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Roles, Constraints, and Prospects of Scientific Knowledge Transfer at Science Shared Campus: Kotebe University of Education

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Abstract

Scientific knowledge transfer (SKT) across various settings is currently increasing worldwide, though it is little in Ethiopia. The purpose of this study was to identify the existence and magnitude of application of SKT based on the concept of the prevailing linkage between tacit and explicit knowledge transfer provided in the regular mainstream teaching and learning processes. This research is theoretically based upon problem solving and SECI (Socialization, Externalization, Combination, and Internalization) models of knowledge transfer. Different tools for data collection including questionnaire, observation, interview, and document review were employed. Based on lottery method, 114 students and their respective parents out of the total 350 students were involved in the study. The questionnaire data were analyzed using SPSS, and qualitative data were analyzed by verbatim translation and interpretation method. The data were validated by the principals, top scorer students, cluster coordinates, and key informants. As a result, about 56.7% of student respondents, 61.9% of parent respondents, and 50% of teachers indicated that the external knowledge transfer was carried out in the field of natural science through academicians, researchers, and laboratory experts with unreserved effort owing to pay for their effort. The result also shows that concerns on time, scope, language, complexity and strategy were found to be barriers. The identified constraints on SKT are internal factors in the instructors' views like communication problems, language problems, interpretation problems, and technologies and techniques used in the transfer of knowledge. Thus, working with these limitations could improve SKT rate in educational institutions.

Key words: Constraints, Prospects, Knowledge Transfer, Science Shared Campus:

1. **Introduction**

Equipping students with effective science and technology-based knowledge and skills help them to overcome practical problems encountered in their future workplace. The term knowledge implies the capacity to use information acquired through learning, observing, and practicing to get things done and make decisions (Delong, 2004). It has a similar meaning to the terms "data" and "information", so portraying their variation becomes necessary. Colman (2010) defined it as anything which is or may be known; information and the body of truths or facts accumulated by the man during time passes.

On the other hand, Zaltman (1982) distinguished data and information from knowledge. In a sense, data might involve statistics that can currently be stored and later retrieved in the information technology system (Teresa & Cedric, 2009). But if this statistic has meaning depending on and is specific to one system, it would refer to information (Chini, 2004). Knowledge results from the combination of different pieces of information, including their interpretation and meaning. The process of combining the information has to be seen in the processes of sense-making and sense-giving, where individuals use different frames of reference and thereby develop different perceptions about their surroundings (Chini, 1998). According to Nonaka and Takeuchi (1995), the basic difference between knowledge and information is that knowledge belongs to individuals, whereas information can be independent of people. Contrary to information, knowledge is about actions, beliefs, and commitment, as it is dependent on the perspective or intention of individuals (Andreasian & Andreasian, 2013; Davenport & Prusak, 1998; Huseman & Goodman, 1999; Teresa & Cedric, 2009).

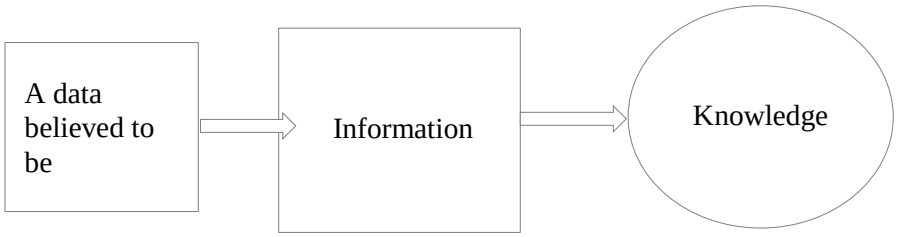

Figure 1.1 data, information and Knowledge linkage (Adapted from Andreas & Roman, 2008)

Knowledge can be alienated into two categories: explicit and tacit. Explicit knowledge is defined by different scholars in different ways. Explicit knowledge is the knowledge that is transferable by the media (Delong, 2004); explicit knowledge is the knowledge that can be consciously identified

(Andreas & Roman, 2008) the knowledge that exists in scientific documents (Roghayeh & Mohammad, 2012). Explicit knowledge is documented, made public, structured, and can be structured and shared through information technology and other means (Ivana & Jaroslav, 2016).

Understandably, thus, those scientific research results, empirical beliefs, opinions, and explanations of experts released in different media, including the internet, are labeled as explicit knowledge. It is knowledge that cannot be transmitted through media (Delong, 2004); knowledge that prevails in people's minds and is usually portrayed through their action and behavior (Roghayeh & Mohammad, 2012). It is knowledge people carry in their minds but are not aware of or cannot access consciously (Andreas& Roman, 2008) while tacit knowledge resides in people's minds, behavior, and perception and evolves from social interactions (Ivana & Jaroslav, 2016). Whether it is explicit or tacit, the process of sharing one's knowledge with others in any organization is understood as knowledge transfer. Both types of knowledge must be diffused because knowledge has a depreciation value if it is not transmitted (Ivana & Jaroslav, 2016). While knowledge might be expensive to generate, it is relatively inexpensive to diffuse it**.**

Knowledge transfer has a multifaceted role in providing relatively sustainable competitive advantages. As a case in point, it helps employees to self-update in parallel with the rapid science and technology progress; to get success in the professional and competitive world economy; to go one step ahead for further invention required for the job; and to be smart in all aspects of the requirements by being full of both practical and intellectual knowledge (Khamaksorn, 2016). If it's so important, the core concern included in the dynamic learning system is that the transfer of knowledge depends on the factors that define how knowledge is to be acquired, in what form, and what knowledge is important for the given organization (Roghayeh & Mohammad, 2012).

This means that there are constraints that hinder the effectiveness of knowledge transfer. Some of these constraints emanate from knowledge transfer or behavior, and others from knowledge lack of absorptive and communication capacity. According to the educational sector, affecting knowledge transfer and externalization depends on time, scope, language, complexity, and strategy. The other factors will determine the effort and resources required for knowledge transfer, and education to improve pedagogical skills, teaching and learning capabilities, and social networks to transfer the knowledge for its successful implementation. The barriers to the transfer of knowledge arise from

many factors, such as communication problems, language problems, interpretation problems, and technologies and techniques that are used in the transfer of knowledge.

There are also institutionalized and technology-oriented limitations, among others. The educational system, constraints vary slightly from those in other productive institutions. According to (Siu Felix L.C. and et al., 2017), the constraints of the KT emanate from three sources: human aspect constraints**,** policy aspect constraints, and technology aspect constraints **(**which include technology, knowledge accessibility, and the nature of knowledge being tacit and explicit). The more points indicated about the policy aspect, the more crucial they are in this research because emphasis is given to the rules and regulations enacted at the school or university levels that determine the transfer level of knowledge.

As to Olomolaiye & Egbu (2013), there is little agreement on a universal context about the classification of knowledge, yet wide consensus abounds that it is myriad and consequential. Colman (2001) classified knowledge into three categories: declarative knowledge, which means knowing what; procedural knowledge, which means knowing how; and acquaintanceship knowledge, which describes things we know unconsciously. According to Love (2016), knowledge is classified into three types: basic science knowledge (knowledge that is related to basic science subjects including math); applied research and development; and practice knowledge. Scientific knowledge is a phrase usually observed in different articles portraying research findings obtained through scientific methodology. This phrase cannot necessarily be applied to the knowledge of pure science fields. Rather, knowledge that is found by way of scientific inquiry can be considered scientific knowledge**.** Babalhavaeji & Jafarzadeh (2011)**,** ascertain the above statement by saying:

> *If experts' beliefs, ideas, experiences, and background information provide the basis for their research and scientific expansions, people's intellectual assets could be introduced as scientific knowledge.*

On the other hand, the knowledge that is acquired in the sciences is also regarded as scientific knowledge Jang & Wagner (2013), Learning science fields requires the coordination of a complex set of cognitive, affective, and motivational strategies and skills in order to acquire and process scientific knowledge. Science teachers and any other interventionist not only need to understand this complex set of methods for obtaining scientific knowledge but also understand where their students want to go for their future careers in the field of science and technology. When they do so, they can impart

scientific knowledge, which allows students to understand the universe, its rules, laws of nature, etc. (Gelena & Andreasian, 2013). STEM has emerged as the best teaching-learning strategy in education that integrates science, technology, engineering, and math to foster students' acquisition of knowledge in science (Sanders, 2009).

The theoretical framework several models of knowledge transfer have been proposed in the literature on education. The ones that are convenient to this study, however, get emphasis and are described as follows. According to Love (1985), Havelock laid the foundations for the current theoretical developments pertaining to KT. These models are subdivided into four main models, such as the research, development, and diffusion (RDD) model; the problem solver model; the linkage model; and the SECI models. The SECI model that has been developed by Nonaka and Takeuchi (1995) remains very essential in this paper because it not only explains the knowledge transfer between teachers and students in formal education but also supports knowledge sharing between students. Each model suggests a somewhat different perspective on the pivotal elements taken into consideration in the KT process. The SECI is a process of knowledge creation on the basis of the distinction between tacit and explicit knowledge (Dahalin & Suebsom, 2010); Gelena & Andreasian (2013).

The model comprises socialization (tacit-to-tacit), externalization (explicit-to-explicit), combination (explicit-to-explicit), and internalization (tacit-to-explicit). On the other side of this study, many aspects are getting specific consideration in order to draw out a conceptual framework. Co-curricular activities foster the actual curriculum-based acquisition of knowledge. So that knowledge is transferred in such a way that students engage in a multitude of co-curricular activities either through interaction or direct action on the tasks required in the activities. Curriculum activities are the basis for building as well as transferring knowledge. Instructional processes are the basis for the task of preparing students to function within a knowledge-based society (Abuhimed, 2015). The conceptual framework for the knowledge transfer process includes extracurricular, external knowledge transfer from others, peer knowledge sharing (students), co-curricular activities, and also curriculum activities (the teaching-learning process).

Beyond teaching-learning activities in the classroom, if favorable conditions exist for experts (from KUE or other sector institutions) to share scientific knowledge with students in their study area,

students might use it for their all-round personality development. Unfortunately, there is no such system in the area under study, and that has inspired the researchers to do research on the role, constraints, and prospects of scientific knowledge transfer in the study area. The central point of the research, including this one, would be focusing on how the study undertaken in this area develops mechanisms to minimize the constraints while simultaneously enhancing the role of knowledge transfer. This study was conducted to address the following guiding questions.

1. How are internal (implicit) and external (explicit) SKT processes going on in SSC?
2. What are the roles of scientific knowledge transfer processes for the gifted students of SSC?
3. What are the major constraints and possible solutions to diffusing scientific knowledge in the area under study?
4. What are the mechanisms adapted to be underway in the processes of both explicit and tacit knowledge transfer in the study area?

The study result is hoped to be significant for school administrators who are looking for ways to address the learning styles of gifted students in the school, and who are trying to implement the enhancing and acceleration programs of gifted education. It opens up a strong linkage between SSC and the main campus (KUE) that is needed to work in collaboration to help talented students. It can be exemplary and be the cornerstone for the schooling of talented students in Addis Ababa and somewhere else in the country. Planners, policymakers, and educators whose work is linked to gifted students may use the study results as a reference source. It also opens viable opportunities to researchers dealing with thematic research areas for further research work on knowledge generation, transfer, utilization, and management as well.

2. Research Method

The research approach was a mixed method: qualitative and quantitative. During the analysis and interpretation stages of the research, the qualitative and quantitative findings were integrated and validated in a discussion. This allowed a comprehensive analysis of the intended outcomes for all stakeholders based on the research track. Mixed-method research connects or combines both qualitative and quantitative data to provide a more thorough understanding of a research problem. It involves philosophical assumptions and the linking of both approaches (Creswell, 2003). When our

research analysis uses both qualitative and quantitative approaches, a better understanding of the research problem is obtained than by utilizing either approach alone.

The study was designed to follow the interpretive and constructivist paradigms, which are really suitable for the mixed research methods (quantitative and qualitative) employed in this study. Contrary to experimental studies, descriptive studies may be fruitful for more quantitative data. Thus, a descriptive study was the general framework of this study's research design. Questionnaires, interviews, and observations, which are parts of mixed-method research strategies, were used to gather data. Instead of experimental and exploration methods, simple descriptive analysis was used in this study because the majority of the data were qualitative in nature. Interpretation, direct quote, and insight of the researchers were applied to analyze qualitative data gathered through observation and interviews from different sources.

Data Sources

Descriptive survey research, which determines and reports the way things are and which involves collecting numerical data to address questions about the status of the subject of the research was employed in this study. Numeric data were collected using a questionnaire to provide a quantitative description of the general situation of the roles, constraints, and prospects for the transfer of scientific knowledge. To substantiate the primary data source with the facts available, reviewing documents became essential, and hence policy documents, journals, the annual work plan of the SSC, the yearly work plans of the Research and Development Directorate, and the University-Industry Linkage Directorate, including their reports and minutes, were of the key documents that were reviewed.

In this study, both interviews and questionnaire were used so as to gather relevant data, and key informant interviews were prepared on the basis of close-structured questions. An in-depth interview was conducted face-to-face with the researchers and school principals about the general school structure, processes of teaching and learning, extent of knowledge transfer, and its roles, constraints, and prospects. Key informant interviews were carried out face-to-face with high-scoring students about the problems of knowledge transfer in informal education, the process of practicing scientific knowledge, the capacity of the science teachers, whether it goes in line with their demand or not.

Table 1.1 participants involved in this study

S. No	Target groups	Methods	Number of participants	Sampling techniques
1	Students & parents	Questionnaire	114	Random/lottery
2	School teachers	questionnaire	20	Quota
3	Student trainees	questionnaire	37	Systematic
4	Top scorer students	Key informant interview	6	Purposive
5	Cluster coordinators	Key informant interview	3	Purposive
6	School principal and V/principals	In-depth interview	3	Purposive
7	Academicians/researchers/ managers	Key informant interview	7	Purposive

I. Questionnaire

Four different types of questionnaires were prepared and administered to students and teachers in the study area. The first three questionnaires were targeted at sample students and their respective parents. The theme of the first questionnaire was the process of internal knowledge transfer. It focused on the process of transferring knowledge from science teachers to students. A few (8 items) fully structured five-point Likert scale questions were prepared on top of how teachers impart content knowledge in or der to address the learning style of gifted students. The second type of questionnaire was prepared to be filled in by a sample of students, aiming at gathering information about whether or not external (tacit) knowledge transfer exists at the school level, including the roles that knowledge transfer played in their academic and behavioral development.

A semi-structured question comprising 15 items was administered to sample student respondents to gather information on the focus points. Both questionnaires were the continuation of field and classroom observation processes being undertaken during the pre-understanding phase. A semi-structured question (encompassing 10 items) was also prepared for sample student parents for triangulation. This question was administered to parents with the consent of the sample students.

The third type of item was a semi-structured question which was distributed to be filled in by those students who engaged in the external knowledge transfer (training) prepared by the British Council on top of "life skill development". The question was purposefully conducted to analyze the effectiveness of knowledge transfer processes. The last semi-structured question was prepared for science subject teachers to gather information about the roles, constraints, and prospects of internal

and external knowledge transfer processes. Except for science subject teachers, the rest of the questions were prepared in Amharic, with the aim of minimizing language barriers.

Data collection process

To achieve the research objective, the data were gathered from different stockholders in the study area. The first research target was students. In this study 114 students and their respective parents were selected out of the total target research population of 350. The samples were identified using random lottery. The second research group was the science shared school teachers; 20 teachers out of the 33 total campus teachers were recruited purposively (table 1.2).

Table 1.2 Teachers' profile in SSC

Position	**Number of Instructors persubjects**												**Total**	**Remark**
	Amh	Eng.	Math	Bio.	Phy.	Che.	Geo.	Hist.	Civic	ICT	P. Ed	TD		
Lecturer	3*	2*	3*	4*	3*	3*	1*	*	3*	2*	1*	1*	26	*area of deficit*
Instructor/ Lab. Assis	-	2	-	1	2	-	-	-	-	2	-	-	7	
										Grand Total			33	

In the third targeted group, student trainees were trained in different short-term training. 37 students were selected systematically and requested feedback on the training as well as their challenges. Scientific knowledge transfer does not happen in easy ways in different aspects requested by the questioners. In the fourth and fifth research target groups, purposive sampling techniques were employed to include key informants from SSC and KUE main campus, aiming to reach the exact valuable person from the top scorer students and cluster coordinators. Six and three researchers conducted entirely interviews with key informants of SSC and KUE main campus.

Science teachers in the science fields, top scorer students, school principals and vice principals, experts, academicians, researchers, and managers (from the main campus) were all target groups of this study. Data collected through interviews form administrative bodies, especially the school principal and vice principal, as well as academicians, researchers, and managers were triangulated and validated in detail (table 1.3).

Table 1.3 Numbers of students in science shared campus through the years.

No	**Variables**	**2016 G.C /2008E.C/**	**2017 G.C /2009E.C/**	**2018 G.C /2010E.C/**	**2019 G.C /2011E.C/**	**2020G.C /2012E.C/**

	Sex	M	F	Tot.	M	F	Tot.	M	F	Tot.	M	F	Tot.	M	F	Total
1	No of students through the years **(KMU-SSC)**	34	55	89	84	86	170	131	120	251	184	157	341	189	159	348
2	Completed grade 12^{th} on 2011 current student remain,										34	54	88			

Data Analysis

The descriptive statistics analysis was employed in this study mainly to analyze questionnaires. SPSS (Statistical Package for Social Science) version 25 and Microsoft Excel were the two exhaustively used materials to analyze the data. Information from the questionnaires was first entered into the Microsoft Excel database. The Microsoft Excel program was used to immediately allow the user to arrange data individually. Then, the respondents' data were entered into the Microsoft Excel spreadsheets step-by-step, and then migrated into SPSS software. The measurement of the first questionnaire was based on the five-point Likert Scale (ranging from 0 to 4 where 0 is strongly disagree, 1 is disagree, 2 is uncertain, 3 is agree, and 4 is strongly agree).After reliability analysis was made, descriptive analysis was carried out by using means and standard deviation in tabular format. The reliability analysis is important to indicate whether the statements are reliable. The analysis is done based on Cronbach's alpha, which has a formula.

$$\propto = 1 - \frac{kr}{(1 + (k-1)r)}$$

Where k is the number of indicators or number of the items; r is the mean inter-indicator correlation. As described by (Dahalin & Suebsom, 2008), the acceptable value of Inter-rater reliability fits the observation checklist, 0.00 and 1.0. An alpha value above 0.5 is acceptable and below this value should lead to either collecting more data or rethink which variable to be included.

In addition to mean and standard deviation, frequency (count) and percentage were used for the analysis of quantitative data gathered from students, parents, and teachers, as well as multiple response analysis, which is used in this study for analyzing data obtained on the themes of identifying knowledgeable persons, mechanisms of knowledge transfer, and the interest and capacity of knowledge recipients to use or renounce the knowledge.

The transcription, organization and categorization of data obtained via email from key informants of KUE main campus underwent similarly on the basis of three main themes –roles, constraints and prospects of scientific knowledge transfer. Some of the major themes were broken down further into sub-themes where it was deemed necessary to enhance understanding of the concepts. Then, data were analyzed, triangulated, interpreted using descriptive and narrative method. Furthermore, induction method is applied to interpret the results.

Reliability and validity of the Tools

Validity is used to emphasize how the instrument in particular and the study in general are credible at large, while reliability is used to measure the consistency of the study results if it replicated. Actually, replication of the study result may not be achieved because the area under study is so small and was also intended to address research problems identified at this site. But efforts have been made to test the reliability scale of quantitative research data by using Cronbach's reliability analysis model in addition to various tools for gathering the same information for triangulation purposes.

Ethical Issues

Great efforts were made to respect all kinds of research ethical principles. Ultimate care has been taken not to violate any commonly agreed-upon ethical or legal principle. Whenever the participants were contacted for interview purposes, they were first asked to give their informed consent and voluntary participation. At the same time, all ideas were taken from other authors, and interviewees were duly recognized. As much as possible, we tried to be free of subjectivity during the interview, data analysis, and data interpretation to avoid or minimize bias or self- deception. Respect for intellectual property was guaranteed by giving proper acknowledgement or credit for all contributions to this study. As far as possible, all measures were taken to avoid any plagiarism. Both qualitative and quantitative research approaches will be employed in this study. Quantitative approach was used for those data that were gathered through questionnaires from students and students' parents. Data obtained through interview and key informants were analyzed qualitatively.

3. Results

Observation was made to determine the extent to which internal knowledge (content knowledge) transfer was processed and became fruitful to address the need of gifted students in the study area. Accordingly, researchers observed students when discussing and reviewed the lesson in the class.

Some discussions were in the form of debating while others on the way of narrating and making clarification of the contents learned. The situation was positively comply with the first mission of open observation and taken as a good way of knowledge transfer reviewed in literature of Abuhimed (2015) and Becheikhetal (2007).

With regard to the second mission of open observation, the result shows that some common claims rose up on certain teachers about their teaching techniques, their academic language commandment, time management and ways of ascertaining learning quality (correction and feedback giving for class work, homework, assignment etc.). It was observed plenty of good and bad practices happening both in the classroom and laboratory work and all these situations encouraged researchers to devise a questionnaire in order for triangulation as discussed ensue.

On top of the teaching techniques, resource utilized, and knowledge sharing among students in the classroom, the five-point Likert Scale analysis made relying on reliability analysis test showing about an alpha value of 0.90. The following table indicates a summary of the variables, mean, and standard deviation of the results.

Table 1.4. Mean scale of teaching techniques, resource utilized and knowledge sharing

Item	Variables	Mean	S.D
1	Generally, Applying active learning methods	0.84	1.321
2	Project work as a means of acquiring knowledge	1.92	1.395
3	Individual and tiered assignment technique use	0.79	1.133
4	Status of Lab work in scaling up learning by doing	0.96	1.353
5	Excursion facilitates the link b/n students and university academician	0.65	1.121
6	Ability to use different resources to substantiate curricular materials	1.02	1.141
7	Status of knowledge sharing among students in the classroom	2.55	1.523
8	Satisfaction level in addressing the learning style of gifted students	0.80	1.206

From table 1.4, the mean value is 2.55 for the knowledge sharing in which teachers allowed students to discuss the content in the classroom. This means that the majority of respondents' extent of the agreement rested upon mediocre to the statement mentioned in item number 7. In other words, the knowledge transfer process was going on at a somewhat fair level in the classroom. This is because the mean value lies in the middle between 2(uncertain) and 3(agree) labels on the Likert scale. Contrary to this, the excursion form of knowledge (tacit) acquisition represents the mean value of

0.65 which means the field trip does not exist currently in the school program. This mean value allied somehow to the majority of respondents' agreement level in the middle position of 0 and 1 of the Likert scale.

The analysis of the ability of science teachers to use another resource in addition to the textbook represented a mean value of 1.02. The majority of respondents had found knowledge acquisition outside of the textbook to be at a poor level. This means that the majority of science teachers stuck on the textbook and ran fast to finalize on time rather than to integrate the textbook contents with contents found in other related materials. The worsen result was obtained to pertaining teachers' ability to "satisfying" the curiosity of gifted students learning- 0.80(approx. strongly disagree level) mean value- which means respondents perceived at a poor level the process of internal knowledge transfer in addressing the learning style of gifted students.

In general, the application of appropriate active learning methods including tiered assignments, project works is indispensable for knowledge transfer. In other words, the role of applying different active learning methods including project works and individual/tired assignments are immense in the process of transferring explicit(basic/content) scientific knowledge although certain obstacles are there in the study area and this suggestion goes in line with the suggestion given by (Grassler & Glinnikov, 2008; Dahalin & Suebsom, 2010). As the mean analysis indicates the role of knowledge sharing among students in-and-out of the classroom is so great so that it should be scaled up from the existing fair level to the level of perfect status. The role of additional resource utilization (opposing to stick solely on the textbook) for knowledge transfer processes is also critical as was reviewed by (Millar R., 2004) in that gifted students get the opportunity to enrich as well as accelerate educational processes.

Trip knowledge, experiential knowledge, and observation play significant roles in transferring scientific knowledge especially the tacit one. It also provides linkage chances to the students with resourceful personals (knower's- researchers, expertise, etc) to acquire tacit knowledge which accentuates either learning by doing or in addressing the learning style of gifted students. In connection with explicit scientific knowledge transfer processes, face-to-face interviews were conducted with different sources for triangulation and validation purposes of the results of questionnaires. For the question posed, how do you think the role of internal knowledge transfer and

also evaluate science subject teachers' capacity to impart scientific knowledge to gifted students in SSC? The school principal generally suggested the following statement:

> ". . . Yes, *scientific internal knowledge transfer is basic for gifted students, despite the fact that they require some special knowledge transfer approaches." But as for me, not fully lecturing content knowledge to the gifted students is important; rather, applying appropriate methods that allow gifted students to reflect their knowledge and experience is essential. "Extract the gifted students' mind instead of filing their mind with knowledge."* Mr. Z (one of the school principals)

The above school principal's statement implies the potential roles of sharing knowledge and active learning methods, including project work, problem-solving and tiered assignment provision, as a means of internal knowledge transfer processes. Besides, he explained why these roles were obscured was because teachers follow more of a "teacher-centered approach" and have no positive attitude to apply other methods that are labeled under active learning ways (refer to the extra explanation in the section on constraints).

> "..The *role of internal knowledge transfer is great because it provides the first foundation for science and even helps gifted students further in the field of science in their higher-level schooling. But my fear is how their curiosity is addressed by the instructors in this harsh school environment. By the lecture method, I don't think there would be a full understanding, and instructors have a lack of perception or attitude to follow active learning methods. This doesn't mean this is the character of all instructors. Some have given full time to transfer content knowledge in different mechanisms and should be given acknowledgment for their effort and dedication as well."* Mr. M (the administrative vice principal)

Suggestions by one of cluster coordinate from Information and Technology, department

> "*..The role of internal knowledge transfer played in the knowledge acquisition potential of gifted students is many if content knowledge is properly transferred. But, I do not think this was realized due to a multitude of constraints. Instructors are not committed and give no more time and effort to apply different methods that facilitate internal knowledge transfer processes effectively. For my subject most often I preferred to apply for project work as a better means of knowledge transfer…"* Mr. N. (one of the cluster coordinator)

According to interviewers from natural and social science subject coordinators including the vice academic principle, the overall aforementioned roles that internal knowledge transfer processes

played in identifying the talent of gifted students and in addressing their curiosity are immense and vital despite the many problems encountered with our instructors to put into effect the roles.

Internal (Explicit) knowledge transfer processes

On top of the teaching techniques, resource utilized, and knowledge sharing among students in the classroom, the five-point Likert scale analysis made relying on reliability analysis test showing about an alpha value of 0.90. The following table indicated a summary of the variables, mean, and standard deviation results as described in Table 1.5 below.

Table 1.5 Mean scale of teaching techniques, resource utilized and knowledge sharing assessment

Items	Variables	Mean	S.D
1	Generally, Applying active learning methods	0.84	1.321
2	Project work as a means of acquiring knowledge	1.92	1.395
3	Individual and tiered assignment technique use	0.79	1.133
4	Status of Lab work in scaling up learning by doing	0.96	1.353
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From table 1.5, the mean value is 2.55 for the knowledge sharing in which teachers let students discuss the content in the classroom. This means that the majority of respondents' extent of agreement rests upon mediocre to the statement mentioned in item number 7. In connection to explicit scientific knowledge transfer processes, face-to-face interviews were conducted with different sources for triangulation and validation purposes of the result of questionnaires. For the question posed how do you think the role of internal knowledge transfer and also evaluate science subject teachers' capacity to impart scientific knowledge to the gifted student in SSC? School principal generally suggested the following statement

> "--- *yes scientific internal knowledge transfer is basic to gifted students despite they require some special knowledge transfer approach. But as for me not fully lecturing content knowledge to the gifted students is important rather applying appropriate methods that allow gifted students to reflect their knowledge and experience is*

> *essential. "Extract the gifted students' mind instead of filing their mind with knowledge*" ---

The above school principal's statement implies the potential roles of sharing knowledge and active learning methods including project work, problem-solving and tiered assignment provision as a means of internal knowledge transfer processes. Besides, he explained why these roles being obscured was because teachers follow more of a "teacher-centered approach" and have no positive attitude to apply other methods that are labeled under active learning ways(refer to the extra explanation in the section of constraints).

> "*..The role of internal knowledge transfer is great because it provides the first foundation for science and even helps gifted students further in the field of science in their higher-level schooling. But my fear is how their curiosity is addressed by the instructors in this harsh school environment. By lecture method, I don't think there would be fully addressed and instructors have a lack of perception or attitude to follow active learning methods. This doesn't mean this is the character of all instructors. Some have given full time to transfer content knowledge in different mechanisms and should be given acknowledgment for their effort and dedication as well…*"

Suggestions by one of cluster coordinate from Information and Technology, department

> "*..The role of internal knowledge transfer played in the knowledge acquisition potential of gifted students is many if content knowledge is properly transferred. ----- But I do not think this was realized due to a multitude of constraints. Instructors are not committed and give no more time and effort to apply different methods that facilitate internal knowledge transfer processes effectively. For my subject most often I preferred to apply for project work as a better means of knowledge transfer…"*

According to interviewers from natural and social science subject coordinators including the vice academic principle, the overall aforementioned roles that internal knowledge transfer processes played in identifying the talent of gifted students and in addressing their curiosity are immense and vital despite the many problems encountered with our instructors to put into effect the roles.

External (Tacit) knowledge transfer processes

A semi-structured questionnaire was used for students, parents, and school teachers for obtaining data on trends of external knowledge transfer processes such as identifying the kind of knowledge needed to be transferred, identifying the knower's and the mechanism of knowledge transfers. In this regard, the dichotomous quantitative data (about extant of EKT) were analyzed by using descriptive analysis

such as frequency and percentage. Whereas, data in identifying the type of knowledge transferred and the way how this knowledge was transferred was analyzed by using multiple response analysis and presented as ensue.

Table.1.6 Dichotomous response for extant of KT in the past

No	Questions	Count	Number	Percentage	Remark
1	Did you see when EKT was carried out since you have joined the campus? (**Students**)	Yes***	19	16.7	"***"Of the first batch sample students
		No	84	73.7	
		I do not recognize it	11	9.6	
	T o t a l		**114**	**100%**	
2	Out of the formal mainstream education, did you remember when EKT undertook to your child in the SSC? (**Parents**)	Yes***	16	15.2	
		No	80	76.2	
		I do not recognize it	9	8.6	
	T o t a l		**114**	**100**	
3	Was there EKT to gifted students in the school since you have hired on this campus? (**Teachers**)	Yes***	4	30	
		No	16	70	
		I do not know	-	-	
	T o t a l		**20**	**100**	

Table 1.6 indicates the respondents' opinion upon whether they saw when the external knowledge transfer process was undertaken systematically in the years before the 2018 Academic Calendar. Regarding this, students' response swing between "yes" and "no" depending on their entrance time variation in the school. For about 15.2 % (16) respondents, external knowledge transfer processes were going on in the school, while the majority about 76.2% (80) sample respondents said "No" and hence EKT was never carried out in the school, systematically. And the rest 8.6% (9) students did not recognize when the time EKT is carried out. The field of knowledge that had been transferred was solicited to those students, parents, and teachers who said collectively external knowledge transfer was carried out in the school from the outset. Accordingly, about 56.7% of student respondents; 61.9% of parent respondents and 50% of teachers saw when the external knowledge transfer was carried in the field of natural science. This analysis was validated by interview questions conducted with principals, top scorer students, cluster coordinates, and key informants.

> *However, only one top scorer student, the school principal, and some key informants ascertained the response was right. In summarizing their suggestions, in the years when the school of science shared campus was established, the first batch of students was learning at the main campus(KMU) and hence acquired knowledge in attending a regular mainstream formal education(explicit knowledge), laboratory works, and additional knowledge transfer(tacit knowledge) in the science and technology fields.* Mr. Y (one of the cluster coordinator)

This was due to the closeness of students to those academicians, researchers, and laboratory experts who had helped them with unreserved effort owing to paid for their effort made. Besides, the students were brilliant and keen to acquire knowledge so fast so that teaching them and transferring tacit knowledge delighted most academicians & experts beyond getting money for their effort.

Constraints of SKT

The barriers to scientific knowledge transfer start at the school where curriculum-based formal education going on in affecting the formal content (explicit) knowledge transfer processes. Much has been discussed in the first section of this chapter so that to go through it in detail again might not be the intention of the researchers. Rather, we would like to slightly oversee internal knowledge transfer processes and however, priority for investigation was given up on what barriers are there in the external (tacit) knowledge transfer processes. To this end, researchers used the information obtained during the pre-understanding phase to list out the assumed constraints during an understanding stage in the sample student questionnaire. And hence the frequency and percentage analysis begin with the opinion of sample students. As table 4.3 indicates, out of the total sample respondents, about 14% (16) said school structure and management system created an impediment on SKT processes. Out of the total sample student respondents who said "teachers' lack of interest and commitment" to integrate explicit and tacit knowledge in addressing the need of gifted students' accounts for 9.7% (11). About 11.4% (13) student respondents said generally science teachers have no enough experience of teaching gifted students. Student respondents who said the loaded classroom instructional activities impeded the processes of tacit knowledge transfer were about 9.7% (11). Similarly, for about 12.3% (14) respondents' time is a major constraint of SKT. Lack of teamwork of science subject teachers (7.8%), lack of attitude of the university managerial for SKT (13.2%), resource and infrastructure problem (11.4%), and the weak relationship school administrator has with other institutions (10.5%).

Table 1.7 percentage analysis of students' response upon presupposed constraints of **SKT**

		Responses	
Variable	**Constraints (Optional)**	**No.**	**Percentage**
Choose the one which do you think the major constraint/challenge of SKT processes in the school.	School structural and management problem	16	14.0
	Science teachers' lack of interest & commitment to link tacit and explicit knowledge.	11	9.7
	Science subject teachers have no experience in how to teach talented students.	13	11.4
	Loaded instructional processes in the classroom created the problem in the transfer processes.	11	9.7
	Time is much tapered for teachers by involving in extra school tasks	14	12.3
	Science subject teacher may not be working disciplines as required of gifted education	9	7.8
	University managerial bodies have no attitude about how important is if their academician can transfer scientific knowledge for gifted students.	15	13.5
	Lack of resources such as transport facility and financial support	13	11.4
	Week relation the school administrator with PTA and other institutions working in the science fields.	12	10.5
			100.00

Generally, the constraint in the process of SKT in the SSC was the overall result of the aforesaid barriers despite a little bit difference seen among them in the extent to which is the major and minor constraint. School setting and lack of awareness in school management bodies about the importance of providing opportunity student to have received both explicit and tacit knowledge for addressing their curiosity as gifted students were remaining to be the major obstacle of SKT. In the same vein, KMU managerial attitude and enthusiasm was very low for developing the system by which university academician, researchers, and laboratory technicians help gifted students in transferring tacit knowledge as well. Beyond that, especially science teachers in the school are required to get special training either as a form of CPD or in-service training up on how to teach talented students

and the methods of teaching in the science fields. To teach students as per the requirement of inquiry-based learning, teachers' time may not be tapered, and need to have enough time for guiding, monitoring, coaching, and scaffolding individual talented student work and performance for assuring the quality of learning. Moreover, supplying different facilities and creating linkage of the school with other education and non-education sectors for transferring tacit knowledge is indispensable to make a complement the gap that existed in explicit knowledge transfer processes. These are not simply articulated conclusions rather supported and triangulated by the comments of school principals, cluster coordinators, and key informants'. Some of the interviewee comments are discussed here in an ensuing way.

> *"--- whatever is fundamental SKT for gifted students that we have, it has not been put into effect in the school due to lack of positive attitude and perception among higher rank manager of the school and the university and the instructors as well. As you know that each subject teacher engaged in many curricula and co-curricular activities so that they do not have spare time to mull over linking the classroom instructional process (explicit knowledge) with the ways students get supplementary knowledge (Tacit) from university academician or other sectors. Besides, the school environment is not conducive for talented students. There are many problems such as insufficient infrastructure, low standard of laboratory equipment including technology that foster instructional processes, etc. these all shortcoming hampered the practicality of external knowledge transfer processes in the school."* Mr. X (one of the school manager)

The school cluster coordinates substantiated the above analysis of the constraints of the SKT process about the problem with science teachers, school administrators, and the attitude of managerial personnel of the university (KUE). The Interview made with university academicians, researchers, and experts were used to substantiate the variable more in the following way. There are many constraints. First, the KUE teachers are university teachers. Hence, it would be difficult for them to teach high school students. This is a scope related constraint. Second, KUE teachers are conducting research and community service, along with teaching their students. Because of this, they are busy. It goes to time related problem. The laboratories, library, and the school environment, in general, are below the standard and are not suitable for talented students. These ones are organizational culture problem.

A lack of having a strategy that helps to find resource persons and link them to the school to transfer tacit knowledge including technologies. Moreover, there was no mechanism in building the capacity of teachers engaged in teaching talented students. In this regard, should be continuous training in the science subject content knowledge transfer, methods of teaching, assessment, and application of technologies for teaching gifted students. This is basically **s**trategy related constraints. Demonization among students is one of the major problems due to the low level of school infrastructure. The infrastructure needed to be properly arranged to be conducive to the level of talented students in that they are attracted and focus on the learning of science, innovation, and technology. The initial intention was to integrate SSC with STEM center where students nurture their talents through working on projects they have in mind. Unfortunately, this intention was reverted and now the SSC became even very much less than any ordinary high school. It describes an interpretation related constraints (Dahalin & Suebsom, 2010)

Prospects of SKT

In all these problematic situations of scientific knowledge transfer processes in the school, there will be hope that seems to be reversing things to the normal condition. This is because students in the school still eagerly wait for looking at the system set up in the school that enables both explicit and tacit knowledge transfer processes going on side by side in addressing their learning style. In this regard, sample student respondents were solicited if the need still be there with them for having tacit knowledge in the interim of receiving explicit (curriculum-based) knowledge. To this end, for the question "Do you like knowledge and experience of some prominent individuals should be transferred to you?" Almost the entire respondents (93.9%) replied "yes" while the rest 6.1% (7) respondents said "No". This response reveals that still; students want to receive tacit knowledge if conditions are allowed for them. In the subsequent reply for the question "In which one of knowledge- field you are interested with to have tacit (external) knowledge?" the majority of respondents have selected out two areas such as natural science including the medical field of knowledge and technology-related knowledge. The selection of these two areas is not a surprising event because the students are science learners so that they preferred external knowledge should be transferred in science and technology perspectives if the school system enabled doing so. Figure 1 depicts the percentage choice of field of knowledge that should be transferred in the future.

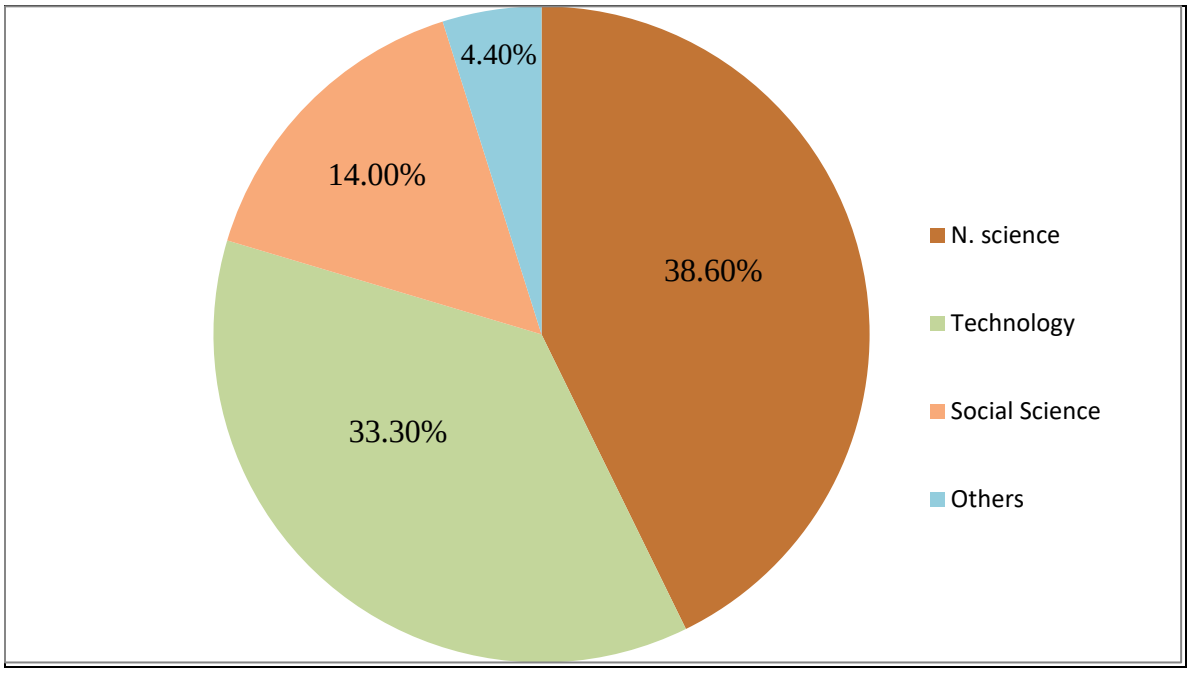

Fig. 12 Percentage description of students reply for their preference of field of tacit knowledge

As the figure illustrates, about 38.6% (44) out of the total 114 respondents, preferred natural science fields, including the medical field of knowledge to be transferred while about 33.3%(38) of student respondents preferred technology-related fields of knowledge including ICT. About 14% of student respondents were preferred social science-related external knowledge should be transferred to them. The rest who selected out laboratory- technical works, language-related knowledge, and others were about 4.4% (5).

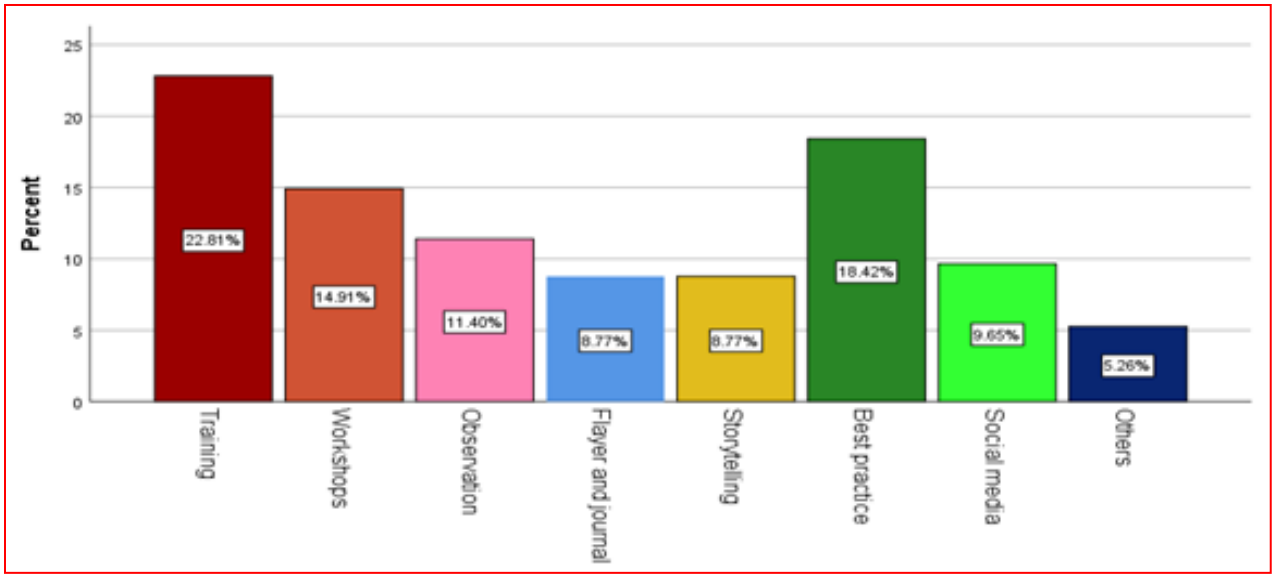

Figure 1.2 mechanisms of External knowledge transfer.

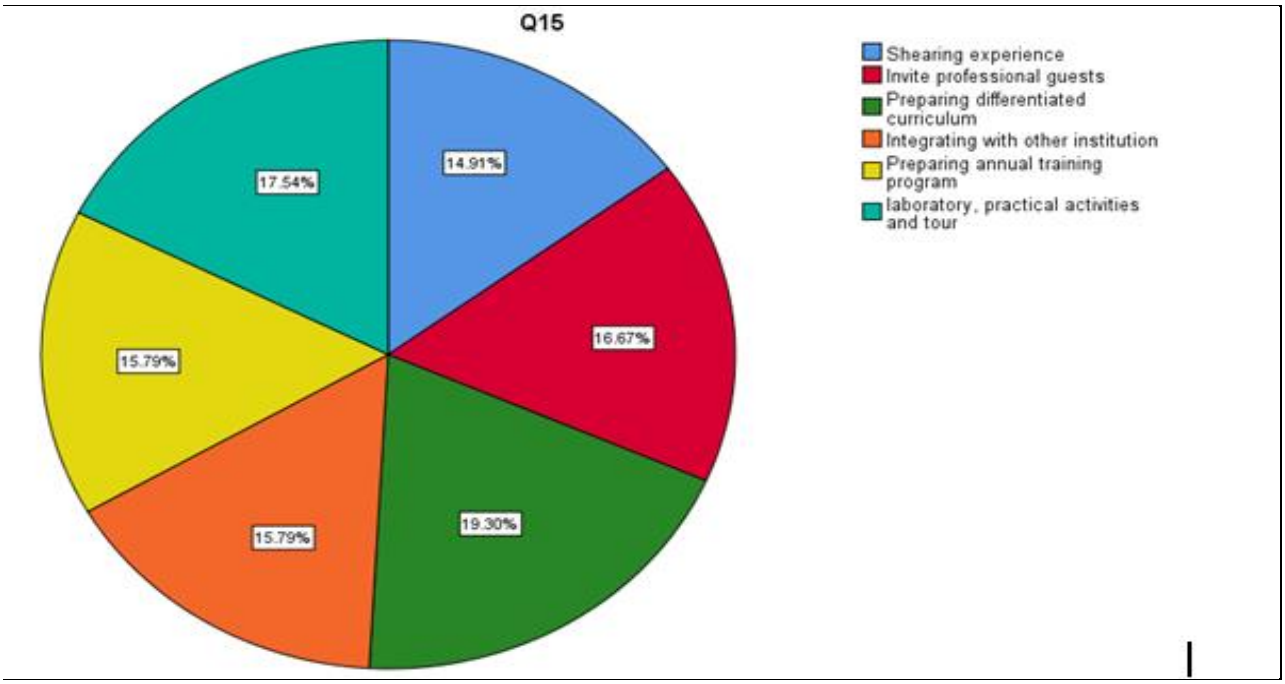

Figure 1.3 Percentage descriptions of methods of tacit knowledge transfer in the future.

Student respondents were also asked to choose which mechanisms of knowledge transfer provide them an opportunity to grab efficiently the knowledge that will possibly be transferred. As figure 4.2 reveals, sample students preferred knowledge should be transferred by *training* (22.8%), *best practice* (18.4%), *workshop* (14.9%), *observation* (11.4%), by using *social media* (9.7%), storytelling(8.8%), by using flayer & journal (8.8%) and others(5.2%). Generally, training, the narration of best

practices, and workshops constitute the larger portion of students' preference mechanisms whereby tacit knowledge will be transferred from resource persons. In the meantime, the statements of those interviewees solicited to express the points that they thought left aside to be not mentioned, were presented as follows.

> *I believe this research is relevant. We should help the SSC students to be important citizens who are hopes of their country Ethiopia.* ---- N's reflection.
>
> *Not enough attention is given to the students based on the initial aim of the school. That is why there is a mismatch between the potential of the students and what they learn right now. Thus, a special curriculum, teaching methods, and specially trained teachers are needed for these students. The current teachers in SSC should be given continuous training on different issues related to teaching these students.* ---- O's reflection

In connection to this, sample students in the questionnaire were asked to select ways (because more than one option was allowed to select) with which the sustenance of SKT will be ascertained in the future in the school. For the student, the pallet questionnaire for sustainable knowledge transfer with regard to being developed suggested that the knowledge transfer in our campus will achieve the mission of the SSC. *The* given replies were summarized as a questionnaire in Table 1.9.

Fig.1.9 Students response on their preference of the KT through sustainable in our campus.

Variable	Sustainable manner OF Kt (Optional)	Responses	
		No.	Percentage
Which would you suggest for the future to sustainable KT in campus?	Shearing experience	62	15.0%
	Invite professional gusts	81	19.6%
	Preparing attractive and interesting program	70	16.9%
	Integrating with other institution	64	15.5%
	preparing annual training program	66	15.9%
	laboratory, practical activities and tour	71	17.1%
	T o t a l	414	100.0%

From the above data, it is possible to say that 19.6% of the majority of respondents invited professional experts to suggest sustainable knowledge transfer for their students. The other three options, like laboratory, practical activities, and tour, preparing attractive and interesting programs, and sharing experience, are preferred for sustainable knowledge transfer on our campus.

A typical example of the prospect of EKT process

To depict how was effective the given training and how will it be valuable if students have it in the formal education, the researcher used the data obtained through the questionnaire that was prepared for the students who attended the STEM power training scheme. The data were analyzed by using the mean and standard deviation of which drawn from the rating system of the five Likert scales ranging from 1-5 (1 was very important, 2 was important, 3 was not sure, 4 was somehow important and 5 was not important at all). Before analyzing the data, a reliability scale test of prevailing variables has been made, and found the variables to be more reliable (as Cronbach's alpha shows in table 3.8).

Table 1.10 result of reliability analysis of the variables

R E L I A B I LITY STATICS	
Cronbach's Alpha	N of Items
0.958	7

In the questionnaire, students were requested to indicate the level of effectiveness of the training given and how much training is sustained as a system of receiving additional knowledge in their formal education. The study findings were presented at the table 4.8

Table 1.11 Importance and effectiveness of the training given by **STEM** power program

The aspect of evaluating the effectiveness of the given training	**Mean**	**Standard Deviation**
Please rate the overall level of the given training and your expectation.	1.37	0.817
Rate the relatedness of contents in the training with contents you have learned in some subjects.	1.38	0.733
The level of the training could be effective means of knowledge transfer	1.42	0.846
Please rate the importance of the training to your overall curiosity of tacit knowledge receipt and long – term retention.	1.48	0.799
The status of the training in terms of transferring knowledge and skill as goals set aside.	1.50	0.744
Please rate the level of the training relative to fill the gap of knowledge created by formal education.	1.50	0. 875

Rate the level if such training will be part of the school system along with the regular mainstream of formal education.	1.71	1. 148

The findings in table 4.2 show that the majority of trainees rate that the overall training situation was very important for them as this was indicated by a mean of 1.37 with 0,817 S.D. also the study found out that respondents evaluated that there are relations between contents of the training and the contents learned in some science subject in the formal education. This was indicated by a mean of 1.38 and 0.733 S.D. Further, the study found out that the majority of trainee respondents also rate by a mean of 1.42 (0.846S.D) that training became a very important mechanism of knowledge transfer during the training. Also, as indicated by a mean of 1.48 with S.D of 0.799 majorities of trainee found the training given to be very important in connection to receiving tacit knowledge which can be retained for a long in the mind of the students (trainee). Further, the study found out that majority of the respondents as was indicated by a mean of 1.50 with S.D of 0.744 in this case rate that the training was very important in terms of transferring scientific knowledge relative to its own goal. Also, the majority of respondents found the training to be very important again in filling the gap of scientific knowledge created informal education. This was indicated by a mean of 1.50 with S.D 0. 875.

4. Discussion

The observations were conducted to observe the extent to which internal knowledge (content knowledge) transfer was processed and became fruitful in addressing the needs of gifted students in the study area. Accordingly, in the field, researchers observed when the students discussed and reviewed the lesson learned in the class. Some discussions were in the form of debating, while others were in the form of narrating and making clarifications of the contents learned. This conclusion is positively consistent with the first mission of open observation and taken as a good way of knowledge transfer, as reviewed in the literature of Abuhimed (2015) and Becheikhetal (2007). With regard to the second mission of open observation, the result indicates that some common claims rose up against certain teachers about their teaching techniques, their academic language commandments, time management, and ways of ascertaining learning quality (correction and feedback giving for class work, homework, assignments, etc).

The role of applying different active learning methods, including project work and individual/tired assignments, is immense in the process of transferring explicit (basic or content) scientific

knowledge, although certain obstacles are present in the study area, and this suggestion goes in line with the suggestion (Grassler & Glinnikov, 2008; Dahalin & Suebsom, 2010). As the mean analysis report indicates, the role of knowledge sharing among students in and out of the classroom is so great that it should be scaled up from the existing fair level to the level of perfect status. The role of additional resource utilization (as opposed to sticking solely to the textbook) for knowledge transfer processes is also critical, as was reviewed by Millar (2004) in that gifted students get the opportunity to enrich as well as accelerate educational processes. Trip knowledge, experiential knowledge, and observation play significant roles in transferring scientific knowledge, especially the tacit one. It also provides linkage opportunities for the students with resourceful people (knowers, researchers, experts, etc.) to acquire tacit knowledge, which accentuates either learning by doing or addressing the learning style of gifted students.

5. Conclusion

This study found out that the role of content knowledge transfer is basic for the future academic competence of the students and by which effectiveness in turn relies on active learning methods, teachers ability to adapt in the classroom teaching-learning activities and which in its expense let students go at their pace for knowledge acquisition. If it could be effectively applied in classroom instructional processes, for example, problem-solving, project works, tiered assignment, inquiry-based learning, etc., there would have been numerous roles that active learning methods played.

Active learning method fosters a productive learning environment which students, teachers even the school is benefiting from. Since active learning promotes active engagement of students in the teaching-learning processes, therefore, it enhances interest in the subject as well as to the science field in the future schooling progress or else in the future career. In this reality, applying active learning methods plays great roles in academic performance of the student. Yet, the reverse is found to be the reality again in the study area. Most instructors follow teacher-centered approach which prohibits in its side students' active involvement in instructional processes as against to the learning style of gifted students.

With regard to tacit knowledge transfer, once in the past there was such a transfer to the first batch of students, who benefited from acquiring implicit knowledge given by university researchers and academicians due to better communication the school leaders had with them. But the study reveals

that, currently, such a trend has stopped and students have no chance to acquire additional knowledge in the science fields. In principle, gifted students, like the student in the study area, need to engage in enrichment and acceleration gifted education, which support the idea of transferring external knowledge, and knowledgeable persons must let students acquire their knowledge, skills, and experiences through different mechanisms. Based on the analysis result, the following recommendation and further insight of indicating the thematic area of other research will be presented as follows.

The role of internal (explicit) knowledge transfer is multifaceted in shaping both the academic and behavioral development of students. By taking this into considerations, there should be support for teachers in equipping teachers with the necessary know-how on top of applying active learning methods in instructional processes by way of improving their teaching capacity via CPD, in-service training, scholarship for advanced learning, etc. Besides, reinforcement and recognition for those teachers who showed good deeds in their work are important. Providing, mentoring, counseling, monitoring, and coaching services one step ahead to the present nil position. Paying little attention to the shared science campus was one of the great problems that led to a shortcoming in internal and external knowledge transfer processes. Thus, as special needs learners learn on campus, special attention should be given by KUE leaders to the overall circumstances.

With the consent of the student, parents can arrange extra time (that may be after school or on weekends) to transfer both tacit and explicit knowledge to gifted students. KUE's R & D directorate and others should design and develop a development plan that can be cascaded to the school level, specifically related to knowledge transfer processes for gifted students. Essential facilities and financial support must be budgeted for specific purposes in order to transfer tacit knowledge as quickly as possible. Advise, order, awareness, and necessary incentives should be given to KUE researchers and academicians to make it convenient to transfer their potential knowledge, skills, and experience to the gifted learners in SSC. Finally, one must think about conducting other research on top of how the system is developed to execute effective and efficient scientific knowledge transfer processes in the study area.

Limitations

The study was confined to the Science Shared Campus due to the fact that researchers work there and looked at all the pitfalls that occurred in the teaching-learning processes there, especially some limitations for requesting instructors and key informant persons about the barriers to knowledge transfer. Plus, SSC is more accessible, being found at the main lane and positioned at the pivotal place of the Addis Ababa City Administration. Although the study was aimed at being finalized within one year, due to the repercussions of COVID-19, it has consumed more than that time frame.

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Declaration of competing interest

The authors declare that there is no conflict of interest in this study.

Authors' contribution

All authors contributed equally.

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