

# **CROSS-LINGUISTIC ADAPTATION OF TEST FOR BASIC SCIENTIFIC LITERACY: PROCESSES, CHALLENGES AND POSSIBILITIES**

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## Abstract

*Cross-border exchange of research instruments has become a norm in academia. However, tools that cross cultural and linguistic boundaries require attention to ensure their relevance and validity in the context for which they are being imported. One such tool, the Test for Basic Scientific Literacy (TBSL) is a 110-items paper pencil test that was developed to measure scientific literacy among university entrants in South Africa. TBSL was adapted and translated for the doctoral study discussed in this paper, for exploring the level of Basic Scientific Literacy (BSL) among pre-service teachers (n=688) across two cities in the province of Sindh in Pakistan, to address the linguistic and contextual needs of the participants. This paper illustrates the complexity of the multi-step process of translation, along with its technical, linguistic, and conceptual challenges. Findings reveal how English-Urdu translation creates multiple equivalency threats. Key considerations for establishing linguistic equivalency of research instruments are suggested, to enhance cultural appropriateness while adapting cross-border research tools for future research.*

**Key Words:** Basic Scientific Literacy, Equivalences, Tool adaptation, Translation.

## 1. Introduction

The use of research instruments across borders has become a practice in academia, specifically in fields that are of general interest and global significance. However, instruments that cross cultural and linguistic boundaries require detailed attention to ensure their validity and relevance in the context for which they are being imported. The present doctoral study aimed to explore the level of basic scientific literacy among pre-service teachers enrolled in a four-year Bachelor of Education (B Ed.) program in Sindh, Pakistan. For this purpose, an adapted version of the Test for Basic Scientific Literacy (TBSL) tool was used to test 688 pre-service teachers, in Public teacher education institutions in two cities in Sindh, selected through multistage cluster sampling. TBSL is a 110-items paper pencil test developed to measure scientific literacy among university entrants in South Africa (Laugksch & Spargo, 1996). While importing TBSL for this study, it was adapted in order to suit the linguistic and contextual needs of the participants, through an extensive process, of which translation was an important part.

This paper focuses on the researcher's experiences related to tool translation, while trying to establish semantic, cultural, and conceptual equivalencies between the original and the adapted tool. The paper highlights the multi-step process of translation, along with the possibilities and challenges in establishing equivalences. Moreover, key considerations for establishing linguistic equivalency of research instruments are suggested, for enhancing the cultural appropriateness of adapted tools in future research.

## 2. Literature Review

The literature presented here provides a blend of theoretical and pragmatic perspectives on translation. Intersecting, as well as contrasting, notions between theory and practice highlight the sensitivity of the associated concepts and the areas needing attention to enhance competence in the area of translation.

### 2.1 Concept of Equivalence in Translation:

The practice of cross-cultural adaptation of research instruments has increased in the last few decades due to the economic viability of the process, as relatively less resources and time are required to adapt a tool than to develop a new one. More importantly, a careful adaptation process also offers a possibility of cross-national comparison of the research finding (Hambleton, 1993). However, equivalence between the actual and the adapted version of the research tool remains one of the major concerns for researchers. Arguably, equivalence, in a holistic sense, can only be attained if consistency is ensured at the level of literal meaning (*semantic*), colloquial expression (*idiomatic*), contextual experiences (*cultural*) and in-depth meaning (*conceptual*). That said, emphasis on the above-mentioned levels may differ according to the nature and purpose of text (Ohrbach, Bjorner, Jezewski, John, & Lobbezoo, 2009).

Hambleton (1993) reported practical challenges leading to inequivalences in tool translation. He suggested to use validated standard methods to unravel these issues. Similarly, Ohrbach et al. (2009) proposed a multi-step process of tool translation to examine technical gaps in the translation through forward-backward method and statistical validation. However, they acknowledged that culturally valid instruments cannot be created by “strictly following a pre-specified set of instructions” (p. 7). Pragmatically speaking, tool translation is a meticulous yet flexible process, where new approaches are added by the researcher as per the available resources and the psychometric requirements.

Although it is established that equivalence is the central focus in translation, it is conceptualized in different ways by different scholars (Gambier & Van Doorslaer, 2010; House, 2008; Newmark, 1988; Nida, 1991; Pym, 2010). This multiplicity leads to equivalence becoming imprecise, ill-defined, and an elusive representation of symmetry between languages. (Kashgary, 2011; Pym, 2010). Panou (2013) states that the problem may not necessarily lie in the diversity but the bipolar nature of theoretical views in most of the linguistic oriented theories; for example, formal and dynamic equivalence (Nida, 1991), semantic and communicative translation (Newmark, 1988), overt and covert translation (House, 2008), and many others. This dichotomous notion of equivalence makes translators sub-ordinates of the source text, forcing them to fulfill the stated requirements of equivalence. This makes equivalence a troubled notion, as it is mostly misunderstood as a set of criteria that any translation

needs to meet, rather than as a relationship between the target text and the source text.

In spite all critiques and theoretical divergences, equivalence will remain central to the practice of translation (Gambier & Van Doorslaer, 2010; Xiabin, 2005). This paper argues that if equivalence is an absolute requirement in translation, the nature of equivalence should be understood and dealt with caution, at the semantic, contextual, and conceptual levels.

## **2.2 Non-Equivalence between English and Urdu:**

Considering that equivalence is the essence of translation, its absence creates non-equivalence at the word, grammatical, textual, and pragmatic levels. However, non-equivalence is a constant factor between any two languages. Kashgary (2011), in his analysis of English-Arabic translations, realized that many terms which are considered as equivalent, if closely examined, are found untranslatable. This non-equivalence prevails within many languages, as each language has its own way of lexicalizing meaning and concepts. The same is true for English-Urdu translation, as the two languages differ from each other in textual, grammatical, and socio-semiotic expression of words.

As far as Urdu is concerned, it differs from English in morphological, technical, and grammatical aspects. For example, the two languages represent different syntax or word order in a sentence, the Subject-Object-Verb (SOV) order in Urdu versus the Subject-Verb-Object (SVO) order in English makes literal translation both difficult and incomprehensible. Another issue relates to the different grammatical construction of words in Urdu. Urdu has multiple forms of words and varying gender overtones with noun and verbs (Ahmed & Alvi, 2002). Words in Urdu change their form with respect to gender, numbers, and other features of the sentences.

Considering the differences in the linguistic features of two languages, borrowing words from the source language has become a common practice in translation, particularly in the context of scientific text. This is one of the strategies for handling inequivalences in translating technical terms between different languages. However, Ngoben (2013) stresses to use borrowing as a last resort; considering it as a threat to local

language. Maqsood, Saleem, Aziz, and Azam (2019) disregard the belief that borrowing is a random process; rather, suggest grammatic arrangements for borrowing nouns and verbs while translating between English and Urdu. This systematic approach can make language integration appropriate both morphologically and syntactically. Though English has more capacity of borrowing and has borrowed words from many languages in the past, it has now become a powerful donor language due to its place in knowledge economy.

### **2.3 Complications in Translating Scientific Texts:**

Challenges in establishing equivalences in tool translation are multifold in case of technical texts (e.g. scientific terms), where language depicts specific meaning. Ngoben (2013) states that messages within a scientific discourse include subject relevant information and implicit cultural perspectives. This cultural aspect embedded in the text may add to the complications of translation of scientific texts. Stolze (2009) highlights some examples of inter-cultural incongruence of concepts between comparable terms in the German and English languages. The study found that German expressions were more explicit whereas English had semantic variations in the form of multiple words. He also found that literal translation of idiomatic phrases mostly resulted in difference in levels of cognitive ideas, as compared to the original text. Similarly, several other studies mention difficulties in translation due to lack of one-to-one equivalence between the words in two languages; for example, Arabic-English (Ahmed, 2016; Ashuja'a, Almatari, & Alward, 2019, Ethelb, 2019), Urdu-English (Halai, 2007). Silalahi, Rafli, and Rasyid (2018), while analyzing the Indonesian translated version of English scientific text highlighted lexical, morphological, and syntactic errors. One of the reasons for this was lack of understanding of the source text among student translators involved in the translation process.

Contrary to the structural approach, Halai (2007) used cultural decoding as a theoretical lens in her study. While translating bilingual interviews, she realized that the richness, meaning, and cultural flavor of Urdu was lost in its English translation. She called the process "transmutation" (p. 348), because though the resultant text preserved the essence, the textual form changed. She suggested ensuring equivalence at

the level of meaning rather on the structure of sentence. This theoretical lens has been used while translating the TBSL for this doctoral study. The main focus has been on meaning rather than on the composition and structure of the sentence.

## **2.4 Test for Basic Scientific Literacy (TBSL): Target Tool for Translation:**

Considering the need of a comprehensive tool suitable for a large-scale test, the Test for Basic Scientific Literacy (TBSL) tool was developed by Laugksch and Spargo (1996), to measure scientific literacy among university students in South Africa. It is a paper pencil 110-items test, with a three-point scale: yes, no, don't know, for marking the given statements. These 110 statements were drawn from 472-items question bank, initially developed by the authors of the tool as a part of doctoral study.

The tool is based on the definition of scientific literacy mentioned in the document of Science for All Americans (AAAS, 1989) and uses three dimensions of scientific literacy given by Miller (1983). The total items for each dimension are: science content knowledge (72 items), nature of science (22 items), and the impact of science and technology on society (16 items). The authors of the tool suggested cut-off scores through the Ang-off method as a qualifying criterion for each dimension, whereby, a person securing cut-off scores or more in all three dimensions would be considered as scientifically literate. This non-compensatory standard to pass the test makes this criterion stringent. Moreover, the coverage of a large number of concepts, along with the selected response format, makes this criterion-referenced test a suitable tool for identifying the mastery and non-mastery groups in a large sample, in a valid and feasible manner.

Rigorous steps were taken by the authors of TBSL tool to ensure content, construct, and item validity (Laugksch, 1996). Internal consistency between the items was measured through the Kuder-Richardson 20 coefficient, and values obtained were found to be acceptable for a criterion referenced test (i.e. TBSL=0.95, NoS=0.73, SCK=0.94, STS=0.78). Though the tool was developed for high school leavers/university entrants in South Africa, its Chinese translated version

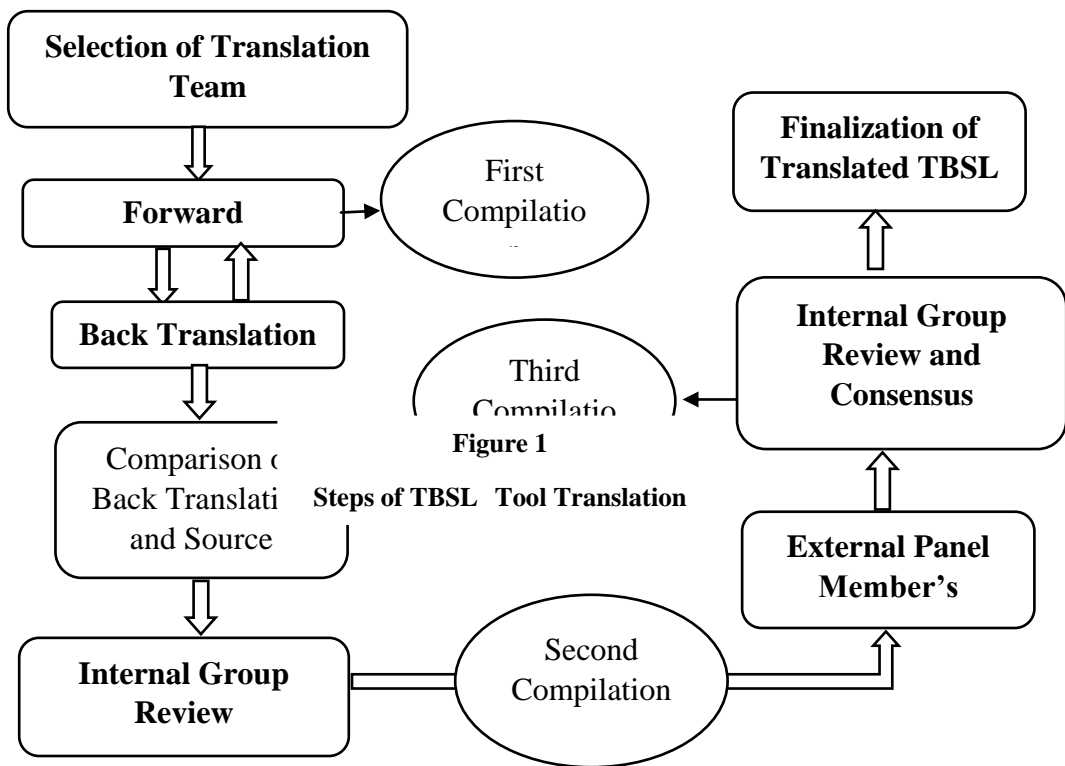
has been used to gauge the level of scientific literacy among first year pre-service teachers enrolled in four teacher's colleges in Taiwan, with an overall reliability of 0.93 (Chin, 2005). Similarly, the tool maintained its reliability ( $\alpha=0.92$ ) for a sample of Turkish pre-service science teachers (Cavas, Ozdem, Cavas, Cakiroglu, & Ertepinar, 2013). This consistency in tool psychometric in different contexts supports its suitability for wider application.

With this backdrop, TBSL was selected for the present study to measure the level of Basic Scientific Literacy (BSL) among pre-service teachers in Sindh, Pakistan. However, English as the source language in TBSL was found to be one of the major challenges in its implementation, due to diversity in the language and culture of the two countries. Though English is an official language in Pakistan, Urdu is the lingua franca. Further, Urdu is mostly used as a medium of instructions at almost all academic levels; particularly in public institutions of higher education (Ahmad & Gopang, 2007; Nadeem, 2012); and the teaching learning practices in B Ed. (Hons.) classrooms are not an exception. Therefore, it was imperative to translate the TBSL into Urdu, to make it user friendly for the Pakistani context.

### 3. Methodology

The TBSL underwent three stages of tool validation before its actual use in the field. This included (i) expert review for content and face validity, (ii) translation of TBSL in the Urdu language, and (iii) piloting of the adapted tool for respondents' feedback and psychometric evaluation. This paper discusses the steps and challenges during the second phase of tool validation, that is translation. A multi-step process of translation was carried out, as shown in Figure 1; each step is described below.





### **3.1 Selection of the Translation Team:**

The translation team comprised the team coordinator, two forward translators, a back translator, an internal review committee, and a panel of independent reviewers. Special consideration was given while selecting the translation team members; for example, most of them had at least a Masters-degree either in science or science education, and had an excellent command of both the source and target language. Further, the team was a blend of science teachers, teacher educators, researchers, textbook writers, and translators, with experience ranging from five years to twenty-five years in the relevant field. Information about the purpose of the study and the translation phase, specific guidelines related to language equivalence, along with the review tool were provided to the respective team members, as per their roles.

### **3.2 Forward Translation:**

The first step was forward translation, where two independent translators translated the tool from the source language (English) to the target language (Urdu). These translators had the target language (i.e. Urdu) as their mother tongue and also had command on English. However, both had different subject backgrounds. One translator had a science background and was aware of the concepts being examined in the TBSL, whereas, the other had a nominal understanding of science. The two versions of translations helped in comparing the discrepancies and in ensuring a balance between the technical and common language used in the translations. The researcher, as the team coordinator, reviewed both the versions and synthesized them into one tool by adjusting all discrepancies through back and forth discussion with both forward translators.

### **3.3 Back Translation:**

Totally blind to the original version, a translator, having command on both languages and science content, translated the Urdu tool back into English. The purpose of this step was to ensure that the translated version reflected the same concept and ideas as the original TBSL tool. The researcher reviewed the source document and the back translation to

compile key discrepancies in both the versions, for further review by the internal review committee.

### **3.4 Internal Group Review:**

This step was carried out by the internal review committee, consisting four members: three supervisors of referred doctoral study and the researcher. These internal reviewers were well-informed about the entire study. One member had a doctoral degree in educational assessment, whereas, the other two professors were experienced science educators, researchers, and curriculum developers. Items having discrepancy between the source document and the back translation were discussed for mutual agreement. The researcher incorporated those decisions and revised the translated tool for the next step, that is, external review by independent panel members (practitioners).

### **3.5 External Panel Members' Review:**

Six external reviewers, having content background, independently reviewed the tool to ensure that all four equivalencies: semantic, conceptual, idiomatic, and cultural were met in the translated version. The reviewers were practitioners from the field, having experience as science teachers and teacher educators at the secondary and higher secondary levels. Each of them was given guidelines and a review tool to rank the 110 items, on a scale of 1-4 (1=not equivalent, 2=somewhat equivalent, 3=quite equivalent, and 4=completely equivalent). Moreover, comments and suggestions were sought for items marked 1 or 2 on the scale of 1-4. For analysis, scores 1 and 2 were merged as non-equivalent category, whereas 3 and 4 were merged as equivalent category. Average was taken for each item. Results showed that, except for five, all items got average, more than 0.83, which means that five out of the six reviewers considered them as either quite equivalent or completely equivalent.

### **3.6 Internal Group Review and Consensus:**

Revisions suggested by the external panel members were reviewed by the internal review committee, specifically on the five items that were marked non-equivalent by either two or more external reviewers. These

suggestions included changes in specific words or phrases within sentences, for clarity and simplification. The final consensus of the internal group reviewers was documented and was used by the researcher in the compilation of the pre-final version of the adapted TBSL.

### **3.7 Finalization of the Translated TBSL:**

The pre-final version of the adapted TBSL had three sections: (i) demographic information of respondents (e.g. gender, year of B Ed. program, academic qualification), (ii) instructions and test items with options (True, False, Don't Know), (iii) consent form for participation in the second phase of the study. All three sections were presented in both languages (English and Urdu) to facilitate respondents coming from different demographic and academic backgrounds. The pre-final adapted TBSL was then sent for field testing, which was the third stage of tool validation and is beyond the scope of this paper.

## **4. Findings and Discussion**

The findings revealed the threats to equivalences encountered during the translation of TBSL from English to Urdu. Further, key considerations, with reference to the translation strategies and translators' style, are discussed, which describe the pragmatic approach used by the team to ensure the quality of translation.

### **4.1 Paradox of English-Urdu Translation:**

**(4.1.1) Urdu lacks equivalent terms:** The original TBSL contains certain specific terms that have no direct Urdu equivalent. Table 1 presents some of these specific terms along with their closer Urdu alternates suggested by the forward translators and the reverse English translations made by the back translator.

**Table 1**

***List of Terms that Lack Urdu Translation***

Terms	Forward translation	Back translation
Mutations	تبدیلیاں / Tabdeeliaan	Changes
Abnormal	خلاف معمول / Khilaf-e-ma'mool	Unusual
	بے قاعدہ / Bei-Qaai'da	Irregular
Encoded	لکھی گئی / Likhi Gayee	Written
Data	معلومات / Ma'lumaat	Information
Phenomena	واقعات / Waaqiyaat	Incidents
	عمل / Amal	Action
	مظاہر / Mazaahir	Manifestations

Evidently, the suggested alternatives in Urdu provide approximations in meaning but may not fully express the exact meaning, with the same details, as in the original term. A few examples from Table 1 are discussed to show the possible threats to equivalences, and the devised rules by the translation team to mitigate the risk.

*Example 1: Abnormal genes do not affect how human body parts or systems function.*

ایب نارمل جینز اس بات پر اثر نہیں کرتے کہ انسانی جسم کے اعضاء یا نظام کس طرح کام کرتے ہیں۔

The term “abnormal genes” is a specific science term, which refers to the unwanted changes in normal genes leading to genetic disorder. It

was realized that if translated as “بے قاعدہ چیز” or “خلاف معمول چیز”, as suggested during forward translation, it would not express the concern of it being something that worries somebody or is harmful or not wanted biologically. The problem faced was creating an equivalence in the expression, or the intensity through available terms. To preserve the conceptual meaning, the translators decided to borrow this word from English instead of using its literal translation.

*Rule 1: Wherever there is no exact word available in the target language and close translation would not reflect the same depth or concept in meaning, borrowing the word from the source text should be done (Loanng words).*

*Example 2: New combinations or **mutations** of parents' genes do not result in new characteristics which can be inherited.*

والدین کے جین کے نئے ملاپ یا چینیاتی تبدیلیوں کے نتیجے میں کوئی ایسی نئی خصوصیات حاصل نہیں ہوتیں جو ورثے میں منتقل ہو جائیں۔

In example 2, the term “mutation” refers to the changing of the structure of a gene, resulting in a variant form that may be transmitted to subsequent generations, caused by the alteration of single base units in the DNA, or the deletion, insertion, or rearrangement of larger sections of genes or chromosomes. This change in DNA sequence occurs due to a mistake or environmental factors. However, “تبدیلیاں (changes)” does not depict the same context of this scientific term. Further, borrowing of the word was likely to increase the complexity for the reader due to the difference in the lexical touch of this English term. The translation team, therefore, decided to use a closely matched translation supplemented with an additional word to ensure the better comprehension by the readers.

*Rule 2: When no exact alternate word is available in the target language and borrowing from the source text does not synchronize with the textual structure, a closer matched term with an additional word should be used in order to avoid readers' difficulty in meaning making (Supplemented Translation).*

*Example 3a: Scientists try to make sense of **phenomena** by inventing explanations for them. These explanations rarely use currently accepted scientific principles.*

سائنسدان واقعات کی سمجھ بوجھ کے لیے ان کی وضاحتیں مرتب کرتے ہیں۔ ان وضاحتوں میں موجودہ تسلیم شدہ سائنسی اصول کبھی کبھار ہی استعمال ہوتے ہیں۔

*Example 3b: Sooner or later, the validity (i.e. truth) of scientific claims is settled by referring to observations of **phenomena**.*

جلد یا دیر سائنسی دعوؤں کی سچائی ان عمل کے مشاہدات سے طے پا جاتی ہے۔

In examples 3a and 3b, the term “phenomena” is used, which means something that exists and can be experienced or felt, especially because it is unusual or interesting (“phenomena,” n.d.). Though this characteristic of being unusual can be expressed through translation as “مظاہر” provided by the online translation databases, contextually it sounds unfamiliar due to very limited usage of this term in day-to-day communication. Thus, to facilitate readers’ comprehension, the closest alternates that synced with the sentence context and structure were used. Examples 3a and 3b show two different translations of the term “phenomena”, “واقعات”, “عمل”, respectively, to preserve the semantic equivalence of the original and translated items.

*Rule 3: Terms which do not have an exact alternate in the target language and the closest word would be challenging for readers’ comprehension, an alternate word should be selected keeping the content and context of sentence in mind (Item-contextual Translation).*

**(4.1.2) Multiple alternate words available with different meaning expression:** During translation, the team came across English words that had more than one alternates available in Urdu, but these differed with respect to context, syntax, delicacy, and/or level of complexity, impacting

readers' comprehension. A few examples from the list mentioned in Table 2 are discussed.

**Table 2**

*List of Terms with Multiple Urdu Translations*

<b>Terms</b>	<b>Multiple Urdu translations</b>
Physical	جسمانی / Jismani طبعی / Tabaée
Money	رقم / Raqam پیسہ / Paisa (colloquial use)
Each	ہر / Har ایک / Eik
Segment	حصہ / Hissa ٹکڑا / Tukra
Scientists	سائنسدانوں / Saainsdaano سائنسدان / Saainsdaan
Oceans	سمندروں / Samandaro سمندر / Samandar
Seldom	شاذونادر / Shaz-o-nadir کبھی کبھار / Kabhi Kabhar
Unaltered	غیر متغیر / Ghair Mutaghayyar تبدیل نہ ہونے والا / Tabdeel na honey wala
Living Organisms	ذی حیات / Zee Hayaat جاندار / Jaandaar



*Example 4a:* All things of the **physical world** are made up of different combinations of about 100 chemical elements.

طبعی دنیا کی تمام اشیاء تقریباً سو (۱۰۰) کیمیائی عناصر کے مختلف طرح کے مجموعے سے بنی ہیں۔

*Example 4b:* Psychological distress (such as the death of a close family member) does NOT affect any person's chance of becoming **physically ill**.

نفسیاتی پریشانی (جیسا کہ قریبی رشتہ دار کی موت) کسی شخص کے جسمانی بیماری میں مبتلا ہونے کے امکانات پر اثر انداز نہیں ہوتی۔

*Example 4c:* The way atoms bond together is determined by the arrangement of the outermost electrons in **each** atom.

ایٹم ایک دوسرے سے جس طرح کا بونڈ بناتے ہیں، اس کا پتہ ہر ایٹم کے بیرونی الیکٹرانز کی ترتیب سے چلتا ہے۔

The term “physical” has been translated as “جسمانی” (e.g. physically ill, (جسمانی بیمار) as well as “طبعی” (e.g. physical world, طبعی دنیا) depending upon the context of the item in which the term has been used. Similarly, two different, but exact, alternates were available in Urdu for the term “each”. It was clear that the exact translation of the term “each” in example 4c is “ہر” because it refers to the arrangement of the outermost electrons in both the atoms forming the bond. It was realized during translation that context of the term in the sentence decided which one of the available terms best suited the translation.

*Rule 4:* If more than one alternate word is available in the target language, selection should depend on the context in which the word is used in the sentence (Item-contextual Translation).

*Example 5:* **Scientists** share certain beliefs and attitudes about what they do and how they view their work.

سائنسدان جو کچھ کرتے ہیں اور اپنے کام کو جس نقطہ نگاہ سے دیکھتے ہیں، اس کے بارے میں ان کے نظریات اور رویے ایک جیسے ہوتے ہیں۔

During translation, it was realized that the plural form of the English term could not be translated into the conventional plural form in Urdu, like in example 5, the use of the term “سائنسدانوں” is syntactically inappropriate. Moreover, unlike English, Urdu has some terms, for example, “سائنسدان”, “سمندر”, which are used in both singular and plural forms, and other words in the sentence, like “کرتے ہیں”, “دیکھتے ہیں”, “ان کے”, depict their plural sense.

*Rule 5: If the conventional plural form in the target language does not match the grammatical structure, the singular form should be used, along with the syntax-relevant plural expression. (Syntax -contextual Translation).*

*Example 6a: Scientists can **seldom** bring final answers to matters of public debate (e.g. nuclear power or conservation of the environment).*

سائنسدان کبھی کبھار ہی عوامی بحث و مباحثے کے معاملات پر حتمی جواب دے سکتے ہیں (مثلاً نیوکلیئر پاور یا ماحول کا تحفظ)۔

*Example 6b: In most biological respects, humans are unlike other **living organisms**.*

زیادہ تر حیاتیاتی اعتبار سے انسان دوسرے جانداروں سے مختلف ہیں۔

Specific terms used in examples 6a and 6b are “seldom” and “living organisms”, respectively, which have good equivalents available in the Urdu language, for example “شاذ و نادر” for seldom and “ذی حیات” for living organisms. However, these are not a part of common vocabulary in daily conversation, hence, may appear complex to the readers. In such a situation, the translators had to make choice between use of sophisticated language, contributing to its delicacy, or to go for commonly used language for ease of comprehension. The translation team decided that the

term “seldom” should be translated as “کبھی کبھار” instead of “شاذونادر”, and the term “living organisms” should be translated as “جاندار”, instead of “ذی حیات”, in order to facilitate readers’ comprehension and comfort.

*Rule 6: If multiple exact alternates are available in the target language, common terms should be preferred to facilitate readers’ understanding and mental comfort (Reader-contextual Translation).*

**(4.1.3) Clash between semantic, conceptual and cultural meaning.** The complexity of translation was intensely realized with regard to technical terms, particularly those where different equivalences were conflicting. The examples in Table 3 required a lot of deliberation and discussion amongst the translation team members for simultaneously preserving the semantic, cultural, and contextual meaning of items. Each of these examples is explained in detail with reference to the actual and translated items.

**Table 3**

*List of Terms leading to conceptual, cultural and semantic inequivalences*

Terms / Phrases	Forward translation	Back translation
Level of the cell	سطح کی / Khalyey ki Satah	Surface of the cell
Liquid water	پانی / Paani	Water
Background radiation	تابکاری / Taabkaári	Radiation

*Example 7a: Many of the basic functions of organisms, such as extraction of energy from nutrients, are carried out at the **level** of the cell.*

جانداروں کے کئی بنیادی کام، جیسا کہ غذا سے توانائی کا حصول، خلیے میں ہوتے ہیں۔

The term “level” in example 7a has the Urdu equivalent term “سطح”. However, the term “سطح” has two meanings in Urdu language. One is

“surface” (e.g. the surface of the table is rough, میز کی سطح کھردری ہے) whereas the other meaning is “level” (e.g. This is a national-level program, یہ ایک ملکی سطح کا پروگرام ہے۔). Example 7a presents the idea that the cell is the unit where all functions in living organisms occur. However, during back-translation, it was realized that the use of the term “سطح” may lead to an understanding that all functions in living beings occur at the surface (outside part or upper most layer) of the cell.

*Example 7b: There is no **liquid water** at the surface of planets other than the earth.*

زمین کے علاوہ دیگر سیاروں کی سطح پر پانی مائع شکل میں نہیں ہوتا۔

In Example 7b, the term “liquid water” is used, whose literal translation is “مائع پانی”, whereas in Urdu there is no such terminology. In Urdu, the word “پانی” represents the liquid state of water. Therefore, the term “مائع پانی” sounded absurd from the cultural angle. On the other hand, using the term “پانی” only in the item, could lead to confusion in the readers’ mind (if they consider it as a compound rather the state). It is scientifically proven that water (compound) does exist on other planets in the solid and gaseous forms. Research participants knowing this fact may mark it as a false statement and lose marks. This reflects the complexity in simultaneously creating cultural and conceptual equivalences for the given items.

*Example 7c: A low level of **background radiation** exists naturally in the world around us.*

ہمارے ارد گرد کی دنیا میں معمولی سطح کی پس منظر تابکاری (background radiation) قدرتی طور پر موجود ہوتی ہے۔

Both forward translators used the term “تابکاری” for “background radiation”, with the rationale that there is no such term as “پس منظر تابکاری” in Urdu for this scientific term. On the other hand, the back translator proposed “radiation” for the proposed term “تابکاری” during the reverse translation process. This issue was noticed by the researcher when a discrepancy was seen in the back translation and the original TBSL, where the former used “radiation” and later used “background radiation”. This made researcher seek an explanation from the forward translators. However, unsatisfied with the rationale given by them, the researcher took this case to the internal review committee. Discussion among the reviewers revealed that the term “background radiation” has a specific meaning, which is different than the term “radiation”. Background radiation refers to the radiation which is present all around us. These are found naturally on earth and come from some soil, rocks, etc., and from outer space (e.g. cosmic rays and radioactive rays). Unlike radiation (e.g. nuclear radiation), background radiation refers to one that is present in the environment without deliberate introduction from a radiation source.

The above examples clearly show the risk of conceptual errors occurring due to cultural and semantic aspects of equivalences. In such cases structural changes were made in translation in order to retain the conceptual meaning, without compromising much on the cultural and semantic aspects. For instance, in example 7a, the term “level” was omitted in the translation. The new translated version preserved the concept of having cell functions within cells. Moreover, structural change within the sentence in example 7b preserved the cultural sense of “water” as well as the conceptual part related to its liquid state. In example 7c, the team decided to add the term “پس منظر” with “تابکاری” to distinguish it from other types of radiations; however, the original English term was kept in brackets for the readers’ clarity and reference.

*Rule 7: In cases where literal translation creates cultural, conceptual, and/or semantic issues in meaning making, major or minor changes in the sentence skeleton and word expression can be made, as per need (Adaptation).*

## 4.2. Key Considerations:

Though scientific terms are considered to be universal, communicating specific meaning, examples in this paper show that even scientific texts are dependent on culture for interpretation. The inequivalences in scientific text can be seen at the words and syntax level. In case of words, some internationally standardized terminologies of science (e.g. molecule, atoms) carry no cultural differences, but such terminologies are few. While new terminologies are being created to express the similarities in the function, form, or position of the object, different interpretations of the same scientific idea in two cultures may lead to different cognitive concepts, thus making the translations unidentical (Ngobeni, 2013). This varied cultural interpretation is a threat to equivalence, particularly if the translator does not belong to the same culture.

To standardize the process, several dictionaries and databases have been developed, but these are not exhaustive, as creation of new terms is an endless process in language development. Stolze (2009) has, therefore, pointed out that using these dictionaries and databases does not guarantee correct translation. Moreover, in case of sentence structures, word compounding, or stylistic forms may be different in two languages. The difference in stylistic formulation in the source and target language excludes the option of literal translation for translators. Hence, Stolze (2009) suggests that translators should have a global view at the beginning of the translation process, rather focusing on the syntactic elements of the given text.

Further, cross-cultural translation should not be considered as a linear and simple process. It is important to focus on the cultural context, discourse fields, conceptual world and predicative mode (Stolze, 2009, p. 138) together, which requires in-depth discussion amongst the translation team members. Dialogue is, therefore, the *soul of cross-cultural translation*, as it leads team members to keep an eye on multiple fronts and to take wise decisions, maintaining a balance between form and the meaning of scientific language.

The experiences during this study showed that there is no “one size fits all” strategy. Depending on the context, loaning words, supplemented

translation, item-contextual translation, syntax-contextual translation, reader-contextual translation or adaptation strategy can be used. Translators, being the key players in this process, have a significant role in the selection of the most appropriate strategy to make translation culturally, conceptually, and semantically equivalent with the source text. However, the selection of language and approach in translation mainly depends on the underlying theory of translators. If translators are faithful to the message, they ensure that they preserve the semantic and pragmatic meaning. On the other hand, if they have “exaggerated respect” (Nida, 1969, p. 496) for the source language, they might consider it a divinely text and prefer the formal word to word approach of translation. Moreover, translators’ subjective interpretations and transfer decisions are based on their linguistic and cultural intuitive knowledge and experiences (House, 2008; Newmark, 1988; Stolze, 2009). Considering these factors, the selection of translators is a crucial step in the process. Hence, translators who are faithful to the message and know the cultural and conceptual features of scientific text should be selected in the team.

Regardless to all this, creating language equivalences is never simple. It is a continuous problem-solving process that requires several back and forth consultations, discussions, and debates. This rigour in the process makes it tedious; but it is worth experiencing the translation of a cultural embedded scientific text.

## 5. Implications and Conclusion

This paper highlighted the key challenges faced while establishing equivalence between the English-Urdu translation of TBSL instrument, as the two languages represent different cultures and linguistic frameworks. The paper also presented strategies that were used in the translation of scientific text. The whole discussion depicted that translating scientific text is a challenging task. The following implications and recommendations in the field of translation, have been surmised:

- Text for translation should be seen and interpreted within the cultural and contextual background right from the beginning. This will help in identifying the cultural traces within the text for selecting the right meaning.

- Translation is a dynamic process where pre-decided steps cannot be followed with a linear approach. It requires several modifications, a critical lens, and ongoing discussion within translation team.
- Translation should not be taken as easy-going task, which can be done by anyone randomly. Rigor and precision are important, which requires professional competency and a systematic approach on the translator's part.
- Translation should be done by a team of experts who possess knowledge of content, good comprehension ability, and a good linguistic background in the source and target languages. Also, they should be grounded in the social context to incorporate contextual sensitivity in translation.
- The presence of internal reviewers within the team is important for bringing a critical stance during translation. These experts must possess comprehensive knowledge about the scope, content, and purpose of the study. Their active involvement can help the team in understanding the conceptual issues in totality and in coming up with best options in case of discrepancies.
- Translators' approach should be critically examined during the translation review process, as their bias towards a certain language and/or strategy might influence the quality of translation.
- Professional training of translator should be considered as a pre-requisite of the translation task. Such training should encompass a range of knowledge and skills, including translation strategies, issues and gaps in creating equivalences, content and context of the scientific themes, and appropriate vocabulary and grammar of both languages.

Considering the centrality of translation in the cross-cultural tool adaptation process, it is recommended that the concept of equivalence be made a part of graduate level studies. The real experience in the field can help them try out innovative ideas and share their challenges and approaches with a wider community of researchers. Future publications in the field of translation can generate a new knowledge base, as well as raise the professional status of the translation field in academia.



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