Evaluation of an Innovative Technology Curriculum

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Hanifi Üker
Istanbul Sabahattin Zaim University, Turkey
https://orcid.org/0000-0002-7492-6784

Kamil Arif Kirkiç
Istanbul Sabahattin Zaim University, Turkey
https://orcid.org/0000-0002-8902-437X

Abstract
This research aims to devise an innovative curriculum, to determine the opinions of parents, teachers, students, and educators of the curriculum, and to present results using the CIPP approach. The study employed a qualitative research method, a program execution case study. It used maximum variation sampling, a purposeful sampling method. The study, involving eighteen participants, was conducted in a high school that runs a technology education program. Data was obtained using the semi-structured and focus group interview methods. Participant confirmation was obtained to increase reliability, which was then subjected to external audit, allowing another researcher to examine the process and results. Awareness of the "Proficiency in Technology" (PIT) curriculum and curriculum implementation emerged as the main facts. The research findings show that a lack of communication and trainer qualifications caused disruptions in the program.
Keywords: CIPP Evaluation Model, Innovative Technology, Program Evaluation, Technology High School

Introduction

Rapidly increasing technological developments are the driving force of change in the fields of communication and informatics. From agricultural society to industrial, and then from industrial to information society, technology has had a massive impact on how society develops, accelerating the transformation of societies from industrial to information societies. In information societies, individuals can be expected to have strong communication skills, use information well, benefit from the possibilities of technology, and be productive and innovative (Taşçı et al., 2010). Developing innovative and technology-oriented programs is vital for Turkey to become a competent information society. The findings obtained through evaluation will contribute to program improvement and the development of new programs in the future. Accordingly, this research attempts to answer the following questions about an innovative technology program applied in a high school: What level was the program aiming at? Was the number and length of lessons sufficient? Did educators sufficiently know its content? What impact did the program have on students? Within the framework of the above questions, this study aims to reveal findings regarding whether the program provides the expected educational content, the level of success concerning administrators, teachers, students, and parents, and to evaluate the results using the CIPP method.

In the 21st century, countries' development is measured by the science and technology they produce (Karasar, 2004). Such rapid developments impose a crucial responsibility on future generations in the production and use of technology. This rapidly changing technology is reflected throughout human

life and in educational situations (Timur et al., 2013). Technology and education have therefore become inseparable (Komis et al., 2007). This relationship has led to an increase in education and investment and has led to the formation of an economic structure called today a productive, innovative, and knowledge economy (Arokiasamy, 2012). In recent years, new technologies have led to the emergence of new learning situations other than the familiar educational environments (Simoes et al., 2013).

In parallel with the developments in technology, learning in education and training environments has become more interactive and accessible. The most significant contribution comes from information communication technologies, which enable more robust education systems, creative ideas, and meaningful and permanent learning (Chou et al., 2010). In particular, the continuous development of computers, advances in software, and technology integration provide students with the opportunity to produce and use technology within lessons (Holden & Rada, 2011). Thus, students can be involved in interdisciplinary learning with a problem-centered approach that corresponds to real life. These developments have carried educational technologies to an advanced stage. As a result of the relationship between education and technology, robotic coding applications have spread to every level of education and now affect science (Benitti, 2012), leading to the development of educational approaches that enable the use and production of technology such as Science Technology Engineering and Mathematics (STEM).

Robotic applications and developing digital objects provide benefits in many stages of education (Han et al., 2008). According to Williams et al. (2007), robotic applications are beneficial at the K12 level. The literature shows that robotic coding technologies in education are generally used for teaching robotics topics such as programming, robot construction, and mechatronics (Caci et al., 2003; Williams et al., 2007). As in all other subject areas, the curriculum is an essential part of teaching robotics and coding education. Curricula are made up of specific standards, and many countries have produced their own national standards. In 1998, the international educational technology community set the National Educational Technology Standards (NETS) (Barron et al., 2003). Over time, these standards have been renewed and developed. ISTE standards support students to become influential digital citizens in a globally collaborative environment (Armfield & Blocher, 2019).

An Innovative Technology Curriculum "Proficiency in Technology" (PIT)

A private school in Istanbul, together with the Scientific and Technological Research Council of Turkey (TUBITAK) and the Turkish Management Sciences Institute (TUSSIDE), designed a curriculum called "Proficiency in Technology" (PIT), developed following Ministry of National Education (MoNE) standards. The PIT curriculum was created by taking into account the interactions and changes experienced in the processes of science and technology in different fields. The technology programs and standards applied in many countries were examined. Educational officials from Turkey visited schools worldwide to observe what has been done in this area, an exchange program of university scientists was set up to share information, and various workshops were held with stakeholders. In developing the program, several fields were taken into consideration: 21st century competencies, artificial intelligence, block chain technology, internet of objects, robotics-coding, industrial manufacturing, aviation and space, nanotechnology, data mining, energy technologies, national innovation systems, Islamic science history, financial literacy, entrepreneurship, project techniques, and scientific ethics. Each level of primary, secondary, and high school education was designed with a spiral approach, units of work and expected achievements were devised in light of current developments in the field, and changes were made in the process where needed. Rather than being part of global technology, nations prefer to have their own national technology and information systems in order to protect the country's security.

The PIT program is an original program that focuses on making, living, mutual interaction, and life responses using knowledge. The curriculum was developed for five skills: knowledge generation, thinking and problem-solving, design and innovation development, using technology, and self-management. Each skill is enriched with

acquisitions and goals. Evaluation is very important for the sustainability of any program. In this context, administrators, teachers, students, and parents' views about the curriculum are essential.

CIPP Evaluation Model

Program evaluation is a complicated task. It is the process of making decisions about the effectiveness of a program by comparing data measured for purposes such as approving and changing the curriculum according to the effectiveness scale (Tekin, 2019). Stufflebeam and Shinkfield (2007) see evaluation as systematic research and define the operational situation in terms of the program as a process of defining, reporting, and implementing with a series of analyses. Stufflebeam developed the CIPP (Context-Environment, Input-Input, Process-Process, Product-Product) Evaluation Model in 1971. This model aims to transfer information to decision-makers. The 4-component dimensions of the model are shaped around the following four questions. Context: What should we do? Input: How should we make it? Process: Are we doing as planned? Product: Does the program work? (Birgili & Kirkic, 2021).

Research Questions

1. Is the PIT curriculum considered appropriate in terms of teaching context according to the opinions of parents, teachers, students, and educators?
2. Is the PIT curriculum considered appropriate in terms of teaching inputs according to the opinions of parents, teachers, students, and educators?
3. Is the PIT curriculum considered appropriate in terms of the instructional process designed according to the opinions of parents, teachers, students, and educators?
4. Is the PIT curriculum considered appropriate in terms of the teaching products it envisages according to the opinions of parents, teachers, students, and educators?

Method

A qualitative research method was used to evaluate the Proficiency in Technology (PIT) curriculum. The PIT curriculum was determined as the central phenomenon. The program has many stakeholders, including parents, students, teachers, and administrators. Whether these stakeholders have sufficient information about the program, how they perceive it as a process, their technical equipment, and educational status have guided the study. The program execution case study was used (Creswell, 2013). A case study is essentially qualitative research used in social sciences. It is defined in three ways: explanatory, descriptive, and exploratory (Yin, 2017). A program execution case study helps to understand whether the program is fit for its purpose. This application is suitable when there are concerns about problems in the program as it is vital to comprehensively report what happened in the process (Simşek & Yıldırım, 2011).

Sampling Procedures

The study environment of this research was a private high school affiliated to the Ministry of National Education in Üsküdar, Istanbul during the 2019-2020 academic year. The school applies the PIT curriculum. The research involved eighteen people: six parents, six students, four teachers, and two school administrators. In qualitative research, depending on the research purpose, selecting samples according to time, sources, and what it is expected to know is essential. (Büyüköztürk et al., 2010). A maximum variation sampling method was used in the research. This method is a purposeful sampling strategy which includes individuals or situations that differ according to particular qualities and characteristics (Creswell, 2013).

Table 1 Demographic Characteristics of Participants

Participant	Gender	Age	Education	Participant	Gender	Age	Education
Admin1	Male	51	Undergraduate	Parent 4	Male	28	Undergraduate
Admin2	Male	37	Undergraduate	Parent 5	Male	46	Undergraduate
Teacher1	Male	42	Undergraduate	Parent 6	Male	50	Undergraduate
Teacher2	Female	35	Undergraduate	Stu1	Male	14	High School

Teacher3	Male	27	Undergraduate	Stu2	Female	14	High School
Teacher4	Female	48	Undergraduate	Stu3	Male	14	High School
Parent1	Female	39	High School	Stu4	Female	15	High School
Parent2	Female	39	High School	Stu5	Male	15	High School
Parent3	Female	40	Primary School	Stu6	Female	15	High School

Data Collection Tool and Data Collection

For the research, semi-structured interview questions were prepared. The questions consisted of two parts. The first part aimed to determine the socio-demographic characteristics of the participants with closed-ended questions, and the second part aimed to obtain information about the opinions of the participants regarding the PIT curriculum with open-ended questions.

Data was collected using the interview technique. A focus group meeting was held with the students. Focus groups are a method used to generate in-depth thoughts and knowledge utilizing the effect of group dynamics (Bowling, 2014). According to Krueger (2014), the focus group discussion environment should be planned effectively for the group in order for ideas to emerge freely. Focus group interviews are used in many academic studies (Krueger & Casey, 2000; Morgan, 1996). One-on-one interviews were also conducted with participants, except for the students. After the necessary information was given about the content of the interviews, notes were taken using audio recordings with participants' consent. Where one parent did not consent to audio recording, detailed notes were taken of their interview.

Analysis of Data

The data obtained through face-to-face focus groups and the semi-structured interview forms were subjected to descriptive analysis. The primary purpose of descriptive analysis is to organize and interpret data from interviews and observations and present them to the reader. With this analysis, a cause-effect relationship is established between the findings and comparisons are made (Simşek & Yıldırım, 2011). A general framework was established for data analysis. After the interviews were completed, all sound recordings were transcribed into a written report. The data was transformed into sub-themes as expressed by participants. Categories and themes are shown in Table 2. Direct quotations were selected from the data in order to strengthen the themes and sub-themes. To indicate what percentage of teachers agree (number of teachers with the same opinion/ total number of teachers), a formula was used. Also, research findings related to participant views were coded as Dir1 (administrator), Parent1 (parent), Stu1 (student), Teacher1 (teacher).

Validity and Reliability

Internal validity is essential for qualitative research. The role of the researcher is critical here as the researcher can influence results (Creswell, 2013). In this respect, it is crucial to avoid subjectivity and prejudice. The questions prepared for content validity were presented to five experts in their field to examine their suitability for the study. The content of the research was shaped by taking the opinions of the researchers. It was subjected to external audits, and another researcher examined the process and findings to increase validity. As a result, additions were made to the themes. Also, participant confirmation was received. The accuracy of the report was confirmed by sending the findings to the participants. Two types of triangulation were made in order to ensure reliability. Interviews were held with parents, students, and administrators for data triangulation. In the researcher triangulation, the research director and two experts from TUBITAK took part in collecting data. Thus, high reliability was provided in the research. A semi-structured form was prepared by expressing the research method clearly and distinctly.

Results

As a result of this study for the PIT curriculum, two categories, namely, "PIT curriculum information" and "PIT curriculum," and eight themes were created. The findings related to these categories are given in Table 2.

Table 2 Categories and Themes

		Parent	Teacher	Student	Administrator
Category	**Theme**	***f***	***f***	***f***	***f***
PIT Curriculum Information	PIT Curriculum Pre-Introduction	6	2	5	2
	PIT Curriculum Information on Semester, End of Term, and Next Term	6	*	*	*
	PIT Curriculum Information about competitions and events	6	*	*	*
PIT Curriculum	PIT Curriculum Lessons and Hours	6	4	5	2
	Content Awareness for PIT Courses	6	2	5	*
	Practical Studies and Activities in PIT Curriculum	5	2	*	*
	PIT Curriculum Instructors	3	1	3	1
	The Impact of the PIT Curriculum on Students	6	4	5	*

*No opinion has been given

PIT Curriculum Information

Opinions regarding the briefings made within the PIT program were collated under five different themes: pre-introduction, meeting in the term, meeting after the term, information about the upcoming period, information about competitions and events.

Theme 1: PIT Curriculum Pre-Introduction

All of the parents (6/6) stated that they had received sufficient information about the PIT curriculum content and the education process within the scope of the pre-introduction.

Most of the students (3/5) stated that they were not informed during registration, while the others (2/5) stated that they were only informed a little. Student views on this situation were as follows: "I do not remember anything, no interviews were made" (Stu1 focus group interview).

Looking at school administrators' views, they appear to feel that adequate information was lacking or that parents were indifferent. Views of the administrators regarding informing parents and students were as follows: "I do not think we can convey clearly. We could not reflect these to the students because it was the first year, TÜSSİDE was not equipped enough, and we were not equipped" (Admin1 semi-structured interview).

Theme 2: Information about the PIT Curriculum During the Term, at the End of the Term, and for the Next Term

All parents clearly stated that they felt they were not provided with any information about the PIT curriculum content and the training process in the form of a term meeting (6/6). Accordingly, some parents' views were as follows: "We would like to be informed more about the content and flow of the program. During the year, there has never been an event that includes an overview of these issues. (Parent2 semi-structured interview) Parent2 stated that it is essential to be notified during the term.

Theme 3: PIT Curriculum Information about Competitions and Events

All of the parents stated that they received sufficient information about the relevant competitions and activities organized throughout the term within the scope of the PIT curriculum (6/6). Accordingly, some parents' views were as follows.

"We know that our child took part in the underwater robot competition. It does not matter whether he got an award or not in the competition; it does not matter; he could participate in the competition. It was his excitement, experience, and the atmosphere. It made us very happy to see the competition in that ecosystem. Because as we enter that ecosystem, we can get to know the world. Otherwise, just coming to high school and going home would not add anything but mediocrity to the student" (Parent4 semi-structured interview).

PIT Program

Regarding the curriculum category created within the PIT program, the number and length of the lessons were collected under four different themes: information about the lessons, application studies, the effect on the trainers, and the effect on the students.

Theme 1: PIT Curriculum Number and Length of Lessons

Parents gave different answers about the adequacy of the eight hours of the PIT program. Accordingly, some parents' views were as follows. "The program is not only at the high school level. It is very nice that it is also implemented at the primary and secondary school levels. I am followed up socially during and after lessons. I find it insufficient to have eight hours of technology lessons a week in addition to the compulsory courses. The reason I think that is because I do not believe all eight hours were very productive. If one could get one hundred percent efficiency, then eight hours would be enough" (Parent1 semi-structured interview).

Like teachers, school administrators expressed positive opinions about the course time. However, they said there were problems with students' readiness.

Theme 2: Content Awareness of Pit Courses

All of the parents stated that they had sufficient knowledge about the course content designed within the scope of the PIT program. In the light of the information obtained, some suggestions and criticisms were made. Accordingly, some of the parents' views were as follows: "Our life is completely math, science, not English. There are some facts in life, like technology. As both parents and students, our perspective on these lessons is positive. I think technology is a part of our lives. As we learned about the training content and received positive feedback from the student, we became more motivated during the year. Especially seeing concrete outputs in the form of projects made us even more excited" (Parent2 semi-structured interview).

The students stated that they were informed about the course content by the coordinator but that the course teachers did not give precise information about the content. In addition to the students who found the program's content complimentary, some students thought that some subjects were unnecessary. In this sense, the approaches are directly proportional to the competencies of the students in the program. Teachers (2/4) expressed different information about the course content. In general, it can be said that they knew the process but not in terms of content.

Theme 3: Application Studies and Activities in the PIT Program

All of the parents stated that they had information about the studies supported by theory and practice throughout the term within the scope of the PIT program. As a result of studying the implementation, some suggestions and criticisms were made. Accordingly, some of the parents' views were as follows: "It was a supportive and satisfactory element for us to implement part in the technology program. In this respect, we are delighted with the program content. We think that the laboratories used in the application part are at a sufficient level both in terms of the studies carried out and the equipment used according to the feedback we receive from our child" (Parent3 semi-structured interview).

Theme 4: PIT Curriculum Instructors

The students also had different opinions about the instructors. Accordingly, some student views were as follows: "The teacher change was very negative" (Stu1 focus group interview). "The teachers teach the lesson. But we do not want to come because it does not interest us" (Stu2 focus group interview). "Why did Burak teacher leave while the process was progressing? We talked about the project we conducted an hour before we left, friends asked, how is it going? Teacher was very qualified" (Stu3 focus group interview). The students did not like the change of teachers. They stated that teachers take the lesson but do not listen because they are not interested.

There were differences in managers' views, some of which were as follows. "We have seen that the teachers could not conduct some of their lessons" (Admin1 semi-structured interview). Principal stated that the lesson teachers were sufficient in their fields; in particular, the teacher who gave the Technological Life lessons was excellent.

Theme 5: The Effect of PIT Curriculum on Students

All parents commented about the effects on the students of the PIT curriculum and how it reflects daily life.

Parent 4 stated that his child developed a team spirit and an analytical perspective. He stated that he questions mechanical tools in his daily life and supports his productivity.

The students' opinions about how the PIT curriculum had affected them were as follows. "These lessons were useful, and they made a difference for me. If these lessons happen, I can continue" (Stu1 focus group interview). "I think the economics lesson was perfect. I think this lesson should have been more than an hour" (Stu4 focus group interview). Most of the teachers (3/4) declared that the PIT curriculum created significant changes in the students. Teacher 4 stated that the students did not make what they learned to feel in their lessons, but they realized that they had gained something in general.

Discussion

This study obtained information about applying the PIT curriculum and examined the results. The data collected provided insights into the level of information expected in program implementation, how it guides success, how to implement the curriculum, and its possible results. The results are presented following the CIPP program evaluation model.

Discussion Regarding Context Assessment

There was a problem with quality with some of the teachers who implemented the program. Students and some parents stated that the content of the lessons was not covered completely. Parents were delighted with the experts from TUBITAK.

Students were allowed to create a project and apply their ideas in the technology lab, which helped motivate unwilling students. They stated that the satisfaction of the students increased over time, and their awareness of technology increased.

Mainly, parents stated that informing them of the program during the process was insufficient and that they are not regularly informed. They stated that they expected follow-up and student orientation, but these expectations were not met. The students also confirmed this.

Discussion Regarding Input Evaluation

Technology programs that aim to produce qualified individuals with the high level of skills and competencies that our country needs have to adapt to the changes in the education system (Yüksel, 1998). One of the most exciting findings of this study was that parents were informed about the content thanks to the applications created by the students. The parents stated that the program was not promoted sufficiently and that this issue needs to be addressed. This situation was noticeable for students and parents and was harmful to the goals of the program. Apart from the teachers who ran the program, other teachers in the school stated that they did not have much information about the content, but they assumed it was sufficient given the output of products. They stated that the students who were willing participants were happy during the lessons. However, the teachers emphasized that the program did have some shortcomings since it was the first year of implementation.

Discussion Regarding Process Evaluation

Planned and scheduled extracurricular activities were organized under the knowledge and guidance of the school administration. These studies not only feed the interests and abilities of the students but also helped them gain good citizenship education (Ekici et al., 2009). They stated that the parents knew about the process and supported their children. In particular, parents were delighted with their children's projects and with the end of the year exhibition. These concrete outputs of the PIT curriculum implemented throughout the year increased student motivation. One of the most critical features of the program is that it is practical. Although some parents found the practices and activities sufficient, they stated that more opportunities should be created for practical work. They stated that laboratory resources should be enriched, and students should spend more time working individually.

Discussion Regarding Product Evaluation

Some parents think their children received a high-level program and that this is a privilege for them. Subjects such as entrepreneurship, financial literacy, and the history of science courses taught within the technological life courses have been relatively highly accepted. Parents and students express this clearly. The things learned in these lessons reflected on the daily life of some students and created a noticeable change in them. The PIT curriculum had a lasting impact on students. This effect is relatively high in those who were motivated and willing. According to Niyazi (2004), an effective teacher should enable students to experiment and try out their ideas. From this perspective, the technological life, history of science, philosophy, and innovation lessons were realized at the desired level and with high satisfaction.

Various activities, competitions, and projects were carried out within the program's scope, which every student took part in. The parents were delighted with this situation and stated that these activities gave their children different skills. A process-oriented measurement of success was taken through project studies, measurement of applications, and various observations. However, differentiated written exams were also implemented. Parents and students welcomed these evaluations.

Conclusions and Implications

The competencies, skills, and achievements of the PIT curriculum have integrity. Based on the results obtained in the research, the following suggestions are presented;

- Communication with parents and students regarding the process should be more lively and informative and more regular.
- Students should be informed about the technology curriculum and what awaits them in registration interviews.
- Student counseling services should study students' compliance with the technology curriculum and their readiness during registration, create statistics, and share them with the manager.
- Technology lecturers should also attend parent meetings throughout the year, and parents should be informed in general at class meetings.
- All school teachers should be informed about the process, and their opinions should be taken at the meetings.
- Parents should be included in the process.
- Free workshops for practical work should be established during the holidays.
- Technology activities should be organized in which parents can play a role with their children.
- Alternative course opportunities should be offered to students who do not want to take technology classes.
- Deficiencies in the curriculum content should be identified and eliminated.
- The level of initiative in the duties and authorities of the manager who will direct the program should be increased.
- Regular coordination meetings should be held among top managers with the technology curriculum, and the level of accountability should be increased.
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Author Details

Hanifi Üker, *Istanbul Sabahattin Zaim University, Turkey,* ***Email ID****: hanifiuker@hotmail.com*

Kamil Arif Kirkiç, *Istanbul Sabahattin Zaim University, Turkey,* ***Email ID****: kamil.kirkic@izu.edu.tr*