English Language Teachers' Perceptions about Design Thinking

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Abstract

This study aimed at investigating the English Language Teachers' perspectives toward design thinking and to examine the effect of experience, gender, and qualification factors on their perspectives. The study sample consisted of 135 teachers (64 females, 33 male) from Amman 1 Educational Directorate. The researcher developed a design thinking scale, its validity and reliability were approved. The results indicated that English Language teachers had a high degree of knowledge and practice about design thinking (mean= 4.10, S. D= 0.37) and there were no statistically significant differences in the design thinking means attributed to gender, teachers' experience, or qualification. The study recommends conducting more research on design thinking, including different samples of teachers from disciplines other than English, and conducting qualitative research to observe the degree to which teachers apply design thinking strategies.

Keywords: design thinking, teachers, perception, English language

1. Introduction

1.1 What is Design Thinking?

Over the years, many challenges, scientific knowledge, and techniques appeared in order to get the best skills and knowledge. Educators face many problems and difficulties in practicing teaching; these problems were very complicated and varied in many ways such as, in teaching and curricula developments, classroom environment and the students' attitudes, motivations, knowledge and skills.

Creativity is the core of 21st-century thinking skills for students (Mirsha & Metha, 2017). Societies try to give children a lot of skills and creative experiences to have the ability to take immediate decisions to find several solutions for the problems that they face by using new tools and methods. To reach that, they developed a high level of educational programs that provide benefits for their children and for them too (Peters & Stout, 2015).

One of these tools and problem-solving approaches is Design Thinking DT, which comprises a variety of creative strategies for organizing programs with multiple elements: "It helps deal with ambiguities and articulate the right questions, as well as identify and formulate possibilities and potentials." (Grots & Creuzanacher, 2016, P.191). DT is considered one of the most promising ways of transforming organizations and businesses in a competitive environment (Gloppen, 2009).

DT is a non-linear, iterative process that teams use to understand users, challenges, assumptions, redefine problems and create innovative solutions to prototype and test. This approach has five steps: Empathize, Define, Ideate, Prototype, and Test, it is most useful to tackle problems that are ill-defined or unknown. Also, the Centre of this process is the human; because we aim to solve the human's troubles and by this system, we can produce a creative, strong, and responsible person who can face any kind of problems by deep understanding and close solutions that suits the situations. On the other hand, many kinds of research showed how important is this strategy for pupils; because it gives them the chance and the ability to understand and face the changes in the real life. (Brophy, Klen, Portsmore, & Rogers, Dorts, 2008).

In DT the students can make as many ideas as they can, in order to find solutions for the problem that have no right or wrong opinions and opposes traditional approaches, as "the information needed to understand the problem depends upon one's idea for solving it". (Rittel & Webber, 1973, 161).

The goal of DT is to make learners go deeper in contexts that make them think and practice like expert designers. In that connection, encourage civic literacy, empathy, cultural awareness, and risk-taking (Sharples et al. 2016).

(Elwood, et al 2016) defines DT as a creative approach to solving problems which are a combination of practical acts concluding interrelated processes like ambiguity, repetitions, productions, visualization, collaboration, and empathy, all of them are done in a non-linear path manner, and you can return to the previous point in order to get new information and to improve the solution that you have already found in order to put the prototypes and examine them.

Rauth et al. (2010) define DT as a comprehensive concept of design that allows students to cooperate and work as groups successfully to make an effective positive change, which is chosen to solve complex and vague everyday- life problems that are easy or difficult to be understood or solved.

DT concentrates on finding ideas and solutions: products, services, suitable systems, congruous with the human needs. On the other hand, Goldman and Kabayadono (2017) described DT as a way to solve any problems that require a complex set of skills, procedures, and brains that help find new solutions. Rizk (2018) informed that: the solution-based activity that intends to create the largest number of new and creative solutions and then choose the best one to solve the problem.

Hammam (2018) said that DT is an approach of thinking which improves pupil's abilities to empathize problems, recognize it and be innovative in generating opinions and solutions, modeling, building design to find answers, and inspecting the models to test them based on all of the prior definitions, it can be concluded that DT is a creative-critical process.

Based on dealing deeply with the situation and reincarnation of their roles, distinguishing problems and challenges that face them, producing ideas, and encouraging thinking out of the box, founding the new inventive solutions that help them deal with many daily problems, and to put the prototypes of the procedures that show them the way or the solution to improve their abilities to deal with problems and test them in order to find new services.

This methodology has raised the interests of many experts and teachers in many sectors of industry, engineering or medicine. In addition to the interests of teachers and educational experts. These interests can be attributed to research. This approach is an effective tool that pushes and stimulates students to make creative and unique solutions based on experience, knowledge, observation, science fiction, and experiment. Also, it is a methodology that is used for activating and developing twenty-first-century skills to solve problems facing individuals, by assembling, organizing, and sharing information with others to find the perfect solutions re-design them according on experience, and feedback from other designers in order to get up with appropriate suggestions. DT makes life and the world around us better, and its main reason is to improve the technological systems and information, the Industrial Revolution, equipment that make our lives easier nowadays.

Many books are considered as the core books that provide a theoretical background about DT (Kelley, 2001), (Gladwell, 2000), (Pink, 2005), and (Kelley & Kelley,2013)

Stanford University recognizes the importance of DT, it established a design school that concerns to use DT model in the educational process in all of its five stages and was supported by the Henry Ford Company. Stanford University provides many practical programs for teachers to use DT in the classroom, and it provides them with an explanatory guide to develop and improve the student's skills as well as the teachers. (Zubaidi, 2019)

As mentioned before, DT is a non-linear strategy and it's not a cycle process. This process contains five stages that we can go forward and come back again to the previous stages according to the feedback and rating data we gather in each step, or if we want to reach more understanding and better solutions for the problem, so DT is an iterative process and the newest interventions and problem-solving way that is used in teaching education and related to the areas of planning and creative design which depends on the needs of the beneficiaries.

1.2 The Benefits of Employing DT

Design Thinking concentrates on human needs and interests. It is a systematic human-centered process. The most important issue is to make individuals have the ability to inspire and be able to find solutions and face their challenges (Twisi et al, 2021). The elements of DT including observations, abilities, and investigation make designers recognize human needs and the appropriate information to drive the creation of products and experiences that are useful for humans (Skaggs, 2018). DT shows people how to choose the best solutions. It doesn't depend on linear approaches, but it depends on repetitions on procedures of the design, the ability to go back to the previous steps, inspirations, brainstorming, build prototypes, taking the feedback to improve and repeat procedures again and

again in order to make a faster test for the solutions that they find (Twisi et al, 2021). DT helps individuals to go deeper in research and to try more than one time in making research, experimentation, monitoring, and observation, so by it we start from a point that we don't recognize the answer of it, but we are sure that we will find the best and the most creative solution for the problem by repeating over and over again the steps, going deeper in research experimentation, observing the elements, building prototypes and examine and improve them (Elwood et al, 2016). DT provides a way to learn from our failure because failure is not a negative issue in DT. But reaching the solution from the first try is not the most important aim, it believes in repetition and learning from searching on new and creative solutions (Rauth et al, 2010). DT supports the positive changes; because it allows the positive changes through finding the solutions slowly to fit the needs and the requirements of the beneficiary which allows the innovation to happen next to the things that are available, or that fit the real-life and the new requirements of the market. So we look at DT as an opportunity to design and build new solutions that weren't existing before, which improve the environment of work, productivity, performance, and service, so that it adds the element of positive change whether in making new products or the way of reaching to those products as well (Henriksen et al, 2017).

1.3 The Limitation for Employing DT

1- DT can't suit all kinds of problems, because of the nature of the challenge play role in that, and some problems need to employ and use scientific analytical method to find the solution, otherwise DT concentrate on the human-centered problem. However, it can't suit anything, any problem, or any context. As Thienen et al. (2014) said about it: "If design thinking is a means to solve problems- what problems is it good for? Obviously, it is not made to help physicists compute precise mathematical solutions" (von Thienen et al, 2014, p.97).

2- Lack of people who have experiences and talent to create and implement innovation, so it is very important to pay attention to have the abilities and skills for employing this methodology and DT (Twisi et al, 2021)

3- How is the idea of DT is adopted, including the process of repetition, the ability to test many designs and prototypes to solve the problem? It is difficult in some organizations and institutions to adopt the culture of trial and error in addition of all of these departments need to understand the benefits of testing- prototypes and the repetition of the approaches in order to accelerate the pace of innovation, but not having enough time and any support from the administration make the design thinking approach hard and low efficiency (Harrris, 2017).

4- Accessibility of the necessary support from top to bottom in organizations. For example, if we take the public sector as an organization made by design leaders have to commit experimental and extemporized, leading others by example and setting the tone for change on the ground (Twisi et al, 2021).

5- Culture, where public services need to make a good atmosphere for their employees that motivates them to design, experiment, and creativity (Twisi et al, 2021).

6- The little resources, the lack of time, the weak level of the students inhibit switching the traditional way in teaching to a new method (Renta, 2016).

7- How the participants interact with each other can affect the performance of design thinking. (Valentim, Silva & Gonte, 2017). If we work alone we will face many problems, there won't be any clashes inside the team and we will fall in love with our ideas and we will refuse any other solutions. "Conflicts among group members seem endemic in teamwork and surfaced in this study" (Goldman et al .2014, p 13).

1.4 Stages of Applying DT

DT consists of five stages, in which it can be done step by step, and when the feeling of wrong results, going back to the steps before again in order to get more understanding is a good way to have more recognition of the problem, and according to (Twisi et al, 2021; Zubaidi. 2019; and Henriksen, 2017) these stages are:

(1) Empathy

This is the basis of DT that concentrates on the human needs as a basic starting step to make a solution or empathy as an idea to solve the problem. Empathy is to show how to share the others their problems and happiness when talking to them. Your feelings may not come from your deep heart, but empathy is more profound and sincere, as the empath puts himself in his place and try to feel his feelings. In this stage, the designer deals with the situation in a deeper and stronger understanding. Thinking with others' needs and problems must be as a verb not as a noun, in DT people, don't need a book, but they need to know how to treat this book. This is a creative way of thinking about people's needs and solving their problems. Most of the time the designer asks people about their needs to get clear answers and the best solutions, but through observations for their behaviors and listening to stories and experiences and submerge in their lives and their environments to lead us to find their needs and realize them.

(2) Defining the Problem

In this stage observations and information are collected from the sympathy step to focus on the problems, identify them, and examine their complexities and variables. Challenge is understood by framing it from many points of view, and Its formulation is bigger than simple problem definition because it describes everything related to the beneficiary and concentrate on the problems and its framing, then focusing on the solutions of it, the more time that is taken to focus on the problem, the more creative solution can be reached. Finishing this stage is by getting out with several points of view about the problem statement and formulating this sentence according to this model. The beneficiary suffers from _____ the need_____because of_____.

(3) Idea Generation

A large number of answers and solutions are generated and developed to go beyond the problem, and how it can be solved in an effective way. After that, the process becomes in progress from the ordinary and simple solutions to the creative ones, and return back to the last steps and go over the challenge again to get more understanding based on discussions and additional information.

(4) Modeling (sons of the first model)

Here the aim is to build the prototype. The best thoughts and ideas are chosen, modeled, and the process of gathering the best ideas into practice by making prototypes to find solutions, in order to get the suitable answers. A prototype is a simple design of a proposed solution used to test the ideas and the expectations, design assumptions so that the designers involved can take the appropriate improvements and changes in direction. Prototypes don't need to be complete products, they can be in many forms, and the only thing the different forms have in common is that they are all tangible forms of your ideas. Such as acting outs, simple comics, models, paper models…..

(5) Testing

In this last step, the designer tests the prototypes that he has made with the beneficiaries or their representatives. The designer can make an interview with the beneficiaries and watch their responses about the models, or they can use other ways and solutions to get to the point or to improve the solutions, again even in this last stage we can go back to the previous steps to have new information and make new solutions.

2. Related Literature

Using DT in teaching provides the educational content in real problems that are related to the student's lives, which makes them use all the concepts that they have learned to solve these problems. Most of the educators who know about DT recognize its importance; to get knowledge, skills, and concepts effectively, which help them to apply and use them in real life. Many studies were conducted to explore the effectiveness of DT; McLaughlin, Wolcott, Umstead, and Rider (2019) conducted a qualitative review of about 15 articles about health profession education after examining 169 sources using DT. Two purposes were identified for use in education, (a) enhancing creativity and innovative thinking skills of individuals, (b) informing curricula and programs.

Zubaidy & Bani Kalaf (2019) investigated the effect of teaching an educational unit in science based on DT in the acquisition of physical concepts in eight grade students in light of their formal thinking.to achieve the aim of this study the researchers used the qusai -experimental approach, and developed educational content of the unit" The Electricity in our lives". The number of the study members reached (62) female students in Ein Al-Basha Directorate of Education. The physical concepts test and the formal thinking test were used to collect data. The results revealed that it is a statistically significant difference in the degree of acquisition of physical concepts attributed to both the teaching strategy based on DT and the difference in formal thinking.

The study of Tu,liu & Wu (2018) aimed to investigate the effect of using DT in university education. The researchers used the experimental research, choosing three teachers, three university professors, and fourteen male and female students from several universities in Taiwan. The researchers used deep interviews after 15 days of practicing based on DT for three hours weekly. The results showed that DT improves the student's creativity and invents positive relationships between students and their teachers and motivates the students to self-learning.

Harris (2017) conducted a study in one of the private tools in Colombia, aimed to determine opportunities and challenges that may teachers face through using DT and integrative thinking in basic education. Five teachers had six workshops for an hour for each one. The results showed that the most important challenge that teachers may have in DT is the time limitations and the administrative support. On the other hand, these challenges don't make this strategy less effective in teaching.

Retna (2016) conducted a study that aimed to examine teachers' perceptions, experiences, and challenges faced in adopting DT, to provide insight on a recent initiative adopted in Singapore schools. The researcher used qualitative case study research was carried out in a school using teacher narratives. Data includes in-depth face-to-face interviews and participant observation. The findings showed that teachers perceive that DT holds the potential for enhancing skills such as creativity, problem-solving, and teamwork as well as empowering students to develop empathy for others within and beyond the community.

Rauth et al. (2010) conducted a total of 17 semi-structured interviews with teachers in Stanford in the design school (USA) and Potsdam (German) in order to find out more about the underlying strategies and methods of DT. The results showed that there are many qualifications of DT education, such as prototype skills, emotional skills, the ability to adopt perspective, empathy, and a certain mindset. All of these abilities assure the students of their own desires to act and make creative ideas.

3. Statement of the Problem

English is a very important language in the whole world, and it is considered as the language of science and communication between all people from different countries, according to that teachers must find new ways to deal with the language skills creatively and by using motivated approaches, one of these approaches is DT. Some schools used DT in some subjects like science (Kolodner et al., 2003). Mathematics (Goldman, Knudsen, & Latvala, 1998), and other subjects. But this study aimed to understand teachers' perceptions of using DT as an approach in teaching the English language and to show how much they are using this approach in the classroom. Also, the researcher showed the importance of it for teaching English especially since most of the students and their parents believe that English is a difficult language and not easy to learn, and from this point of view, DT may make teaching English more interesting and more useful especially that it relates learning with their everyday life, and it makes an expert English student that can use the learned concepts to solve problems in different situations. The difficulty of teaching and learning in English made the researcher thinks of new methods and strategies, and through a communication workshop about DT the researcher decided to make a study about it, because of its ability to relate knowledge and scientific concepts in real life, specifically this study aimed to answer the following question:

1- What are the English teacher's perspectives of DT?

2- Are there any differences in teachers' perceptions of DT attributed to gender?

3- Are there any differences in teachers' perceptions of DT attributed to experience?

4- Are there any differences in teachers' perceptions of DT attributed to a qualification?

4. The Importance of the Study

The importance of this research is to explore teacher's perceptions about DT, in order to develop the capacity teaching building and to provide the decisions makers with the appropriate feedback to build development programs and make conduct training courses for teachers that concentrate on DT to find a creative and effective strategy for teaching in general and specifically teaching English. As Skaggs (2018) said that many tools are used while using DT, like, observation, experience, and inquiry make the students able to recognize the human needs and shape information to drive the ability to create new solutions that build strong relationships through aesthetics, need finding and identify meaning. As Sharples et al (2016) said, DT makes the students involved in the context which lets them observe, think, and be expert designers, which builds many elements such as empathy, cultural awareness, and risk-taking that build a stronger relationship between pupils and their teachers.

5. Objectives of the Study

This study aimed to explore:

1- The English teacher's perceptions of DT.

2- The differences between the teacher's perceptions according to gender.

3- The differences between the teacher's perceptions according to experiences.

4- The differences between the teacher's perceptions according to the educational level.

6. The Terminology of Study

DT: A non-linear creative approach that is used to solve problems based on human needs, that has five stages: empathy, defining the problems, idea generation, modeling, and testing in order to reach best teaching practices, in this study, DT is the degree that the teachers acquire on the DT scale.

English teacher: An academic person who teaches the student English Language with its four skills (reading, speaking, listening, and writing) from 1st grade to 12th grade.

7. Method

7.1 Design

A descriptive research approach was used for this study, since it is the appropriate research approach for this type of study.

7.2 Population

The population of the study consisted of 427 English Language Teachers in Amman 1 educational directorate according to the human resources statistics. Table 1 represents the study population according to the demographic variables.

Table 1. The Study Population

	Experience (years)		Qualification	
	(1-10)	>10	Bachelor	Higher studies
male	110	52	146	26
female	205	60	225	40

7.3 Sample

The sample of the study consisted of 135, they were chosen randomly from the population of the study, table 2 represents the study sample.

Table 2. Sample of the Study

	Experience (years)		Qualification	
	(1-10)	>10	Bachelor	Higher studies
male	33	18	31	20
female	64	20	54	30

7.4 Instrument

The researcher developed an instrument consisted of 2 parts: part one is personal demographic information, part two: the domains and the items of the questionnaire, it included 5 domains: Empathy (25 items), Defining the problem (9 items), Idea generation (7 items), Modeling (8 items), Testing (6 items).

7.5 Psychometric Characteristics

7.5.1 Validity

The instrument was distributed to 10 academic and experienced referees in curricula and assessment. The notes of the referees were considered, and the items were modified according to their notes.

7.5.2 Reliability

The reliability for DT scale was approved using test re-test and Cronbach alpha equation by applying the scale on a piolet sample which consisted of (25) teachers, table (3) represents the findings:

Table 3. Reliability of the Scale

Scale domains	Test-retest	Cronbach α
Empathy	0.93	0.90
Defining the problem	0.89	0.85
Idea generation	0.81	o.75
Modeling	0.85	0.81
Testing	0.87	0.83
Total	0.96	0.94

8. Results

Question 1: To answer question 1 which states: What are the English teachers' perceptions of DT? Means and Standard Deviations were used. Table (4) represents the findings of teacher's perceptions of (D.T) as shown;

Table 4. Means and Standard Deviation for English Teacher's Perceptions of DT

	N	Mean	Std. Deviation	degree
Empathy	135	4.02	.44	high
Defining	135	4.14	.43	high
Idea generation	135	4.13	.42	high
modeling	135	4.13	.43	high
Testing	135	4.23	.42	high
total	135	4.10	.37	high

As shown in table (4), the degree of teachers' perceptions of DT is high in the total score and all domains, and it was ordered as follows: Testing, Defining, Idea generation, Modeling, Empathy respectively.

Question 2: To answer question 2 which states: Are there any differences in teachers' perceptions of DT according to gender? Means and standard deviations are found to show the degree of English teachers' perceptions of DT according to gender, table (5) represents the findings.

Table 5. Means and Standard Deviations in the Degree of English Teachers' Perceptions of DT According to Gender

gender	Mean	Std. Deviation	Std. Error Mean
male	4.11	.38	.087
female	4.09	.37	.037

To show if the differences in the degree of English teachers' perceptions in DT were statistically significant ($\alpha=0.05$) independent samples test was used. Table (6) represents the findings.

Table 6. Independent Sample T-test for the Differences in the Degree of Mastery of English Teachers' Perceptions according to Gender

t	df	Sig. (2-tailed)
.235	133	.82
.229	29.16	.82

Table (6) shows that there aren't any differences in the degree of mastery of English teachers' perceptions in DT according to the gender.

Question 3: To answer question 3 which states: Are there any differences in teachers' perceptions of DT according to experience? Means and standard deviations are found to show the degree of English teachers' perceptions of DT according to experience, and table (7) represents the findings.

Table 7. Means and Standard Deviations in the Degree of English Teachers' Perceptions of DT According to Experience

	exp	Mean	Std. Deviation	Std. Error Mean
Total	1-5	4.051	.380	.074
	6-more	4.053	.337	.056

To show if the differences in the degree of English teacher's perceptions in DT were statistically significant (α=0.05) independent samples test was used. Table (8) represents the findings.

Table 8. Independent Sample T-test for the Differences in the Degree of English Teachers' Perceptions According to Experience

t	df	Sig. (2-tailed)
-.019	60	.985
-.019	49.92	.985

Table (8) shows that there aren't any differences in the degree of mastery of English teachers' perceptions in DT according to the experience.

Question4: To answer question 4 which states: Are there any differences in teacher's perceptions of DT according to educational level? Means and standard deviations are found to show the degree of English teachers' perceptions of DT according to the educational level, and table (9) represents the findings.

Table 9. Means and Standard Deviations for the Degree of English Teachers 'Perceptions of DT According to Qualification

	qualif	Mean	Std. Deviation	Std. Error Mean
Total	Bach	4.07	.37	.04
	graduate	4.16	.35	.05

To show if the differences in the degree of English teacher's perceptions in DT were statistically significant (α=0.05) independent samples test was used. Table (10) represents the findings.

Table 10. Independent Sample T-test for the Differences in the Degree of Mastery for English Teachers' Perceptions of DT According to Qualification

	T	df	Sig.(2-tailed)
total	-1.26	133	.209
	-1.28	101.92	.202

Table (10) shows that there aren't any differences in the degree of mastery of English teachers' perceptions in DT according to the educational level.

9. Study Discussion

The results revealed that English teachers' perceptions of the DT are high, and there aren't any differences in the degree of mastery of English teacher's perceptions of the DT according to gender, experience, and academic qualifications. These results are attributed to the fact that the teachers have a high level of qualifications which make them have the ability to develop their skills and build a good environment to improve students' thinking. Also, their high qualifications can be because of the plans of their graduate studies that needed many courses on thinking and strategies, this is consistent with the findings of Alassaf (2013).

Also, the Ministry of education pays attention to the importance of DT and its tools (brainstorming, role-playing, and creative thinking…) in order to develop the student's thinking skills, that by building courses and workshops for the teachers to practice DT and use it in the classroom. This is consistent with the findings of the study of Rauth. et al (2010) and Awwad (2018).

Another reason is the spread of workshops and electronic courses on social networks sit as Edrak and teacher e-training platforms; that the teachers take part in to have ranks and promotions enhance the knowledge of DT skills and encourage them to use it in the classroom. This is consistent with the findings of the study of Mahdi (2018) and Aldahshan (2019).

On the other hand, the challenges imposed on the education sector due to the COVID-19 allowed distance learning and was the perfect solution for the teachers to get an additional qualification to improve their career development and job promotion which was a strong resource for many strategies and methods of teaching including DT. This is consistent with the study of Al Omari (2020), UNECCO (2020).

This study is different from other studies in the amount of understanding about DT, some studies found that the teacher's perceptions are not enough and they are not certain about what is DT (its goals and steps), and in other studies, DT was a new approach or anew teaching strategy that has many challenges. This is consistent with the study of Renata (2016), Lahey (2017).

Recommendations

The study recommends conducting more research on design thinking, including different samples of teachers from disciplines other than English, and conducting qualitative research to observe the degree to which teachers apply design thinking strategies.

References

Al Dahshan, J. (2019). E-training as an Introduction to the Training Organization in Egypt. *The Arab Journal for Training and Development Research, 2*(4), 1-16.

Al Omari, O. (2020). An Evaluation of the Experience of Mu'tah University in Using the Learning Management System (Moodle). *Jordanian Journal of educational sciences, 16*(2), 129-141.

Alassaf, J. A. F. (2013). *Attitudes of Social Studies Teachers toward Developing Creative Thinking.*

Awwad, S. (2018). *The Degree of Effectiveness of Training Courses and its Relation to the Level of Teachers' Job Performance in Secondary Schools in Amman* (An unpublished master's thesis). The Hashemite University, Jordan.

Brophy, S., Klein, S., Portsmore, M., & Rogers, C. (2008). Advancing engineering education in P-12 classrooms. *Journal of Engineering Education, 97*(3), 369-387. https://doi.org/10.1002/j.2168-9830.2008.tb00985.x

Elwood, K., Savenye, W., Jordan, M. L. J., & Zapata, C. (2016). *Design Thinking: A new construct for educators.* In Paper session presented at the Annual Convention of the Association of Educational Communications and Technology. State University. USA

Gladwell (2000). *The Tipping Point: How Little Things Can Make a Big Difference.* New York. Little, Brown.

Gloppen, J. (2009). Perspectives on design leaderships and design thinking and how they relate to European Service industries. *Design Management Journal, 14*(1), 33-35. https://doi.org/10.1111/j.1942-5074.2009.00005.x

Goldman, S., & Kabayadono, Z. (2017). *Taking Design Thinking to school.* New York: Routledge. https://doi.org/10.4324/9781317327585

Goldman, S., Kabayadondo, Z., Royalty, A., Carroll, M. P., & Roth, B. (2014). Students' teams in search of design thinking. *Design Thinking Research*, 11-34. Springer. https://doi.org/10.1007/978-3-319-01303-9_2

Goldman, S., Knudsen, J., & Latvala, M. (1998). Engaging Middle Schoolers in and Through Real World Mathematics. In L. Leutzinger (Ed.), *Mathematics in the Middle* (pp129-140). Reston, VA: National Council of Teachers of Mathematics.

Grots, A., & Creuzacher, I. (2016). Design Thinking: process and culture? *In Design Thinking for Innovative.* Springer. https://doi.org/10.1007/978-3-319-26100-3_13

Hammam, A. (2018). *The Effectiveness of a Proposed Unit in the Light of (STEMA) Approach to Developing Design Thinking in Science for Students of Official Schools of languages.* Unpublished master's thesis, Faculty of Education, Helwan University.

Harris, R. (2017). *Teachers as designers: Creativity, innovation and technology in professional development.*

Unpublished Dissertation. Columbia University, USA.

Henriksen, D., & Richardson, C. (2017). Teachers are designers: Addressing problem of practice in education. *Phi Delta Kappan, 99*(2), 60-64. https://doi.org/10.1177/0031721717734192

Henriksen, D., Gretter, S., & Richardson, C. (2020). Design Thinking and the Practicing Teachers: Addressing Problems of Practice in Teacher Education, Teaching Education. Retrieved from https://scholar.google.com/scholar?q=Henriksen,D.+Gretter,+S.+Richardson,+C.(2020).+Design+Thinking+and+the+Practicing+Teachers&hl=ar&as_sdt=0&as_vis=1&oi=scholart

Kelley, T, & Littman. J. (2001). *The Art of Innovation*. Stanford: Amazon Books Clubs.

Kelley, T., & Kelley, D. (2013). *Creative Confidence*. Stanford: Amazon Books Clubs.

Kolodner, J., Crismond, D., Fasse, B., Gray, J., Holbook, J., & Puntembakar, S. (2003). Putting a Student-Centered-Learning by Design Curriculum into Pracice: Lessons Learned. *Journal of the Learning Science, 12*(4). https://doi.org/10.1207/S15327809JLS1204_2

Lahey, J. (2017). How design thinking became a buzzword at school. The Atlantic. Retrieved from https://www.theatlantic.com/education/archive/2017/01/how-design-thinking-became-a-buzzword-at school/512150/

Mahdi, H. (2018). *E-Learning towards a digital world.* Amman: Dar Al Masirah.

Mclaughlin, J., Wolcott, M., Hubbard, D., Umstead, K., & Rider, T. (2019). A qualitative review of the design thinking framework in health professions education. *BMC Medical Education, 1*9, 98. https://doi.org/10.1186/s12909-019-1528-8

Mishra. P., & Mehta, R. (2017). What our educators get wrong about 21st-century Learning: Results of a survey. *Journal Digital learners in Teacher Education, 33*(1), 6-19. https://doi.org/10.1080/21532974.2016.1242392

Peters, J., & Stout, D. (2015). *Teaching science in the basic stage: Methods, concepts, and investigations.* Boston: Pearson.

Pink. D. (2005). *A Whole New Mind: Why right- brainers will rule the future*. New York: Riverhead Books*.*

Rauth, 1., Koppen, E., Jobst, B., & Meinel, C. (2010). Design thinking: An Educational Model towards Creativ*e Confidence.* In DS 66-2: Proceedings of the 1st International Conference on Design Creativity (ICDC 2010).

Retan, K. S. (2016). Thinking about Design Thinking: A Study of Teacher Experiences. *Asia Pacific Journal of Education, 36*, 5-9. https://doi.org/10.1080/02188791.2015.1005049

Rittel, H., & Webber, M. (1973). Dilemmas in general theory of planning. *Policy Sciences, 4*(2), 155-169. https://doi.org/10.1007/BF01405730

Rizq, H. (2018). Effect of Strategy Based on the Entrance if Design Thinking for Teaching of Mathematics on the Self-Efficacy Intermediate School Girls Students in Makkah. *Association of Arab Educators, 100*, 223-240. https://doi.org/10.21608/saep.2018.32835

Sharples, M., de Rock, R., Ferguson, R., Gaved, M., Herodotou, C., Koh, E., … Wong, L. H. (2016). *Innovating Pedagogy: Open University Innovation Report 5*. Milton Keynes: The Open University.

Skaggs, P. (2018*). Design Thinking: Empathy through Observation, Experience, and Inqui*ry. In E. Langran & J. Borup (Eds.), Proceedings of Society for Information Technology & Teacher Education International Conference (pp. 1168-1172). Washington, D.C., United States: Association for the Advancement of Computing in Education *Skills among the Students of the Basic Stage in the Third Directorate of Education of Oman*. The Islamic.

Todd, R. (1999). Design and technology yields a new paradigm for elementary schooling. *Journal of Technology Studies, 25*(2), 26-33. https://doi.org/10.21061/jots.v25i2.a.7

Tu, J., Liu, L., & Wu, K. (2018). Study on the Learning Effectiveness of Stanford Design Thinking in Integrated Design Education. *Sustainability, 10*(8), 26-49. https://doi.org/10.3390/su10082649

Twisi et al. (2021). *Capacity Building of Teachers and Educational Process in Public schools using Design Thinking Course*. Amman: Ministry of Education.

UNESCO (2020). A guide for Policy Makers in Academic, Vocational and Technical learning. King Salman Humanitarian Aid and Relief Centre. *University of Educational and Psychological Studies, 21*(1), 269-29.

Valentim, N. M. C., Silva, W., & Conte, T. (2017). *The students' perspectives on applying design thinking for the design of mobile applications*. In Proceedings of the 39th International Conference on Software Engineering: and Education Track (pp. 77-86). IEEE Press.

Von Thienen, I. M., & Nicolai. C. (2014). *How design thinking tools help to solve wicked problems*. In Design Thinking Research (pp. 97-102). Springer. https://doi.org/10.1007/978-3-319-01303-9_7

Zubaidi, N., & Bani, K. M. (2019). The effect of teaching an educational unit in science based on design thinking on the acquisition of physical concepts for eighth- grade female students. *Journal of the Islamic University of Educational and Psychological Studies, 6*, 1045-1065.