go back, there is an

influence on me, I have never seen such a development before coming to China.

Furthermore, a few students developed new professional interests during their studies at University H. Luke from the Communication and Information Engineering programme discussed his newly developed career interests:

I have developed an interest in the international relations and I hope I will get a role in the future to function between China and my country and just help accelerate the exchange, so I have developed an interest in international relations, I don't know what form to take, but I would be happy if I could play a role towards being a bridge between industry in China and my country, whether it is businessman, a government official or as an individual.

Work Ethics

Most students reported that they had to be industrious to catch up with their Chinese counterparts. For instance, Bob from the Mechanical Engineering programme said:

The first skill I learned here is to work hard, because the competition here in University H is fierce, but this is very important, so there is no time to be wasted, I could adapt myself to work more hours and to be more industrious you know.

Indeed, some students believed that the more advanced education system made them work hard to adapt to the new learning environment. One reported:

Actually I am studying hard these days and in my country I don't study in such a level. I keep studying on most of the day, maybe sometimes at night; I have to look at something early in order to finish the job given by my supervisor.

In summary, the themes from the qualitative analysis revealed several interesting findings about the African students' learning outcomes at University H, China. Since most students were first-time travelers to China, their self-reported learning outcomes in all three dimensions demonstrated that they were quite overwhelmed by cultural differences. The results indicated that students acquired cultural knowledge and cross-cultural communication skills and changed their perceptions of Chinese culture and Chinese people. These are consistent with the findings of other researchers (McNeil, 2010).

Furthermore, several students reported changes in their academic and professional vision. This suggests that the comprehensive programme curriculum combined with an interactive learning environment facilitated their self-development. In addition, some students worked harder and were more open to new cultures through the experience of studying at University H.

Discussion

The analysis of students' self-reported data shows that these students not only gained academic knowledge but also improved their cultural knowledge through the experience of studying in a Chinese context. Cross-cultural communication skills and research skills were the most common skills developed. Presentation and teamwork skills also improved. Furthermore, the students' experiences appear to have resulted in some changes in their personalities. They self-reported that they were more industrious in their work and were more open to new cultures. Changes were also reported in students' academic and professional vision and perspectives.

Intensive course programmes as well as wide exposure to Chinese culture were key factors in the above learning outcomes. Indeed, many students described their main daily activities as course work, meeting with supervisors and exploring the city/China, which helped them acquire academic and cultural knowledge. However, little was observed in terms of students' acquisition of industrial knowledge. A few mentioned the lack of practical or industrial experience as a shortcoming of the programmes. This is thus an area for future improvement in the Chinese engineering education context.

The findings suggest that students also enhanced their cross-cultural communication skills. This could be associated with the international learning experience in which students gain exposure to people from all over the world. Given the opportunity of living and studying with peers from different continents, students understood diverse cultures and were capable of communicating with people from different cultural backgrounds. This finding is similar to that of Jesiek et al. (2012), who found that students involving in immersive research abroad programmes enhanced their cross-cultural competence.

Presentation and teamwork skills were reported to be the second most popular skills acquired by students. One reason is the amount of group work practice in the course content. Most students reported that they were involved in a variety of academic activities, including lectures, seminars, group work and individual presentations, etc. On the one hand, they developed research skills by working on individual and group assignments. For some, group work and presenting in front of classmates and professors was a new experience. As a result, they became more confident once they learnt how to work in a team and present research findings in public.

As the preceding findings suggest, for most students, it was their first time to leave their home country to study in China. Many reported changes in personalities. This could be the result of their deep, cultural immersion experience, which could impact some of their characteristics, such as being better able to rise to challenges and to transcend their comfort

zone and be open to unexpected challenges. Furthermore, most students stated that they became more open to new cultures as a result of the international learning environment.

Compared to previous studies, our findings provide themes that are consistent with existent reports on engineering students' learning outcomes in study abroad or international learning programmes. For example, McNeill's (2010) investigation of the learning outcomes of engineering undergraduates in three study abroad programmes found that, apart from acquiring intercultural skills, students underwent attitudinal or value changes upon completion of programmes. Zhu et al.'s study of international students' learning experience and learning outcomes in China through summer programmes revealed that some students' professional goals and interests changed (Zhu, 2015).

Based on the lessons learnt from our analysis and possible challenges, we present several recommendations that are relevant for those involved in developing and/or administering engineering programmes in a Chinese context and for the multiple stakeholders involved in improving African students' learning experiences in a Chinese context:

- Design and incorporate industrial training sessions and create internship opportunities to ensure that students gain 'real-life' work experience;
- Engage students in multiple forms of group projects or group assignments to develop team spirit;
- Develop a diverse learning community which involves students with different cultures/nationalities/backgrounds;
- Invite and engage seasoned working professionals from corporations or non-governmental organisations in lectures and/or extracurricular activities;
- Provide African students with more career support, not only in terms of online services such as job search engines, but support from professional career supervisors to guide their professional development during their degree studies and on completion of programmes.

Conclusion

In response to the 'One Belt, One Road' national strategy, many Chinese higher education institutions are internationalising their courses and curricula to attract international students, including those from Africa. While this often requires significant investment of time, money, and energy, it is unclear whether the learning outcomes of international students live up to the strategy's goals and objectives. Of particular note is the lack of assessment of learning experiences and outcomes of African engineering students in a Chinese context.

Our qualitative analysis of the learning outcomes of African engineering students at one of the leading universities in China revealed that had rich learning experiences and demonstrated learning outcomes in academic and cultural knowledge, 'life-application' of knowledge, cross-cultural communication skills, research skills, personality change and changes in academic and professional vision, etc. These findings contribute to the growing body of literature on assessment of students' learning outcomes and learning experiences within overseas programmes. Finally, while the study was mainly concerned with the engineering discipline, it results could apply to other academic fields.

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