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Abstract: *The purpose of this qualitative study is to investigate science teachers' perceptions of 21st-century skills, i.e., communication, collaboration, critical thinking, and creativity, called 4 C's skills. This study employed a case study where participants were purposively selected in lower Dir Khyber Pakhtunkhwa, Pakistan. A semi-structured interview was used for gathering data. Participants perceived the use of 4C skills for the effective teaching-learning process and the need for collaborative teamwork for the effective teaching-learning process. The data analysis proved the need to acquire 21st-century skills for teachers to be effective teachers, meet the needs of modern education, and be able to resolve issues skillfully that occur inside the classroom or outside the classroom. Further analysis of data revealed that the teachers are aware and perceive the usage of technological devices such as computers and the internet for education purposes as the need of the modern day. Fostering 21st-century beliefs by science teachers is an important goal for professional development, but care should be sought to emphasize broad teaching practices, including self-regulatory learning. Science teachers should develop creative, critical, analytical, problem-solving solving, and Metacognitive skills and should become broad-minded to constructivist teaching conceptions.*

Key Words: 21st Century, Science Skills, Secondary School Teachers, Education, 4 C's Skills

Introduction

Teacher qualifications are popular around the world because they are linked to educational advancement as well as personal and social development. Competence is a key link not only in science and technology but also in the entire process of teacher development. Participating in 20th-century society requires learning new skills that provide access to knowledge, skills, creativity, and innovation (Al-Hariri, 2020). All 21st-century technologies allow students to adapt and respond more quickly to changes in their environment. Once these skills are developed and understood, they will stay with the student for life. As adults, they will now be ready to respond to the inevitable changes in their environment and manage the problems arising from these changes (Lapel, 2017). There are approximately twelve skills for the 21st century, including communication, collaboration, critical thinking, creativity, information literacy, knowledge literacy, technology literacy, change, leadership, initiative, productivity, and relationships. Communication, collaboration, critical thinking, and creativity are known as the 4Cs. Using these skills can support and improve learning outcomes and motivation, making them the basis for new learning (Trilling and Fidel, 2009). Because of the need for education, nothing can be done without focusing on the development of teachers because teachers are the backbone of education. There is a need for the best education system that will adapt to the socio-economic structure of this century and provide students with skills to meet their life and learning needs (Al-Hothali, 2021).

Literature Review

Today's teachers have a greater responsibility to improve themselves to cope with the challenges of the 21st century and to help students develop these skills in a competitive environment (Albaz, 2013). Teachers

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must be able to acquire skills that lead to better learning outcomes, such as integrating technology, curriculum, and 21st-century rules to teach students 21st-century skills (Ornstein et al., 2019). Teachers need to improve their skills in the 21st century due to the problems caused by the information explosion and communication revolution. Students who have creativity, communication, collaboration, and critical thinking skills can adapt to situations, solve problems, discuss ideas, think critically, and learn how a person and words can affect others (Lapek, 2017). One of the biggest challenges in learning is students' lack of interest and participation in class (Jasper, 2021). Much research has been conducted globally on teachers' skills in using and applying 21st-century educational technologies. These results show that teachers have the power to improve education and make learning more sustainable. Moreover, integrating education with 21st-century skills can empower people and create a smart society (Al-Hotali, 2021; Kayange and Msiska, 2016; LaFave, 2020; Lapek, 2017). The results indicate that these studies are limited to developing countries. To the best of the researcher's knowledge, no research, especially qualitative research, has been conducted in the local context. Therefore, the purpose of this study is to investigate the teaching abilities of secondary school teachers in the 21st century.

Methodology of the Study

The study utilized a qualitative research approach with a case study design in order to gather in-depth data for clearly understating secondary school science teachers' perceptions about the integration of 21st-century skills 4Cs in their teaching process. That is how they interpret these skills and inquire about their views on adopting these skills at the school level.

Participants

The participants of this study were selected purposively as the researcher aimed to investigate the scenario deeply. Twenty secondary school science teachers were selected as participants in Lower Dir Khyber Pakhtunkhwa.

Instruments

In order to inquire about in-depth interpretations of 21st-century skills of 4Cs, the researcher applied semi-structured interviews as an instrument for gathering data regarding secondary school science teachers' perceptions about integrating 21st-century skills in their teaching practice.

Data Analysis

The researcher coded and transcribed the collected data, and thematic categories were developed for clear interpretation and analysis. The researcher used the interpretations of the participants under the developed thematic categories in order to develop a clear picture of the secondary school science teachers' perceptions of applying 21st-century skills 4Cs in their teaching practice.

Teachers Interpretation of 21st Century Skills

After analyzing interview data of secondary school science teachers, it is revealed that the secondary school science teachers considered the value of 21st-century skills of 4Cs in developing the educational environment at the school level. The participants interpret 21st-century skills as important in the modern age for the students to acquire knowledge. In this case, some responses are as follows:

“ There are many 21st century skills upon which the most necessary are creativity in students and critical thinking, logical thinking and the same as information and communication are the most necessary” (Science Teacher 2).

“21st-century skills include digital learning, practical knowledge, experimental base learning, and information about literacy, to convey our messages toward students in a digital way and prepare the students to think critically and focus on group learning and develop skills inside them and to upgrade them with the modern world” (Science Teacher 5).

“The requirements of the 21st century are computer literacy to have computer knowledge of the 21st century. They should have new topics, ideas, and new skills. Debates competitions among the students to

apply on them weekly or twice a week, problem-solving methodologies, and solving a problem by their own efforts methods are the requirements and needs of 21st century” (Science Teacher 4).

“21st-century skills for the new generation are new methodologies of teaching, Digital literacy, online learning, information, and communication technology. New teaching methods that are adopted by developed countries are necessary to apply to our students, which are all new skills”. (Science Teacher 9).

The above interpretations revealed that the participant teachers consider the importance of integrating 21st-century skills to improve the teaching-learning environment and to familiarize the students with these skills in order to meet the needs of the modern age. The teacher respondents consider the beneficial integration of 21st-century skills 4Cs for teachers while teaching to the students as interpretations revealed their perceptions that the teachers need to implement the 21st-century skills in their classes in order to familiarize the students with the modern concept of education with practical learning, critical thinking, and promoting digital literacy skills for achieving the education purpose of the modern age. This proved the importance of the integration of 21st-century skills. “4Cs” need to be implemented fully at district schools and in classrooms throughout the country to train the students and employees according to the 21st-century requirements to stand with the developed nations.

Production of Skilled Generation

Education role is significant for raising the values, skills, knowledge, and attitudes of the people for a valuable contribution educationally and for a good future. Knowledge of making purposeful objectives, collaborative work with people of different backgrounds, and knowing the different techniques of solving different rising issues easily. Education trains people not only how to work in different fields in this world but also to train students on how to be respectable, skillful, responsible, and active citizens of a society. In this case, some of the participant responses revealed their perceptions.

According to Science Teacher 3

“In this modern era, our education is totally theoretical. Practical education in our country is equal to nil. The modern technique includes practical education. We need to inform our students about practical education to create critical thinking in them and enable them a task to do it practically by using other techniques and applications that are available to use on the network or through the net so that the creativity in students is enhanced and they are able to make interaction with the modern world.” (Science Teacher 3)

“Skills that are needed for young generations like practical knowledge, creativity, critical thinking, and team learning skills are very necessary” (Science Teacher 2).

“There are many 21st century skills in which the most necessary are creativity in students, critical thinking, logical thinking, information, and communication” (Science Teacher 7).

The above statements revealed that the implication of 21st-century skills 4Cs will draw better results for new generations that they will be more productive and will be able to cope with any circumstances they face. The same findings were revealed by Soufflé (2016), who stated that the traditional teaching styles cannot prepare students for the practical skills needed in modern life. Teachers need to adopt 21st-century skills 4Cs in their teaching-learning process to acquire the students for better outcomes because modern education is mostly based on practical applications.

Education Advancement

The use of technology has facilitated the learning of students easily from different sources, and it has increased students' knowledge and preparation and presentation of content with different digital tools. With the help of the internet and digital tools, it became possible to conduct online classes instead of presenting physically in a class environment. Students can now search for a variety of content they need from anywhere and anytime with the use of modern technology and the internet. This advancement has made the world a “global village,” and the people are connected with each other and acquire knowledge easily. It has made the citizens of particular countries global citizens with the competitive skills necessary



to survive in this age of the 21st century. In this case, some interpretations of the respondents are as follows.

According to Science Teacher 2

“We have to kick out the old teaching methodologies and develop in each school a learning methodology according to student’s mental and learning abilities. We have to make our students of new teaching methodologies, and on each level, we have to teach them” (Science Teacher 2).

Similarly, science teacher 5 revealed that,

“21st-century generation needs and requires modern skills such as critical thinking, logical thinking and new educational methodologies for teaching-learning process are most necessary”.

“Practical knowledge, creativity, critical thinking, and group learning skills are more necessary for the 21st generation” (Science Teacher 5).

Science Teacher 10 is also in favor of 21st-century skills, as said,

“Skills needed for the young generation are most commonly categorized into two types, namely Hard skills that include proficiency in a foreign language, a degree or a certificate, machine operating and other digital skills while Soft skills that are necessary for the 21st century are communication, time management, problem-solving, collaboration, creativity, critical thinking, and flexibility”(Science Teacher 10).

The above interpretations revealed that to enable students to succeed in the future 21st century, skills of the 4Cs should be implemented in their learning activities. The above interpretations proved that the teachers strongly consider the importance of applying 21st-century skills in the teaching-learning process. The views of the respondents proved that both hard and soft skills should be delivered to the students as it is necessary to survive in the modern age.

Needs of New Methodologies

The traditional method of teaching only promotes the use of a blackboard book, and the teacher is only responsible for teaching the students. The student participation is very low in this process. On the other hand, modern teaching methods promote the active engagement of the students in learning activities through different activities where a student is allowed to learn by themselves while doing or creating their own ideas. Modern education stresses the acquisition of the 21st-century skills of science and technology. Modern education also works to enhance student thinking skills, imagining ideas, visualizing creativity, and passion for doing by self are some of the 21st-century skills that teachers need to know about. The skills of 21st-century modern education not only stress raising the interactive skills of students through the use of technology but also train them to be creative and skillful in different aspects of life.

According to Science Teacher 4

“The requirements of the 21st century are computer literacy to have computer knowledge of the 21st century. They should have new topics, ideas, and new skills. Debates competitions among the students to apply on them weekly or twice a week, problem-solving methodologies, and solving a problem by their own efforts methods are the requirements and needs of 21st century”(Science Teacher 4).

This statement was supported by Science Teacher 16.

“For the new generation, new and updated educational skills are required to meet the challenges of the 21st century as our education system is very old and needs new methodologies of the recent challenges. So to avoid the theoretical framework and to adopt practical education just like China, Japan, etc have improved their education” (Science Teacher 16).

This means that Teaching methods are ways to instruct students in a classroom, helping them to understand and remember what they've learned. Some of the best teaching strategies allow educators to convey information in a clear and concise way while also ensuring students retain it over the long term.

Science teacher 17 said that the new generation needs new teaching and learning methodologies.

“New methodologies are the need of this modern age, if the students have new educational methodologies then they will present their own ideas, second is collaboration teamwork to share ideas

with each other, problem solving, practical things and the most important is today's digital laboratories or online learning system to assign especially for students such as digital education, etc are necessary for our young generation" (Science teacher 17).

The above analysis of respondent views proved the importance of inculcating new methodologies in the learning process. The interpretation revealed that teachers stress adapting modern teamwork, group activities, or creative activities for students to achieve better outcomes and to train the students to survive in the modern age. The views of the participants revealed that they fully agreed to utilize the modern concept of teaching techniques and methods for the teaching-learning process. Moreover, the findings proved that the teachers are in favor of adopting the student-centered approach towards teaching as it stresses the active involvement of the student in learning practically instead of just delivering the knowledge theoretically.

Surviving In the Modern Age

The world is changing educationally day by day, which is a challenge for the students to face. This change in the world affects people's lives a lot because if the education system doesn't meet the requirement of modern education skills, it will become difficult to face the other developed nations with acquired modern education. The development according to modern educational requirements is essential for all the nations of the world. The views of teacher participants proved the need to learn 21st-century skills as some statements the following:

"21st-century skills include digital learning, practical knowledge, experimental base learning, and information about literacy, to convey our messages toward students in a digital way and prepare the students to think critically and focus on group learning and develop skills inside them and to upgrade them with the modern world" (Science Teacher 13).

As a follower of scientific beliefs, Science Teacher 8 and Science Teacher 10 are also in favor of modern techniques and online learning in teaching-learning processes that are used by developed countries.

"As a science teacher, our students need to apply those methods which are applied by the developed countries in their education system and kick out the old theoretical learning process in our education system and go ahead in practical knowledge and work, another way to show and get education from online system through mobile or computer"(Science Teacher 8)

"21st-century skills are leadership, information, digital literacy, critical thinking, and we have to improve the abilities of the teaching-learning process according to the modern age."(Science Teacher 10).

Another Science teacher is also exposed to the learning of professional skills that are used by developed countries in their education system to survive in the modern world.

"The young generation of the 21st century needs new and professional skills to survive in this modern age just like developed countries adopted and modified their teaching learning skills, so our young generation also needs such type of advance methodologies to make them professional in all over the world "(Science teacher 13).

The respondent teachers, 18 and 20, agreed that the learner should have flexibility, time management, and digital skills for learning. They supported it by their own experiences. They said:

"I think the first and important skill that these students should have is communication skills, without it they cannot express their ideas to their parents, teachers & society. They should know the use of computers and their knowledge because, in such a modern age, we need this skill to effectively manage our daily lives. Then there comes the learning skills. They should have at least one skill to earn on their own if needed so it will become the new generation to survive in the modern age"(Science Teacher 18).

"Young generation of 21st century needs to improve their international skills as they are the key to thriving in any field of life, especially in a professional career. Some of them are Digital literacy, Communication skills, Creative thinking, Problem-solving, and Leadership" (Science Teacher 20).

The participant's interpretation revealed that they consider the role of education in enhancing



awareness in society and that with education, change can be brought into public life. Interpret that education enables people to be skillful in availing good job opportunities, to be better citizens, and to be able to differentiate between right and wrong. These interpretations are in line with Lee and Hannifin's (2016) concept of modern education, which interprets the significance of acquiring modern education skills and training people for a better living in the modern world.

Discussion

The purpose of this study was to investigate and understand secondary school science teachers' understanding, practice, and thoughts related to teaching 4C skills in the 21st century. Based on the general questions and answers of the interview, all interviewees shared their thoughts on understanding, applying, and using the 4Cs of 21st Century Skills. The participants interpret that the digital age encourages new teaching and learning technologies, leading to a need for cross-cultural intelligence and skills development through the integration of 21st-century skills, as revealed by Wolff and Booth (2017). Modern skills are now considered an important ability to gain new opportunities. Participants said we need to encourage students to collaborate in groups, make decisions, plan and manage time effectively, communicate with others, and choose time-appropriate strategies (Creswell and Creswell, 2017; Lee and Hannifin, 2016). Enforcing these 4Cs skills to meet these new instructional needs can help students succeed in school and in their future careers. In fact, these skills help prepare our students for the 21st century, just as developed countries are used to prepare talented students for the responsibilities of today's society. It is true that secondary school teachers use 21st-century skills in their daily work, as revealed by Arman (2018) and Lapek (2017). This research is related to Lapel's study titled "21st Century Skills: The Tools Students Need". These two studies are similar in that both studies used new technologies for young people, and the teaching methods were similar. In addition, Sofell's (2016) work "21st Century Skills Every Student Needs" describes the characteristics of teachers in the 21st century and is one of the characteristics that teachers should have new skills in teaching. Both works focus on creative ways to live in a rapidly changing world. The data analysis proved that in Lower Dir Secondary School, Science teachers are good communicators and willingly apply 4Cs skills in their teaching process as they revealed the importance of inculcating technological devices like computers and the internet for education purposes, the rising of creativity, logical and critical thinking in students because this ability trains students to think for new ideas. Critical thinking skills enable advanced teachers to make clear and concise decisions. Teachers use different teaching methods. Moreover, the findings of interview data proved that secondary school science teachers perceive practical activities as significant for the students to train the students for living in the modern age. Further data revealed that the participants interpret the learning and integration of modern teaching methods at the school level for a more effective teaching-learning environment as they stressed collaborative teamwork for exchanging ideas to have better results and the integration of digital lab and online learning activities for the young generation, as revealed by Friedman (2005) that successful collaboration among teachers increases their competencies.

Implications of the Study

Different domains of teacher's skills were extracted from this study, which helps to furnish some empirical support for constructivist-based curriculum and teaching reforms.

Implications for Teacher Educators

Teacher educators need new ways to reveal the beliefs of science teachers. Moreover, science educators should follow the beliefs of teachers throughout their development, as well as try to understand how the beliefs of teachers are connected to practice. Teacher educators could jointly work to develop and co-construct curriculum concepts that encourage the implementation of sophisticated beliefs and constructivist teaching paradigms as well as foster teachers' self-beliefs of criticizing the authority sources and becoming critical intellects instead of just knowledge transmitters.

Implications for Teachers

Fostering 21st-century beliefs by science teachers is an important goal for professional development, but

care should be sought to emphasize broad teaching practices, including self-regulatory learning. Science teachers should encourage the development of creative, critical, analytical, problem-solving, and Metacognitive skills and should become broad-minded to constructivist teaching conceptions.

Implications for Students

From a 21st-century point of view, it is suggested to value students' critical and problem-solving skills and encourage a constructivist student-centered paradigm of knowing and learning behavior. It is also proposed to catalyze students to practice their inborn skills for evaluating their knowledge through mutual collaboration and discussions. Research may be suggested to study students' beliefs regarding self-construction of knowledge through Metacognition.

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