

Science Teachers' Integrative Practices in Teaching, Research, and Community Services: The Case of Three Universities in Ethiopia

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Abstract

This study examined university science teachers' integrative practices in teaching, research and community service at Bahir Dar, Dire-Dawa and Wolkitie universities. The data were obtained through questionnaires and interviews from randomly selected teachers. Interview data was also secured from purposively selected managers and teachers. The one sample t-test revealed that, except in their teaching practices, science teachers performed poorly in their research, community service and integrative practices among the missions (teaching, research and community service) of the university. The multiple regression analysis showed that the multiple contributions of teaching, research and community service practices towards these integrative practices was 44.12%, in which research took the major share (34.56%). The questionnaire data showed that institution-related factors (e.g., rigid financial rules) posed serious challenges in practicing research and community services. The interview data did not minimize the challenges related to personal factors (e.g., interest and motivation). This article shows that the university management are committed to providing practical encouragement to science teachers for research and community service. These are important for promoting better teaching delivery and integrative practices within the missions. Instead of attributing most of the challenges to institutional factors, science teachers should acknowledge their own personal problems and work to cope with the available external/institutional challenges. This will enhance the integrative practices among the missions which build the capacity for an effective science academic unit.

Keywords: Teaching, research, community service, integrative practices, challenges.

Интеграционные практики преподавателей естественных наук в области образования, исследований и общественной работы: Кейс трех университетов Эфиопии

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Аннотация

В статье рассматриваются интеграционные практики преподавателей естественных наук в области образования, исследований и общественной деятельности в университетах Бахир-Дар, Дыре-Дауа и Уолкайт. Исследование проводилось посредством анкетирования и ин-

тервью, участниками которых были учителя и менеджеры, составившие целевую выборку. Т-тест для одной из выборок показал, что, за исключением образовательной деятельности, преподаватели естественных наук демонстрировали низкие результаты в исследовательской деятельности, общественной работе и интеграционных практиках. Множественный регрессионный анализ показал, что вклад преподавания, исследований и общественной работы в интеграционные практики составил 44,12%, причем исследования составили основную долю (34,56%). Анкетирование выявило институциональные факторы (в частности, жесткие финансовые условия), препятствующие проведению исследований и выполнению общественной нагрузки. В ходе интервью выявлены личные проблемы, например отсутствие интереса и слабая мотивация. Определено, что руководство университетов оказывает поддержку педагогам в проведении исследований и общественной работы, что содействует повышению качества преподавания и интеграционным практикам в рамках миссии педагога. Преподавателям естественных наук рекомендовано не ссылаться на институциональные факторы, а постараться справиться с внешними проблемами. Это приведет к улучшению интеграционных практик и создаст условия для более эффективной работы академического подразделения.

Ключевые слова: преподавание, исследовательская деятельность, общественная работа, интеграционные практики, проблемы.

Introduction

Ethiopia is located on the horn of Africa with a population of over 110 million. The nation contains nearly 80 tribes and nationalities in which 85% of the economy is dependent to agriculture. In the last 25 years, Ethiopia has seen a significant expansion in universities, from two universities in 1998, to 50 public universities and many private higher institutions. All higher education policy and related documents, show that the nation accepts teaching, research and community service as principal missions of the universities (Almayehu & Solomon, 2017) although there are challenges and limitations to finding an acceptable balance between these missions and their integrative practices. This study, examined the practices of each of the missions and their integrative practices in respect of university science teachers.

The main intent of establishing a university is to support the social, technological and environmental development of society in general and the university community in particular, through the knowledge and skill created, adapted and multiplied within the community. The mere simple accumulation of knowledge at the university by itself may not provide sufficient value for those who pay a lot for its foundation and acceleration (Martin & Etzkowitz, 2000; Sanyal & Varghese, 2006). Therefore, teaching, research and community services, addressing the in-campus and out-campus demands, are seen as inseparable missions of universities across the world (Buture, 2008; Brasov, 2007). To this end, universities around the world have undergone reforms which are intended to advance faculty members by encouraging them, not only to engage in teaching, research and community service but also to look the interactive practices and effects of these three missions by using the processes and products of one as an input for the other (University of Virginia, 2007; Herbert & John, 2002) although the reality is not encouraging (Ogada, 2013; Jenkins, 2007).

University teachers, therefore, are expected to act as teachers, researchers, and community service providers in a way that one role should support for the success of the other (Mahapoon, 2019; Hassna & Raza, 2014; European Commission, 2007). This assumption is important not only for supporting society at large but also for enhancing the quantity and quality of the entire businesses of the university (Brasov, 2007; Mamdouh, 2007; Jenkins, 2007) since learning in the formal academic institution (e.g., the university) is an extension of the experiences of the surrounding social and physical environments (Feldman, 1988; Herbert & John, 2002). This is realized via research and community service which can expose teachers and students to the world outside their university campus (Taylor & Richardson, 2001) so as to give them capacity to integrate

it to their classroom teaching learning practices. Hence, investigating the status of these three aspects (teaching, research and community service) and their integration (Mahapoon, 2019; Kruss et al., 2009; Glenda, 2010) is important for enhancing the overall development of society and the university as well.

With this hypothesis, the study examined the status of science college/faculty teachers' practice in teaching, research, community service and their implication for integrative practices between them. Bahir Dar, Deredewa and Wolkite Universities were taken as first, second and third generation universities respectively. Since the availability and quality of teachers and other resources increase over time, this study selected Bahir Dar, with more than 40 years' experience, Dire-Dawa, with over than 15 years' experience and Wolkite, with less than 10 years' experience. This helps to show relatively the scenario of research, teaching, community service and their integration across generations of Ethiopian universities. In addition, these three sample universities were deliberately taken from different corners of the nation so as to incorporate data from different locations.

The study also tried to identify the possible challenges faced by Science College teachers involved in teaching, research, community service and integrating practices among them. The challenges might be personal, resource and administration (Alemayehu & Solomon, 2017; Hazelkorn, 2005; Hassna & Raza, 2014). For example, Amara (2005) mentioned that, since research is demanding of time and budget, it requires personal interest and motivation, and university teachers were not involved in doing research to the expected level. Other researchers including Jenkins (2007) & Ogada (2013) noted that there are staff/student, administrative and resource related-challenges for realizing and integrating teaching, research, and community service. As a result, identifying the possible challenges in doing and integrating teaching, research, community service in our universities and suggesting alternatives seems valuable and timely agenda.

This study chose university science academic units for its setting for two reasons:

1. Ethiopia gives focuses attention on graduates in science and technology (Federal Democratic Republic of Ethiopia, FDRE, 2012) so as to satisfy the demands of experts in this area which is assumed as key for the overall development of the nation (Ethiopian Science and Technology Agency, ESTA, 2006; Hewan, 2015).

2. Scientific investigations that work mainly on the natural environment is important to maintain the leading role of human beings over other creatures. Science can adjust some mechanisms before the non-human environment becomes uncontrollable and devastating (Russell and Martin, 2007; Lawson, 1995). For instance, if human beings feel certain social crisis (e.g., war, moral conflict, etc.) devastating, they can negotiate and stop. However, it is not so easy to negotiate and stop natural crises (e.g., scarcity of water, flood, earth quake, etc.) (Guo, 2007; Abell & Smith, 1994) because it is relatively uncontrollable (Driver, 1989).

Therefore, early research about these natural aspects seems very important to provide fresh facts for students' learning (Anderson, 2007) so that they will work for the win-win coexistence between the social and natural environments (Leonie & Rennie, 2007). In order to realize such intents, science teaching learning should be based on research/experiment results and community problems. Its research should also be based on teaching and community problems and of course its community service should be based on these same elements (Chatterton & Goddard, 2000; Preece & Biao, 2011). Through such approaches, it is possible to ensure better integration among the three missions and their mutual support, thereby ensuring the multiple and wider intentions of a university which is working for the welfare of society.

Each of the three missions of the university (teaching, research and community services) has their own major concerns that they need to address. University teaching,

for example, is considered as the principal mission of universities, in order to produce trained human resources (Taylor & Richardson, 2001; Akrlind, 2004) that work for the nation's economical, technological and social development. Teaching, might be taken as the basic foundation to equip learners with some scientific procedures and principles and thereby to initiate university practitioners' (teachers and students) involvement towards the remaining two missions (research and community services) (Jenkins, 2007). Therefore, teaching is the main role of academic staff and often takes more than half of the allocated time in their workload (Glenda, 2010; Akrlind, 2004). Therefore, teachers have to give time and attention to find the latest, innovative and appropriate teaching content and strategies to promote students' learning from different perspectives (Anderson, 2007; Biggs, 2003; Feldman, 1988).

University research, as defined by authors including Hammersley (2002), Hazekorn (2005) and Brasov (2007), is the process of rechecking or re-visiting whether today's truth works for tomorrow, through the application of systematic and scientific procedures so as to find something modified or different. It also attempts to search solutions for any kinds of social or natural problems of the community (Koul, 1984; Hammersley, 2002). Therefore, it has to find solutions for problems and investigate recent truths starting from the position of the teaching learning processes and other endeavors of the university, to the wider societal and physical world and then to maximize recent skills and knowledge (Herbert & John, 2002; Hazekorn, 2005) that might be important to deliver teaching. It follows that research is a vital ingredient of university missions for the development of the nation as a whole and particularly for delivering university teaching learning processes and community service practices through updated and innovated means (Kruss et al., 2009; European Commission, 2007).

Community service might be taken as the ultimate destination of the other two university missions: teaching and research. Community service is seen as a bidirectional tool for transferring university knowledge and skill to the community, as well as citizenship values and community responsibilities from the community to university learners (Chatterton & Goddard, 2000; European Commission, 2007). Community service is a potential input to localize the university knowledge system through integrating it into indigenous knowledge systems (Buture, 2008). This can be taken as an effective intervention for adapting and assimilating the imported university curriculum (Holland, 2001). In the same vein, the community will benefit from using scientifically developed principles and procedures (Preece & Biao, 2011) providing mutual enhancement between the university and its community (Chatterton & Goddard, 2000; Holland, 2001).

There is an expectation that the three university missions will be integrated to accomplish both institution- and community-related tasks successfully (Hassna & Raza, 2014). These researchers further contended that university policies need to consider how to improve integrative practices between the three missions to facilitate learning among university teachers, students and of course the surrounding communities. Joint developments between university teaching, research and community services can be realized through planned and thoughtful interactions within and outside the university community by a two-way dialogue (Jenkins, 2007) of university academia as teachers, researchers and community practitioners (Brasov, 2007). This strengthens each of the missions independently, their integrity and the overall improvements of university practices. However, unlike teaching, research and community service, this reality (integrative practices among the three missions) is hardly mentioned in the Ethiopian Education and training policy (MoE, 1994) and higher education proclamation (MoE, 2005). Their actual implementation on the ground is reported as being poor and with many limitations (Hewan, 2015; Zerihun, 2012, Amara, 2005).

The three university missions, therefore, need to be strongly interrelated in order to demonstrate best practices across them and other university assignments. In support of this, the interaction of two or more integrated agents is assumed to have a greater effect than the sum of their individual forces (Brasov, 2007; University of Virginia, 2007). As a result, instead of thinking of and performing the three university missions independently, it is better to think and perform the missions concurrently (Holland, 2001; Hassna & Razza, 2014).

However, as studies in the area have indicated, best practice in the universities' missions and their integration is poor throughout the world in general and in African countries in particular (Herbert & John, 2002; European Commission, 2007). Most universities in Africa focus mainly on teaching. In support of this, Brasov (2007) and Kruss et al. (2009) contended that most of the universities publicize these missions in their organizational documents, notice boards, public speech, etc., but they are not committed to achieving them to the expected standard. There is almost no integration. Kruss et al. (2009) and Sanyal & Varghese (2006) further reported that most African universities did not worry about the practices of integration among the missions and did not include it in their policy documents and guidelines (Lemma & Hoffmann, 2006; Ogada, 2013). This is true in the documents related to Ethiopian higher education (Adama University, 2009; Bahir Dar University, 2019). Moreover, there are no studies examining these integrative practices (Jenkins, 2007; Buture, 2008; Ogada, 2013).

The present study helps to bridge this gap in Ethiopia and elsewhere in the world by investigating the status of, and possible challenges to, university science teachers' integrative practices among the three missions, for the benefit of researchers and teachers in higher education.

Problem Clarifications and Research Questions

Universities are assumed to be the change agents of the entire community (Taylor & Richardson, 2001; Holland, 2001) through their alternative ideas, practices and innovations which might be adapted, matured and promoted during their involvement in teaching, learning and research. This might be accomplished better through integrating the practices of the three missions (teaching, research and community service) of the university, taken as the dependent variable of this study. The study examined the independent and multiple regression power of the independent variables (teaching, research and community service) to the dependent variable (integrative practices of the three missions). It also investigated the possible challenges that hinder science teacher's involvements in teaching, research, community service and the integrative practices among them.

As elsewhere in the other world, Ethiopian universities have taken teaching, research and community services as their principal missions at least in their policy documents. For example, the education and training policy of Ethiopia (MoE, 1994: 15), stated as "Higher education (university) at diploma, first degree and graduate levels, will be research oriented, enabling students become problem solving professional leaders in their fields of study and in overall communal needs." The policy further noted that the participation of teachers, students and researchers in understanding the community through field experiences will be useful in promoting university teaching and research. Accordingly, university legislative-documents (e.g., Adama University, 2009; Bahir Dar University, 2019) clearly stated that teaching, research and community services are their core missions. As a result, Ethiopian universities have created appropriate organizational structures and assigned resources though they lack many things (e.g., procedures and

motivation to carry out the three university missions fairly and to the expected standard (Amera, 2005; Zerihun, 2012; Melaku, 2010; Lemma & Hoffmann, 2006).

There have been attempts to research the practice of each of the three university missions independently. For example, Derebssa (2004), Amera (2005) and Taye (1993) investigated university teachers' involvement in research practices and their effectiveness within some Ethiopia universities. Other authors (Shibeshi, et al., 2009; Zerihun, 2012; Melaku 2010) have examined the teaching learning practices in Ethiopian universities. A few research reports (Lemma and Hoffmann, 2006; Hewan, 2015) have paid attention to the university practices of community services. However, there has been no research (at least in Ethiopia) that investigated the status of each of the three missions together and their integrative practices by university science teachers. This may be due to less emphasis on integration of the three university missions (Herbert & John, 2002; Buture, 2008). As a result, this research may be the first to assess the contributions of teaching, research and community service on their integrative practices, to examine the realities and to bridge the knowledge/skill gap in this regard.

Moreover, the research also examined the possible challenges that hinder science teachers from the accomplishments of these missions independently and in integrative manner. The following research questions were developed to guide the present study.

1) What is the status of teaching, research, community service involvements and their integrative practice among university science teachers?

2) What are the independent and multiple contributions of science teachers' teaching, research and community service involvements on the integrative practices among the three university missions?

3) What are the challenges (if any) that hinder science teachers' proper involvements in teaching, research, community service and the integrative practices among the three university missions?

Significance of the Study

This study should be helpful for all practitioner and beneficiaries of education in general and the university academia in particular. It shows the challenges faced, the weaknesses and the strengths of university teaching, research and community service as complementary so as to increase effectiveness of university performance as a whole. It also helps science teachers to adjust their engagement in teaching, research and community service practices by encouraging integrative practices rather than dealing with the three missions as independent entities. This ultimately helps to maximize the efficiency and effectiveness of the university science academic unit performance. The results of the study also serve as a vantage point for future researchers in the area.

Methodology

Design

The research questions examined the contemporary status, relationships and implications of the variables. As a result, collecting data from a relatively large-scale sample through a questionnaire was a major task in the study. A descriptive survey design was employed. Mixed approach was used by giving main emphasis to the quantitative data and its analysis.

Participants and the Settings

The major data sources were university science college teachers because they were assumed to have direct involvement in teaching, research and community service practices in science contents. To gain further insight into the problem, research and community service officers and deans were identified for the interview sessions. Three

public universities in Ethiopia were selected through purposive sampling. The section criteria were the universities' location (for a representative selection of the nation's public universities), experience in years of service, and access for the researcher. With those considerations, Bahir Dar University, Dire-Dawa University and Wolkitie University - first, second and third generation universities respectively - were identified as the research settings.

The study population was 623 science College teachers, who teach only science courses, in these three universities (Bahir Dar 320; Dire-Dawa 191; Wolkitie 112). Of these, 312 participants were selected through systematic random sampling (Bahir Dar n=128; Deriedawa n=112; Wolkitie n=72). There were 252 males and 60 females. Purposive sampling was employed to identify six proper officers and six information-rich teachers for the interview sessions. The questionnaire was distributed to all 312 respondents (8 of them did not return it). As a result, 304 teachers (246 males and 58 females) properly completed and returned the questionnaire. For the interview respondents, 12 (6 officers and 6 teachers) were identified and participated in the interview. They were selected on the basis of experience, awareness of the variables under investigation, and related office involvements.

Data Collection Instruments

The study employed two data collection instruments: questionnaire and interview.

The questionnaire consisted of three parts. Its first part had 2 completion items, to help the researcher collect preliminary data about sex, university name and department. The second part comprised 53 closed items, to elicit data on science teachers' involvement in teaching (14 items), research (13 items), community service (12 items) and integrative practices among university missions (12 items). The third part of the questionnaire, consisted of single open-ended item to seek data about the challenges faced by science teachers in teaching, research and community service taking their synergy into account. The questionnaire items were constructed on the bases of theoretical as well as empirical grounds of the variables under investigation. It called on the research from Shibeshi, et al. (2009) and Zerihun (2012) used to develop a questionnaire for teachers' teaching practices. Sanyal and Varghese (2006) and Amara (2005) developed a questionnaire for teachers' research practices, while Preece and Biau (2011) and Kruss et al. (2009) developed a questionnaire for teachers' community service practices. Brasov (2007) informed the development of the questions in integrative practices within the three university missions.

A five-point Likert scale was used: strongly disagree, disagree, slightly disagree, agree and strongly agree. In scoring, a point of 1 was assigned for 'strongly disagree,' 2 for 'disagree,' 3 for 'slightly disagree,' 4 for 'agree,' and 5 for 'strongly agree.' After the questionnaire items had been prepared, the questionnaire was given to three professionals (one PhD in educational psychology and two PhD in curriculum and instruction). Based on the comments and suggestions of these experts, three items were revised and two new items were added. A pilot study was then conducted to determine the reliability of the questionnaire and Cronbach Alpha was used to assess the internal consistency of responses from one item to another. The reliability coefficient results of teaching, research, community service and integrative practices items were 0.78, 0.82, 0.75 and 0.84 respectively. Since all the participants of the study were university teachers, the questionnaire was prepared and administered in English.

An interview was conducted with selected officers and teachers to support and justify the data obtained through questionnaire. The session used six guiding statements about the variables of the study. After explaining the objective of the study and obtaining the interviewees' consent to participate, the researcher himself did the interviews. The participants included two research and community service officers/deans and two

teachers from each of the three-sample university. For the sake of ensuring anonymity of responses, the respondents from the management group were coded as M1, M2, M3, M4, M5 and M6; and from the teachers as T1, T2, T3, T4, T5 and T6.

Data Analysis Techniques

The study used both quantitative and qualitative data analysis techniques.

One Sample t-test was applied to examine the level of university science teachers' involvement in teaching, research, community service and integrative practices among the missions as indicated in basic research question one. To determine the testing value of the collected data, as described by Oxford (1990) and used by Mulugeta (2018) and Dawit (2016), the range of the mean scores in the five-point scale was divided into three equal sections: 1.00 – 2.33 (labeled as poor performance), 2.34 – 3.66 (labeled as average performance), and 3.67 – 5.00 (labeled as good performance). Based on this, to claim that science teachers have a good level of performance in teaching, research, community service and integrative practices, they should score an average of 3.66 (Oxford, 1990; Mulugeta, 2018), which is near to the value of 'agree' responses (value=4). Therefore, the testing value (expected value) in this study was set at 3.66.

Multiple Regression Analysis was used to determine the multiple and independent contributions of teachers' involvement in teaching, research and community service on their integrative practices as indicated in basic research question two.

Percentages were used to identify the frequency and prevalence of challenges as reported by the respondents via the open-ended item of the questionnaire (basic research question three).

To show the dispersion and central tendency of the data, the mean scores and standard deviations of the variables were also reported. The interview data collected were studied, categorized, organized and qualitatively analyzed against the theme that emerged from the pre-identified basic research questions.

Results

The results are presented in three sections.

1. The status of science teachers' involvement in teaching, research, community services and their integrative practices.
2. An analysis of the contributions of teaching, research and community services on the integrative practices.
3. Third, the analysis of possible challenges to involve in teaching, research, community services and integrative practices among these missions.

To examine and identify the current status of science teachers' performance in teaching, research, community service and their integrative practices, one sample t-test was employed (see Table 1). This shows that, except in teachers' teaching involvement (4.84), all the variables [research (2.32), community service (1.88) and integrative practices among the missions (2.12)] had mean scores which were below the expected test value (3.66).

Table 1. One Sample t-test Results in Comparing Science Teachers' Involvement in the variables analyzed against the expected average performance (n= 304).

<i>Variables</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>t-Value</i>	<i>P-Value</i>
<i>Teaching</i>	4.84	0.82	3.23	0.00
<i>Research</i>	2.32	1.06	3.12	0.01
<i>Community Services</i>	1.88	1.12	3.87	0.00
<i>Integration among the three missions</i>	2.12	1.08	3.56	0.00

**Mean vs. Average performance value = 3.66*

Table 1 shows that the mean score value (4.84) for teachers' teaching involvement (at t-observed=4.26) was significantly higher than the test value (3.66). But, mean score values for research (at mean=2.32 and t-observed=3.82), community service (at mean=1.88 and t-observed=4.12) and integrative practices among the three missions (at mean=2.12 and t-observed=3.76) were significantly below the test value (3.66). This implies that university teachers' involvement of teaching was in a better position, although their involvement in research, community services and integrating practices among the three missions were significantly below the test value.

The interview data confirmed this picture. Interview respondents said that although teaching, research and community services are theoretically considered as the legitimate assignment of university teachers, in practical terms both the university management members and teachers themselves were not in a position to monitor and facilitate staff towards the latter two missions (T₁, T₃, T₆ and M₃) as expected. In support of this, one of the teacher respondents (T₃), for instance, noted

If a teacher does not offer his/her classroom teaching, he/she will be in charge of getting different level of punishments including firing from job but nothing will be happened if he/she is not involving in research and community services. Therefore, we are taking our teaching accomplishments more seriously than we did in the other two missions. The management members also have the same feelings and decisions. They are reluctant for the implementations of research and community services.

Both the questionnaire and interview data showed that, in comparison to the teaching practices, research, community service and integrative practices are poorly addressed by the university community including teachers. Whether they liked it or not, all teachers were involved in teaching practices though its quality level varies from individual to individual.

The second aim was to investigate the independent and multiple contributions of university science teachers' teaching (T), research (R) and community service (CS) involvements (as predictor variables) on their integrative practices (IP) (as criterion variable). For this purpose, the correlation coefficient and multiple regression statistics are reported in Tables 2 and 3 respectively.

Table 2. Interrelationship among the Variables (X1, X2, X3 & X4) of the Study

Variables	T	R	CS	IP
T	-			
R	0.62	-		
CS	0.54	0.58	-	
IP	0.58	0.82	0.53	-

Table 2 shows that the correlation coefficients between all the variables of the study were positive and of medium level, though it is observed as high between research involvements and integrating practices (0.82). This makes regression analysis possible in order to determine the independent and multiple contributions of the predictive variables over the dependent variable. Regression analysis was used to find the significant contributions of the three missions (teaching, research and community service), as independent variables, on the integrative practices among the missions of the university, as dependent variable, (Table 3). As indicated in the regression analysis result, the multiple contributions of the three predictor variables over the dependent variable were 44.12% (Table 3). 55.88% of the variance for science teachers' integrative practices among the

missions of the university could be attributed to other factors which were not examined in this study.

The independent contributions of each of the predictor variable was reported as follow. University science teachers' research involvement contributed 34.56%, teaching contributed 5.72% and community service contributed 3.84% for the realization of integrative practices among the missions of the university ($R^2=0.4412$, $F=31.2419$). This indicates that university science teachers' teaching and community service involvements did little to facilitate high accomplishment of the integrative practices; rather science teachers' research involvement contributed much (around 34.56% out of the total variant contributions of 44.12%). In general, from the composite contribution (44.12%) of all the predictive variables to the variance of science teachers' integrative practices, 78.34% was attributed to the science teachers' research involvement, 12.96% for teaching involvement and 8.70% for community service involvement.

Table 3. Results of Multiple Regression Statics of Predictor Variables (T, R & CS) on University Science Teachers' Integrative Practices (IP) among the Missions of the University

<i>Predictor Variables</i>	<i>Regression Coefficient</i>	<i>t- Value</i>	<i>P Value</i>
<i>Teaching (T)</i>	0.1121	3.6201	0.001
<i>Research (R)</i>	0.4802	3.4513	0.002
<i>Community Service (CS)</i>	0.0802	3.6822	0.00
<i>Overall R²</i>	0.4412		
<i>F value</i>	31.2419		

The direct effects of the predictor variables on science teachers' integrative practices among the missions of the university were determined using path coefficients. The effects on science teachers' integrative practices among the three university missions designated as research ($\beta=0.4802$, $t= 3.4513$, $P< 0.03$), teaching ($\beta=0.1121$, $t=3.6201$, $P<0.003$) and community service ($\beta=0.0802$, $t= 3.6822$, $p< 0.03$) (Table 3). This implies that science teachers' research involvement played a relatively strong role in maximizing the practice of integrative practices among the missions of the university. On the contrary, the effects of teaching and community service towards enhancing integrative practices were minimal (Table 3).

Interview respondents believed that teaching, research and community services, as missions of the university, are interrelated and supported one another. In this regard, T5 noted "teaching, research and community services are considered as joint practices of university teachers although much time and labor are invested for the teaching practices." Interviewees T2, T5, M1 and M6 noted that better accomplishments of one practice (e.g., research) serves as valuable input for the successful implementations of the other (e.g., teaching) although it faces teachers with time pressure. Despite the time and resource pressures that teachers faced, university science teachers have to take these three missions (teaching, research and community services) as their main agenda and engage in in them properly (T1, T3 & T6) even though they are mainly devoted to the practice of teaching. Nonetheless, teachers did not believe (even in a theoretical sense) that integration of the three missions to be their assignment (M1, M4 & T2) although a few (T3 & T6) claimed that integration among the three seemed to occur by its own right if there were adequate performances in each of the missions. The quantitative data (Table 3) and the interview responses show that science teachers did not perform teaching, research and community service intentionally in a way to enhance integrative practices among the three.

The third concern of this study was to investigate the challenges that hinder science teachers from their teaching, research, community service and integrative practices. In Table 4, respondents described number of factors that negatively affect their research and community service involvement. With regard to their teaching involvement, they did not indicate major challenges except for very few teachers who complained about the weak capacity of students, routines related to mentoring and the superficiality of peer-led learning.

However, many factors such as shortage of laboratory resources, rigid financial rules and procedures, shortage of books and articles, lack of knowledge and skill, etc. were reported as challenges that hinder science teachers' research and community service practices. Table 4 shows the percentage distributions of respondents within the major factors mentioned as challenges. Institution-related factors such as rigid financial rules and procedures (94.08%), lack of incentives (91.45%), lack of real and practical commitments by the management (89.14%), shortage of laboratory resources (chemicals, technicians, etc.) (83.55%) and shortage of books and articles (77.30%) were mentioned as challenges for practicing research and community services by large numbers of respondents (Table 4).

This implies that these institutional factors were considered as the dominant challenges. On the other hand, individual teacher-related factors such as lack of interest and motivation by the teacher (25.65%), lack of awareness in integrating the three missions (27.63%) and lack of knowledge and skill (39.80%) were reported as challenges for participation in research and community services by a relatively small number of science teacher respondents (Table 4). This shows that these individual related factors were viewed as less challenging. Very few respondents (8.88%) identified other challenges (e.g., office problem) which are not listed in Table 4. This confirms it is possible to conclude that these lists of challenges (in Table 4) are comprehensive and exhaustive. Strategies to resolve them can be developed to encourage science teachers towards research, community service and integrative practices among the missions of the university.

Table 4. Responses of Science Teachers about the Challenges Faced in Their Involvement to Research, Community Services and the Integrative Practices among the Missions of the University (n=304)

<i>Challenges Reported</i>	<i>Respondents (in number)</i>	<i>Respondents (in %)</i>
Shortage of laboratory resources (chemicals, technicians, etc.)	254	83.55
Rigid financial rules and procedures	286	94.08
Shortage of books and articles	235	77.30
Lack of incentives	278	91.45
Shortage of time due to maximum workload	212	69.74
Lack of real and practical commitments by the management	271	89.14
Shortage of institutional exposure especially in research	187	61.51
Taking research and community service as our secondary and tertiary assignments	112	36.84
Lack of knowledge and skill	121	39.80
Lack of interest and motivation by the teacher	78	25.65
Lack of awareness in doing the three missions in integrative manner	84	27.63
Others	27	8.88

Related to the challenges for undertaking teaching, research, community service and integrative practices, interview respondents, T₃, T₆, M₁, M₃ and M₄, for example, acknowledged that there are serious institution-related challenges; but maintain that the challenges related to personal interest, motivation, preference, etc., are the main and unreconciled obstacles to research and community services since these personal challenges are difficult to cope with (Amera, 2005). Respondent M₄, for example stated “For that matter, we lack [the ability] to do things in interest and motivation. Even, unlike research and community service, some of us are doing teaching practices because it is a must to survive as a staff of the university.” Respondents T1, T2 and M6 also said that there are teachers who complain about the absence of books and articles for doing research when the Internet solves this problem. Although the university management tries its best to expose teachers towards research through weekly and annual seminars and through periodic increases in research funds (T5, M3 and M1), teachers only express institutional limitations and do not complain about work personalities. Even though science teachers listed number of institutional factors as a dominant challenge in practicing research and community service, their personal factors seem more decisive and critical (M3).

In spite of such facts, the research and community service engagements of science teachers are more challenging than their counterparts in social science (T₂, T₅, M₃ and M₅). The possible reasons mentioned were lack of standard chemicals, equipment's and proper laboratory settings (T₁, T₃, M₃ and M₆) and lack of proper technicians who can manipulate the lab-instruments and chemicals available (T₁, M₃). On top of this, university science teachers themselves were not very familiar and comfortable to work on research and community service with the laboratory instruments and chemicals (Leonie and Rennie, 2007; Guo, 2007) because their previous college/university trainings were more theoretical and procedural. In conclusion, although the questionnaire data showed more challenges from institution related factors, the interview data indicated challenges from both institutional and personal factors, even by giving more weight to the personal ones. Therefore, we understand that both institutional and personal factors are serious challenges to science teachers' involvement in research, community services and their integrative practices.

Discussions

The results of the analysis revealed that, except in their teaching practice performances, university science teachers' performance in research, community service and integrative practices among these three were below the expected level (see Table 1). Mahapoon (2019), Amera (2005) and Ogada (2013) obtained almost similar results. Teachers showed better engagement in teaching than in other university missions. This finding seems realistic because of the following reasons. It is clearly indicated that teaching engagement is mandatory even to stay as a member of the university (Taylor & Richardson, 2001; Hassna & Razza, 2014). As a consequence, it is treated more seriously by teachers than the other two missions (Shibeshi, et al., 2009). A similar result came from the interview data. In comparison to the other missions (research and community services), most of the efforts by the university community in general including science teachers are focused on the practice of teaching and learning (T3 & M5) because it is considered to be their main agenda. Moreover, unlike the other two missions (research and community service) and their integration, teachers' involvement in teaching is relatively non-bureaucratic since its schedule is clearly indicated ahead and there is no further dealing with different stakeholders (finance, data sources, service beneficiaries and transportation).

Therefore, in most cases, teaching can be managed by teachers own devotion (Glenda, 2010) so that teachers prefer it over the other two missions which are relatively

interconnected with bureaucratic and administrative events (Herbert & John, 2002). The interview participants contended that since teaching is an assignment that can be done with the scope and authority of teachers and less reading and preparation, it is relatively enjoyable, unlike research and community services (T_1 , T_6 , T_5 , M_1 and M_5) because these demand a relatively new dimension of thinking and preparation ($M1$), and their practice always faces different experiences (Martin & Etzkowitz, 2000). So, it is a reasonable finding that science teachers perform better in practical teaching, in comparison to the other missions.

In relation to the contributions of teaching, research and community service practices on the integrative practices among the three university missions, the regression analysis indicates that (Table 3) research (34.56%) makes a greater contributed towards realizing the integrative practices, than teaching (5.72%) and community service (3.84%). Mamdouh (2007) and Ogada (2013) found a similar result. Research engagement is powerful in synchronizing relationships between the missions. This result might be because research engagement by its nature is inviting us to see things from different angles and usually works for solving problems, clarifying ambiguities, and searching new perspectives (Jenkins, 2007; Hazelkorn, 2005). Therefore, research practice may be expected to explore the knowledge and skill of a discipline which inform practical teaching (as its theoretical frame) as well as the practical and real experiences of the local community (as its data portion). In support of this, Hassna and Razza (2014) and Brasov (2007) stated that research, as one of the missions of the university, is a scientific tool that serves as a perfect link between the other two missions (teaching and community services).

However, though research has this capacity of facilitating the integrative practices among the three university missions, this study found that it was performed poorly by university science teachers (see Table 1). As a result, the criterion variable of this study, integrative practices among the three university missions, was also low (see Table 1). This can be expected as automatic consequences of science teachers' low involvement in research (Hassna & Raza, 2014) since research makes a better contribution to integration (see Table 3). Interviews with teachers and managers showed a similar result. They reported that both university teachers and management bodies give maximum attention to teaching practices to which they allocate time, budget and other resources. This is not the case for research and community services.

The study also found a minimal contribution of teaching and community services towards the integrative practices (Table 3). Teaching, as Shibeshi, et al. (2009) and Akrlind (2004) found, and community services, as Holland (2001) found, are assumed to be the application of facts and principles which are established through rigorous research endeavors. Therefore, teaching and community service are unable to explore what is going on in research (Koul, 1984; Brasov, 2007), because research is scientifically rigorous than teaching and community service. Hence, enhancing the integration between the three missions, science teachers may apply a more demanding, inquiry-based and comprehensive to teaching and community service so that the whole system will benefit.

Most of the university science teachers mentioned institution-related factors (e.g., rigid financial rules, weak incentives, lack of books and articles, etc.) as the major challenges to their involvement in research, and community service, as well as for integration, although a few considered their own personal factors (e.g., lack of interest, motivation, awareness, etc.) as a challenge (see Table 4). Clearly, although there are many institution-related factors, as Alemayehu and Solomon (2017), Ogada (2013) and Amera (2005) found, the internal trigger (e.g., interest and motivation) probably have the power to break and overcome the external/institutional challenges. But, most science teachers in

this study appear to blame their weakness in doing research and community service on institutional factors.

This belief (because the teachers have already externalized the problem), make it very difficult to identify proper solutions and then work accordingly. The interview results acknowledge the challenges related to institution (as the quantitative data depicted in table 4) although they give greater weight to personal factors. The interviewees' reason for this argument (as presented in the result above) was that personal interest and motivation can overcome the institution related challenges (e.g., shortage of budget, bureaucracy...). From this argument it is possible to understand both institutional and personal challenges affect science teachers' research, community service and their integration.

Conclusions and Implications

From the analysis and discussions made above, the following findings were drawn.

- University science teachers' involvement in research, community service and integrative practices among the three university missions are below average while their engagement in teaching is rather better.

- The multiple contribution of science teachers' involvement in teaching, research and community services on their integrative practices among university mission was 44.12% (to which research contributed 34.56%, teaching 5.72%, and community service 3.84%). This indicates that science teachers' research involvement makes to major contribution to enhancing their integration. Science teachers' teaching and community service involvements, on the other hand, made minimal contributions towards integration.

- Most of the science teachers reported, institutional factors, such as rigid financial procedures, lack of incentives, lack of managerial commitment, shortage of laboratory resources, etc., (see Table 4) were the dominant challenges for teachers' involvement in research, community services and integration. Relatively few teachers reported that personal factors, including their interest, motivation, awareness, knowledge and skill, were challenges in practicing the missions and their integration. Nevertheless, as the interview data and previous empirical literature contended, personal factors are highly influential even to change the scenario of the challenges related to institutional factors. Even though significant challenges related to the teaching practices were not mentioned, the limited capacity of students and the routines related to mentoring and peer-led learning were reported by a few teachers.

The findings lead to the following suggestions. University science teachers should be more involved in teaching, research, and community services as well as their integration. It follows that the university management system must give proper attention and support for teachers' research and community service engagements. This might be realized by encouraging science teachers to plan and carry out at least one research and one community service project each year. The university should provide more resources including laboratory facilities and increasing the efficiency and flexibility of administrative and financial processes. Moreover, providing practical (hands-on) and continuous training for science teachers in research and community service practices might change their attitude, interest, motivation and attitude towards the practice of research and community service and then to integrate these within the three missions. The improvement of research and community services, should facilitate the teaching and integration since teachers can include scientific research findings and practical community experiences in their on-campus duties.

Although the data showed that both institutional and personal factors posed challenges e.g., for working in research and community service, the open items indicated that institutional factors predominated. Therefore, instead of attributing problems and

challenges only to the external bodies/institutions, university science teachers have to acknowledge their own personal problems (e.g., lack of interest, motivation, commitment, etc.,) and work to overcome the external and institutional challenges. Teachers first have to convince themselves that they need to act as a teacher, researcher and community service provider in an integrated way. This will help them to boost their energy to work in challenging institutional environments and create an effective science academic unit in the university.

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