Comparative study of 21st Century Skills of Science Teachers and Students of Formal and Non-Formal Educational Institutes

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ARTICLE DETAILS

ABSTRACT

It is very essential for teachers to practice 21st century teaching and learning skills while teaching in order to foster these skills in 21st century learners. The focus of this study was to explore the skills of science teachers regarding 21st century skills. For this purpose, an online survey was conducted to assess the 21st century skills of science teachers. The survey questionnaire was comprised of different subscales regarding 21st century skills namely as critical thinking, collaboration, communication and creativity. The questionnaire consisted of 5-point Likert scale. The overall results of the study reflected that science students possess more 21st century skills than their teachers. It was recommended for science teachers of formal educational setup to practice 21st century teaching and learning skills more often as possible to inculcate 21st century skills among the students. It is also recommended that teachers of formal educational setup must enhance critical thinking and increase collaboration with students. This study is significant in the way that it reveals the current scenario of the skills of the teachers that will readily be imparted to the 21st century learners.

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1. Introduction

The emergent technologies have offered marvelous opportunities for the people who got the skills to take advantage from the global economy which was spurred by information and communication technologies. These technologies have accelerated the global competence and
collaboration from the past thirty years. Education of the 21st century was among the top area that was profoundly affected by these rapid alterations in the patterns of society such as globalization. The 21st century teaching and learning endorsed the increasing complexities with the spurred penetration of information technologies. Today the educational institutes around the world are working to prepare young students to cope with the increasingly multifarious requirements of life and work regarding 21st century. Chu, Reynolds, Notari, Taveres, & Lee, (2016) highlighted that teaching has been modified rapidly over the past few decades which upthrust the demand of incorporation of 21st century skills in the curriculum.

There were different features of twenty-first century learning which have different characteristics to diverse standards. However, (Soland, Hamilton, & Stecher, 2013) classified these skills into three main categories: Cognitive competencies, Interpersonal competencies, and Intrapersonal competencies. According to Charland, (2014) a state survey in the state of Maine concluded that the educational institutions address “communication and technology” skills more directly and properly than other skills which is evidently a new opening of transition towards 21st century education. There were multiple frameworks of 21st century competencies with different foci (Mishra & Kereluik, 2011) such as the Partnership for 21st century skills, (2010) has identified four categories of these skills: firstly, collaboration and communication skills, secondly, thinking and problem-solving skills, thirdly, interpersonal and self-directional skills, and fourthly, the skills to use 21st century tools, such as information and communication technology (ICT). Wagner, (2008) also assembled seven skills-set that students and educators must possess: critical thinking and problem-solving, collaboration and leadership, agility and adaptability, initiative and entrepreneurialism, effective oral and written communication, accessing and analyzing information, and curiosity and imagination. It was argued that teachers of 21st century need to “use academic content to teach the seven survival skills every day, at every grade level, and in every class” (Wagner, 2008, p. 24). For now, researchers have converged from various frameworks (Dede, 2010: Voogt & Roblin, 2012) and presented most widely accepted framework which includes collaboration, communication, ICT literacy, and social and/or cultural skills (citizenship). Dede, (2010) mentioned the 21st century competencies as creativity, critical thinking, problem-solving, and productivity.

Today in 21st century there were some skill set which was strongly required to surpass life and work in this modified era. All these were expected from teachers to impart the certain skills among the students to prepare them for coping life and work demands of this rapidly transforming era. The core skills were critical thinking skills, communication skills, creativity and innovation skills, self-direction skills, maintaining global and local connections, and using technology as a tool (Ravitz, 2014). Teachers are the drivers of social change and they have to prepare students for successful future. In this scenario, The William and Flora Hewlett Foundation regarding Education Program Strategic Plan, (2010) mentioned five core skills to be imparted in students to prepare them for better future in Deeper Learning Initiative which were: Master core academic content, Think critically and solve complex problems, Work collaboratively, Communicate effectively, and Learn how to learn (e.g., self-directed learning). According to Simmons, (2010) and (Salleh, Kassim, Ismail, & Abdullah, 2015) the effective teaching of 21st century was hooked not only to possess stringent educational theory and management of the classroom but also demands over the skills of the students’ preparation to succeed in challenging global economy. Literature shows that there was a crucial needs to elevate the standards of teaching to develop world-level teaching competences required for teaching spaces and instructions in the 21st century millenium (Ibrahim, Adzra’ai, Sueb, & Dalim, 2019).

The focus of this research was the cognitive competencies that includes critical thinking,
creativity, collaboration and communication known as 4Cs (Schleicher, 2012). Partnership for 21st Century Skills, (2010) an organization established in 2002 for education also advocates the implementation of 4Cs. The 21st century skills were defined by the European Reference Framework of Key Competencies (European Parliament, Council of the European Union, Recommendation of the European Parliament and of the Council of 18 December 2006 on Key Competences for Lifelong Learning, 2006). Cretu, (2017) has measured these 4Cs in Romania and found that teachers have the need to expertise in 21st century skills as students has practised in earlier grades and they are as the teachers of 21st century that would be expected to have expertise and practiced these 4Cs in teaching the 21st century skills among their learners as well as for themselves to survive in this fast changing era. Scardamalia, Bransford, Kozma, & Quellmalz, (2010) concluded that effectually designed learning environments should make it conceivable to progress “communication, collaboration(teamwork), information literacy, critical thinking, ICT literacy”. Rusdin, (2018) in Malaysia found that high readiness in implementing 21st century learning among teachers. Moreover, a significant positive correlation was found between level of understanding of 21st century skills and academic level.

The literature suggested that 21st century cognitive skills were inter-related (Lai & Viering, 2012) and argued that critical thinking has been highlighted to predict various important educational outcomes. Lai & Viering, (2012) was of the opinion that creativity precipitated societal and technology changes which derives new ideas. Lubart & Guignard, (2004) also argued that creativity has its own importance in order to address new imergent problems with the continuing advances of technology, students and people would be stringently required to think in divergently creative ways. Rojas-Drummond & Mercer, (2003) highlighted the need of collaboration that it has powerful impact on student learning which was further endorsed by Ginsburg-Block, Rohrbeck, & Fantuzzo, (2006) that collaboration can increase the social competency. Recently collaboration is found as an important cognitive skills for 21st century. Paul & Elder, (2006) concluded that critical thinking was a key component during creative process. The recent literature showed that teachers were satisfied with “Google Sites” to collaborate (Chu, et al., 2011). But the most recent literature studies highlighted that the current situation of implementation of 21st century skills is not up to the mark and needs attention to immediate focus on it (Alismail & McGuire, 2015) and Santos, (2017) also concluded that practices of 21st century skills were still a challenge in classrooms and endorsed that there exists a significant difference among the perceived 21st century skills of teachers what they transferred and the acquired skills.

Learners of this era come with great exposure of technologies that provides new information on their fingertips. The role of teachers in this century has been framed as learning partner or facilitator. Advances in information and communication technologies (ICT) have changed teaching and learning (T&L) experiences and opportunities in considerable ways. In order to facilitate learning in this fast-paced era, teachers of today needs to equip with 21st century skills to keep abreast with their learners. Teachers must have new skill set of learning not only to cope with learners of 21st century but to instill these skills in the learners to survive in this era.

There is need to prepare the students for the world of tomorrow, the teachers must improve today’s learning environments” (Partnership for 21st Century Skills, 2009, p. 24). It is considered that by acquiring these skills, students can have the ability to continue learning and adjusting to change, effectively prepared to get success in career, life, and civic endeavors (Kay, 2010). As teachers must be able to guide students towards skills needed in future society, they need to acquire competencies to teach 21st Century Skills to their students. The literature shows that teachers of 21st century possess least knowledge of new skills (OECD,2012; Irenka Suto, 2013). However on the other side learners
communicate, collaborate and use 21st century skills every day (Laura Greenstein, 2012). Therefore, this study explores the 21st century skills of teachers.

The followings were the objectives of the study:
1. To find out the difference of 21st Century skills in Formal Setup and for ODL
2. To find out the difference of 21st Century skills among teachers and students
3. To find out the difference of 21st Century skills with respect to different science subjects

The scope of study was delimited in following areas:
1. The study was delimited to science teachers only.
2. The study was delimited to university teachers and students only.

Following hypotheses were made to achieve the objectives of the study:
**H01:** There is no significant difference of 21st century skills among the teachers of nonformal and formal setup.
**H02:** There is no significant difference of 21st century skills on the basis of critical thinking among the teachers of non-formal and formal setup.
**H03:** There is no significant difference of 21st century skills on the basis of collaboration among the teachers of non-formal and formal setup.
**H04:** There is no significant difference of 21st century skills on the basis of communication among the teachers of non-formal and formal setup.
**H05:** There is no significant difference of 21st century skills on the basis of creativity among the teachers of non-formal and formal setup.

2. Research Methodology
   Here is the detail of research methodology.

2.1 Research Design
   Quantitative research design was used. Survey method was used.

2.2 Population
   The university teachers from sciences of formal and non-formal setup were the population of the study.

2.3 Sample and Sampling technique
   The sample of 80 science teachers and students was conveniently selected in which 9 teachers were from the non-formal setup and 31 teachers were from the formal setup. Similarly, there were 9 students from non-formal setup and 31 students from formal setup.

2.4 Research Instrument
   A research questionnaire was served as the instrument of the research that was distributed to the participants online. The questionnaire was created by using Google forms and the participants were invited through email to give responses. Validity Content and Face validity was ensured by scrutinizing the initial drafts of the questionnaire from experts. Reliability The overall reliability of the tool was 0.824 and 20 participants were participated to collect the responses.

Here is the detail of constructs:
Critical Thinking construct had 7 items
Collaboration construct had 08 items  
Communication construct had 07 items  
Creativity construct had 08 items  
Total no. of items 30

2.5 **Detail of Instrument**

The questionnaire has two sections. One section covers the demographic information including the information of their institution. The other section consisted of statements of measuring 21st century skills of teachers. The second section of the research instrument was comprised of 30 items to seek for the 21st century skills based under four constructs that was critical thinking, collaboration, communication and creativity. The 5-point Likert scale was used to code the items.

3. **Data Analysis**

Quantitative analysis was done. SPSS-21 was used to analyze data. Descriptive analysis of frequencies was employed. Independent sample t-test was applied for drawing the inferences and tests the hypotheses.

**Table 1: Descriptive statistics of 21st century skills w.r.t category of institutions**

| Skill              | Institution | N  | Mean   | Std. Deviation | Std. Error Mean |
|--------------------|-------------|----|--------|----------------|-----------------|
| Critical Thinking  | Formal      | 62 | 4.4078 | .30699         | .03899          |
|                    | Non-Formal  | 18 | 4.6032 | .29218         | .06887          |
| Communication      | Formal      | 62 | 4.3548 | .26974         | .03426          |
|                    | Non-Formal  | 18 | 4.4444 | .33553         | .07908          |
| Creativity         | Formal      | 62 | 4.3306 | .30710         | .03900          |
|                    | Non-Formal  | 18 | 4.4931 | .34426         | .08114          |
| Collaboration      | Formal      | 62 | 4.3327 | .28803         | .03658          |
|                    | Non-Formal  | 18 | 4.5069 | .39638         | .09343          |
| 21st Century Skills| Formal      | 62 | 4.3565 | .23752         | .03016          |
|                    | non-formal  | 18 | 4.5119 | .31245         | .07365          |

In table 1, the descriptive statistics of 21st century skills among sampled teachers and students with respect to their institutional type has been presented. It shows that the sampled respondents of non-formal education system possessed comparatively high mean value of all four skills of 21st century skills than respondents of formal educational system.
Table 2 shows the inferential statistics of sampled teachers and students with respect to their institutional type. It shows significant difference among sampled respondents of non-formal education system regarding critical thinking and collaboration than respondents of formal educational system. Hence, there was an overall significant difference among respondents of formal and non-formal educational system regarding 21st century skills.

Table 3 shows the descriptive statistics of sampled teachers and students. It shows that the sampled students possessed comparatively high mean value of all four skills of 21st century skills than teachers.
Table 4: Inferential statistics of 21st century skills between teachers and students

| Skill            | Levene's Test for Equality of Variances | t-test for Equality of Means |
|------------------|-----------------------------------------|------------------------------|
|                  | F | Sig. | t   | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |
|                  |   |       |     |    |               |                 |                   | Lower | Upper |
| Critical Thinking| 7.236 | .009 | -5.41 | 78 | .000 | -.325 | .060 | -.444 | -.205 |
| Communication    | 6.537 | .013 | -5.67 | 78 | .000 | -.307 | .054 | -.414 | -.199 |
| Creativity       | 23.512 | .000 | -7.58 | 78 | .000 | -.415 | .054 | -.524 | -.306 |
| Collaboration    | .012 | .911 | -3.01 | 78 | .003 | -.206 | .068 | -.342 | -.070 |
| 21st Century Skills | 6.973 | .010 | -6.64 | 78 | .000 | -.313 | .047 | -.407 | -.219 |
Table 4 shows the inferential statistics of sampled teachers and students. It shows significant difference among respondents regarding all four skills of 21st century skills. Therefore, there was significant difference was found in overall 21st century skills.

Table 5: Descriptive statistics of 21st century skills among sample w.r.t subjects

| Skill               | Subject | N  | Mean | Std. Dev | Std. Error | 95% Confidence Interval for Mean | Min | Max |
|---------------------|---------|----|------|----------|------------|---------------------------------|-----|-----|
| Critical Thinking   | Physics | 14 | 4.489| .3253    | .0869      | 4.301 - 4.677                   | 4.00| 5.00|
|                     | Chemistry | 22 | 4.454| .3258    | .0694      | 4.310 - 4.599                   | 3.57| 5.00|
|                     | Biology  | 20 | 4.378| .2829    | .0632      | 4.246 - 4.511                   | 3.71| 4.71|
|                     | Mathematics | 24 | 4.488| .3260    | .0665      | 4.350 - 4.625                   | 3.86| 5.00|
| Total               |         | 80 | 4.451| .3128    | .0349      | 4.382 - 4.521                   | 3.57| 5.00|
| Communication       | Physics | 14 | 4.449| .3061    | .0818      | 4.272 - 4.625                   | 4.00| 5.00|
|                     | Chemistry | 22 | 4.396| .2605    | .0555      | 4.280 - 4.511                   | 3.86| 4.86|
|                     | Biology  | 20 | 4.321| .2889    | .0646      | 4.186 - 4.456                   | 3.86| 4.71|
|                     | Mathematics | 24 | 4.357| .3008    | .0614      | 4.230 - 4.484                   | 3.57| 4.71|
| Total               |         | 80 | 4.375| .2860    | .0319      | 4.311 - 4.438                   | 3.57| 5.00|
| Creativity          | Physics | 14 | 4.375| .2941    | .0786      | 4.205 - 4.544                   | 3.88| 4.75|
|                     | Chemistry | 22 | 4.375| .3181    | .0678      | 4.234 - 4.516                   | 3.75| 4.75|
|                     | Biology  | 20 | 4.293| .3095    | .0692      | 4.148 - 4.438                   | 3.75| 4.75|
|                     | Mathematics | 24 | 4.416| .3548    | .0724      | 4.266 - 4.566                   | 3.63| 5.00|
| Total               |         | 80 | 4.367| .3209    | .0358      | 4.295 - 4.438                   | 3.63| 5.00|
| Collaboration       | Physics | 14 | 4.410| .3779    | .1010      | 4.192 - 4.628                   | 3.88| 5.00|
|                     | Chemistry | 22 | 4.409| .2759    | .0588      | 4.286 - 4.531                   | 4.00| 5.00|
|                     | Biology  | 20 | 4.231| .2339    | .0523      | 4.121 - 4.340                   | 3.75| 4.63|
|                     | Mathematics | 24 | 4.432| .3685    | .0752      | 4.276 - 4.587                   | 3.63| 5.00|
| Total               |         | 80 | 4.371| .3213    | .0359      | 4.300 - 4.443                   | 3.63| 5.00|
| 21st Century Skills | Physics | 14 | 4.431| .2919    | .0780      | 4.262 - 4.599                   | 4.01| 4.91|
|                     | Chemistry | 22 | 4.408| .2386    | .0508      | 4.302 - 4.514                   | 3.96| 4.79|
|                     | Biology  | 20 | 4.306| .2227    | .0498      | 4.202 - 4.410                   | 3.97| 4.63|
|                     | Mathematics | 24 | 4.423| .2943    | .0600      | 4.299 - 4.547                   | 3.71| 4.79|
| Total               |         | 80 | 4.391| .2623    | .0293      | 4.333 - 4.449                   | 3.71| 4.91|

In Table 5, descriptive statistics of 21st century skills among sampled teachers and students with respect to their subject type has been presented. It shows that the mean values all four skills of 21st century were almost same in all subjects.
Table 6: Inferential statistics of 21st century skills among sample w.r.t subjects

| Skill                  | Sum of Squares | df | Mean Square | F    | Sig. |
|------------------------|----------------|----|-------------|------|------|
| **Critical Thinking**  |                |    |             |      |      |
| Between Groups         | .159           | 3  | .053        | .533 | .661 |
| Within Groups          | 7.573          | 76 | .100        |      |      |
| Total                  | 7.732          | 79 |             |      |      |
| **Communication**      | .151           | 3  | .050        | .608 | .612 |
| Between Groups         | 6.313          | 76 | .083        |      |      |
| Total                  | 6.464          | 79 |             |      |      |
| **Creativity**         | .169           | 3  | .056        | .537 | .658 |
| Between Groups         | 7.967          | 76 | .105        |      |      |
| Total                  | 8.136          | 79 |             |      |      |
| **Collaboration**      | .535           | 3  | .178        | 1.777| .159 |
| Between Groups         | 7.621          | 76 | .100        |      |      |
| Total                  | 8.155          | 79 |             |      |      |
| **21st Century skills**| .198           | 3  | .066        | .960 | .416 |
| Between Groups         | 5.239          | 76 | .069        |      |      |
| Total                  | 5.438          | 79 |             |      |      |

Table 6 shows the inferential statistics of sampled teachers and students with respect to subject type. It shows that no significant difference with respect of subject type among sampled respondents in all four skills of 21st century skills.

4. Discussion

In this study, 21st century skills of teachers and students of formal and non-formal educational system were found out. The findings revealed that the respondents of non-formal education system possessed comparatively high mean value of all four skills of 21st century skills than respondents of formal educational system. This might be due to the reason that the mean values of critical thinking and collaboration was high among respondents of non-formal educational system as compared to respondents of formal educational system. This provides evidence that as in non-formal educational system, teachers and students are collaborating more than formal educational system. Similarly, in non-formal educational system, the teachers provide such study material that promotes critical thinking among distance learners. The nature of content, its mode of delivery (in recent days its through online mode) and assessment are different than formal educational system, that is why these two aspects of 21st century skills are significantly higher among non-formal educational system. Stoytcheva (2018) also confirmed it that “Online collaborative learning has proved its effectiveness throughout the years, mainly because of its flexibility exhibited at different levels: pedagogical design, learning scenario, learning content, online tutoring”. Roberts & McInerney (2007) also stated that online learning is dynamic in nature as it provides collaborative work. Tathahira (2020) cited Carmichael & Farrel, 2012; Foo & Quek (2019) and stated that “combining critical thinking process and online-based activity, like asynchronous online discussion can be an advantage and opportunity for students to gain their
It is also interesting to note that students were found to possess comparatively high mean value of all four skills of 21st century skills than teachers. However, no significant difference was found with respect of subject type among sampled respondents in all four skills of 21st century skills.

5. Recommendations

It was recommended to widen the scope of this study by including respondents of their disciplines. It was also recommended that teachers must enhance their 21st century skills because the learners have more 21st century skills than their teachers. In order to reduce this gap, different professional development courses can be organized so that teachers and student can have better collaboration with each other which will help to enhance students learning, teachers must be provided exposure to new skills of 21st century learning so that they can effectively teach the learners of 21st century.

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