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A Constructivist Proposal to Enhancing Sixth Graders' Reading Motivation

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Abstract

This study has stemmed from a concern of the perceived decline in learners' motivation to read after the early years of schooling (Ciampa, 2012). Thereby, the purpose of this research-based study was to investigate the effectiveness of an interactive word wall on the reading motivation of sixth-grade learners. Results were based on the participation of twenty-one learners in the Control group who received no instructional method as well as twenty-seven learners in the Treatment group who received an interactive word wall instructional approach (Ariss, 2012, 2013, 2016, and 2019). Each learner's level of reading motivation was measured at the beginning and at the end of the study utilizing a multiple-choice reading survey from the Motivation to Read Profile (Gambrell, Palmer, Codling & Mazzoni, 1996). Qualitative data were collected from learners and then parents through observations and interviews. The findings of that study have proposed that there were differences in the motivation to read between the learners of the two different groups. This study is valuable for educators looking for alternative methods to improve learners' reading motivation.

Keywords: Reading motivation, interactive word wall, vocabulary activities, mixed-methods, constructivism.

Introduction

Reading remains one of the most substantial means to connect with individuals and to make sense of the world (Kirchner & Mostert, 2017). Farther, reading is related to significant cognitive outcomes together with cognitive as well as social correlates (Schutte & Malouff, 2007). As societies grow more intricate, reading and literacy become entangled in various daily activities. Diverse studies have stipulated that the amount individuals read is associated with their reading capacity (McQuillan & Au, 2001; Schutte et al., 2007; Smith, 1991; Stanovich, 2000; Walberg & Tsai, 1983). Thereby, reading competence is a mandatory skill in order to turn into an engaged reader (De Naeghel, Van Keer, Vansteenkiste & Rosseel, 2012; Kirchner et al., 2017).

Thereafter, upon accomplishing their elementary school education, pupils are required to be reading to learn as well as have learned to read (Alexander, 2012; De Naeghel, Van Keer, Vansteenkiste, Haerens & Aelterman, 2016; Duke & Carlisle, 2011). Thus, to attain that goal, learners must develop into competent in reading together with motivated and committed to reading throughout elementary school (De Naeghel et al., 2016).

However, motivation and reading among teenagers in different countries has persisted in being problematic, as only more than one-third read at a proficient level (Grigg, Donahue & Dion, 2007; Paige, 2011; Unrau & Schlackman, 2006).

A great deal of the research-based studies on young learners' reading has centered on cognitive aspects, for example, comprehension skills and word recognition (Ciampa, 2012; Guthrie & Wigfield, 2000). Nonetheless, because reading is, to a large degree, an effortful activity, motivation is a factor in whether pupils select to devote their energy to such a task (Deci & Ryan, 1985; Ciampa, 2012).

Along the past years, research studies have described pupils' motivation as a main concern of several instructors, and then numerous educators have recognized that motivation is at the root of a number of the hindrances they encounter in educating youngsters nowadays (Ariss, 2012, 2016; Edmunds & Tancock, 2003; Gambrell et al., 1996; O'Flahavan, Gambrell, Guthrie, Stahl & Alvermann, 1992; Veenman, 1984). There is a great amount of research, which promotes the idea that motivation plays a critical role in learning (Deci et al., 1985; Dweck & Elliott, 1983; Edmunds et al., 2003; McCombs, 1989). In addition to having an impact on learning, in general, instructors have also supported that motivation has an enormous effect on the breadth together with the amount of youngsters' reading (Anderson, Wilson & Fielding, 1988; Edmunds et al., 2003; Guthrie, Wigfield, Metsala & Cox, 1999; Wigfield & Guthrie, 1997). Increasing reading ability is motivating to learners, and increasing motivation leads to additional engaged reading time (Ciampa, 2012; Guthrie et al., 2000).

Subsequently, recent research into motivation to read has suggested that not only reading motivation overall, but the kind of pupils' motivation to read specifically ought to be regarded (Deci & Ryan, 2000; De Naeghel et al., 2016; De Naeghel et al., 2012; Guay, Chanal, Ratelle, Marsh, Larose & Boivin, 2010).

According to several studies, pupils' motivation differs across grade levels and subjects. Comprehending learners' lack of motivation to read is vital to enhance reading comprehension and then to empower students to think more critically about their assigned readings (Thomas, 2015).

At the time learners first enter school, they are excited about learning as well as highly motivated to learn. As youngsters move through elementary school, their learning motivation seems to decrease in all academic subjects, adding reading (Eccles, Wigfield & Schiefele, 1998; Edmunds et al., 2003; Guthrie et al., 2000; Thomas, 2015). Furthermore, it is likely that the largest decline in reading motivation takes place during the time in which pupils are in the first through fourth grades (Edmunds et al., 2003; Wigfield et al., 1997). That weakening in motivation has been attributed to learners' growing awareness of their performance as contrasted to others and to instruction that stresses on competition and does not deal with youngsters' interests (Edmunds et al., 2003; Guthrie et al., 2000).

Thereafter, when the motivation to read decreases, the amount of reading pupils decreases, that may be detrimental as the amount of reading affects pupils' achievement together with reading comprehension (Anderson et al., 1988; Edmunds et al., 2003; Mazzoni, Gambrell & Korkeamaki, 1999; Taylor, Frye & Maruyama, 1990; Thomas, 2015). Studies have demonstrated that learners who are motivated as well as spend additional time reading become better readers than pupils who spend little time reading (Anderson et al., 1988; Edmunds et al., 2003; Morrow, 1992). Thus, students who are capable of engaging as well as willing to participate in literacy-based activities, particularly reading, have an advantage over reluctant together with less skillful readers (Kirchner et al., 2017).

Thereupon, reading may turn into a painful experience for learners who do not master reading skills early in their school years (Ciampa, 2012; Wigfield et al., 1997). As a result, these pupils may decline possibilities for practice, placing themselves even further behind motivated readers who may be independently reading as much as thrice the amount of text as unmotivated learners (Ciampa, 2012; Wigfield et al., 1997). Numerous researchers refer to the "Matthew effect" (Kirchner et al., 2017, p.3) regarding reading, the ever-widening gap between less competent and skillful learners, together with the significance of motivation to curb that outcome (Bates, D'Agostino, Gambrell & Xu, 2016; Chang, Wang & Ma, 2015; Kirchner et al., 2017; Malloy & Gambrell, 2010).

Therefore, in order to address those disparities, to prevent early reading difficulties as well as to lessen this broadening gap, we ask the following question: "How may instructors motivate pupils from various cultures together with backgrounds to read more" (Ciampa, 2012; Kirchner et al., 2017)?

Theoretical framework

The researcher has chosen the constructivist perspective as the theoretical framework to this research study (Ariss, 2019). Constructivist learning theory is outlined as the student's active construction of new knowledge centered on her/his experiences as well as previous knowledge (Ciampa, 2012; Dewey, 1916; Kroll, 2004; Piaget, 1973). Further, from a constructivist perspective, learning is influenced by the beliefs, attitudes, knowledge, and contexts that learners bring to the classroom (Ariss, 2019; Sharma, 2015). Consequently, when pupils learn, their previous knowledge does not simply go away it becomes integrated with the new knowledge (Ariss, 2019; Garfield & Ben-Zvi, 2009; Sharma, 2015).

Nonetheless, youngsters are identified as self-regulating, inherently active pupils who build knowledge in response to interaction with environmental stimuli; comprehending, thereby, is put up gradually through active involvement together with participation (Bruner, 1960; Ciampa, 2012; Kroll, 2004; Piaget, 1973). As a result, within Bruner's (1960), Dewey's (1916), and Piaget's (1973) constructivist theories, the source of learning is guided discovery as well as youngster-determined exploration instead of direct teaching (Ciampa, 2012).

Furthermore, constructivist theory also stresses the idea that learning ought to be authentic, and then that learning necessitates meeting real-life experiences. In this fashion, instructors believe that reading instruction ought to be grounded in contexts, which are familiar to learners, for it seems that it may assist pupils in connecting recent information to these experiences (Ciampa, 2012; Hooper & Rieber, 1995). Thereafter, the constructivist goals of autonomy support, active problem solving, pupil control, choice, and use of authentic as well as appropriate texts in starting reading instruction are preferred to explicit teacher-directed instruction. Those goals represent crucial factors of the motivation to read (Ciampa, 2012; Gambrell et al., 1996; Renninger, 2000).

Subsequently, within the constructivist learning environment, educators are capable of creating a place where students can support one another then work collectively as they apply an assortment of information resources together with tools in their pursuit of problem-solving activities as well as learning goals (Ariss, 2019; Miller-First & Ballard, 2017).

Literature review

Nowadays, with the changes and innovations that are taking place, individuals forming the society must constantly upgrade themselves.

Further, with the beginning of the information age, people need to be literate so to gain the desired success, to form a social environment, to spend their free time more constructively, to maintain their daily lives, and to adjust to the growing technology (Ariss, 2019; Biyik, Erdogan & Yildiz, 2017).

Learners are unable to move through their school careers without interacting continuously with a diversity of texts, such as assignments, specified textbooks and additional reading material. Farther, pupils may access information not only through printed text, but also by way of audio and visual media, as well as through means of mobile phones in digital format. Research studies point out that the frequency, the breadth, as well as the amount of pupil reading activity influence numerous aspects of performance (Guthrie, et al., 1999; Kirchner et al., 2017; Schutte et al., 2007; Smith & Sheehan, 1998; Wigfield et al., 1997). Therefore, the successful acquisition of the reading skill, which is the root of achieving knowledge, will empower individuals to develop academically together with socially, and then to effortlessly adapt to their environment (Akyol & Kayabaşi, 2018; Ciampa, 2012).

Thereafter, language walls have emerged, regarded as an additional phonics together with a vocabulary technique (Ariss, 2016, 2019; Cunningham, Hall & Sigmon, 1999; Osborn, 2007), and are exploited as a teaching instrument, by instructors, in order to motivate learners to adopt newly learned terminology (AlShaiji & AlSaleem, 2014; Ariss, 2016, 2019).

Educators have conceded that understanding why individuals are compelled to specific behaviors while refraining from others is located within the psychological inquiry (Ariss, 2012, 2016, 2019; Covington, 2000). Moreover, motivational orientation is one of the most crucial and high-powered motivators amongst distinct components of learner motivation (Ariss, 2012, 2016, 2019; Kim, 2003). According to Kim (2003), students may be categorized by following the kinds of motivation or separated in agreement with the levels of motivation (Ariss, 2012, 2016, 2019; Kim, 2003). Afterwards, educators ought to create learning environments where learners are actively absorbed in activities and in discussions (Ariss, 2019; Sharma, 2015).

Motivation

Motivation is surely an umbrella-term entangling a considerable range of countless factors (Ariss, 2012, 2016, 2019; Dornyei, 2001). Dornyei (2001) has justified that this is why motivational psychologists have exerted a large deal of labor in the past trying to lessen the diversity of potential determinants of individual behavior by recognizing a comparatively lesser number of key variables, which will explain a central proportion of variance in human's action (Ariss, 2012, 2016, 2019).

Thereupon, Gardner (1985) has described motivation as the combination of effort and desire to reach the aim of learning the language as well as favorable attitudes towards learning the language. Amongst the varied components of learner motivation, motivational orientation is one of the most influential and worth noting motivators; it is appropriate to the purpose of learning or reasons for studying a second language (Ariss, 2019; Gardner & MacIntyre, 1991; Kim, 2003; Oxford & Shearin, 1994). There are two sub-types of motivational orientation: the integrative orientation, which reflects a personal interest in the culture together with the people of the target language group, and the instrumental orientation, which represents the practical benefits of learning a target language (Ariss, 2019; Gardner, 1985; Kim, 2003).

At this time, motivation has been in the transformation of being radically retheorised and reconceptualised in the context of modern notions of self and identity (Ariss, 2012, 2016, 2019; Dornyei & Ushioda, 2009). However, Guthrie and Wigfield (2000) have pointed out that motivation is the reader's personal values, beliefs, together with objectives with regard to procedures, topics, and then outcomes of reading (Ariss, 2019).

Subsequently, the pupils who believe they are competent readers are additionally expected to excel than those who do not maintain similar beliefs (Ariss, 2012, 2016, 2019; Dornyei, 2001; Wigfield & Eccles, 2002). Stanovich (1986) has outlined the broadening gap between less fluent readers and their peers as the Matthew effect in reading and he has recommended that less fluent pupils need to be given chances to close the achievement gap before the gap expands (Ariss, 2019; Gibbon, Duffield, Hoffman & Wageman, 2017).

Additionally, Gambrell, Palmer, Codling, and Mazzoni (1996) have specified that highly motivated readers are those who initiate their own reading chances and then are self-determining. Nonetheless, learners who consider reading as critical as well as valuable then hold personally adequate reasons for reading will eventually embark on reading in an effortful and a better-designed style (Ariss, 2012, 2016, 2019; Gambrell et al., 1996). They have also acknowledged two components of reading motivation: self-perceived competence, termed as well as self-concept, together with value of reading (Ariss, 2019; Gambrell et al., 1996; Gibbon et al., 2017).

1- Reading motivation

Reading motivation is both a powerful predictor of later reading skills as well as the vital element for actively engaging young pupils in the reading process, and goes beyond the time spent in reading. Actually, it is reflected in how learners think about the act of reading together with associated language-based activities and how they think about themselves as readers (Deci et al., 1985; Ciampa, 2012).

Reading motivation is a complex and a multifaceted concept, composed of multiple features (Ariss, 2019; Baker & Wigfield, 1999; De Naeghel et al., 2016; De Naeghel et al., 2012; Watkins & Coffey, 2004). Reading motivation may be defined as internal processes that maintain as well as incite reading activity (Ariss, 2019; Schunk, Pintrich & Meece, 2008; Unrau & Quirk, 2014). From that point of view, motivation to read is regarded as the thoughts, self-perceptions, and beliefs, which provide the impetus for a person to maintain or engage in reading-related activities (Ariss, 2019).

However, based on this definition, motivation to read does not require or guarantee a person to read. More specifically, it is a pre-requisite to engaged reading. Similar to prior frameworks of motivation to read, that point of view persists that learners' reading motivations are interrelated, interactive, multifaceted, as well as changeable over time together with easily influenced by manipulation (Ariss, 2019; Unrau et al., 2014).

Therefore, learners are additionally motivated when they engage in tasks that fall within their zone of proximal advancement, at a level of difficulty barely beyond what they may be able to accomplish independently, but at which they may attain with expert help together with guidance (Ariss, 2019; Miller, 2015; Vygotsky, 1978). Margolis and McCabe (2004) have linked motivation to differentiation, uncovering that high self-efficacy, a component of reading motivation, necessitates that the difficulty of the task be matched with the learner's instructional or independent level. Further, Margolis et al. (2004) have also stressed on the importance of peer modeling for boosted self-efficacy (Ariss, 2019; Miller, 2015).

In addition, furnishing pupils with occasions for meaningful social interaction around books is a major factor in fostering their motivation to read. Kohn (2010) has suggested against isolating learners as they read. Students ought to be able to share the experience of listening to a book and/or text read aloud by a teacher, share book, and/or text recommendations with one another, and then discuss common texts with peers. Farther, Kohn (2010) has discussed that, together with isolating pupils, concentrating on skills instead of engaging authentically with rich texts is a sure fashion to stop learners' interest in reading (Ariss, 2019; Miller, 2015).

2- Vocabulary

Vocabulary is recognized as foundational to reading comprehension. The purpose of vocabulary instruction is to aid pupils (a') in applying then developing vocabulary knowledge, (b') in linking new vocabulary to existing experience together with knowledge, (c') in understanding a text, and (d') in developing better utilization of strategies to figure out new vocabulary independently. Helpful vocabulary instruction specifies both contextual and definitional information about the meaning of new words. It also embroils learners in the active learning of new words and then proposes diverse exposures to significant information about words as well as related words (Ariss, 2019; Linan-Thompson, Vaughn, Hickman-Davis & Kouzekanani, 2003; Tam, Heward, & Heng, 2006).

Research studies stipulate a variety of productive strategies and methods for teaching vocabulary in middle school, entailing the need for active together with meaningful engagement, and the importance of pupil autonomy as well as choice in learning. Although there has been hardly any research to determine the competency of word walls in upper grades, it is thought that both of these characteristics are crucial factors for implementing interactive word walls in middle school classrooms (Ariss, 2019; Vintinner, Harmon, Wood & Stover, 2015).

3- Interactive Word Walls

The use of a word wall implicates promoting vocabulary learning instead of operating as a display of words to ease the elaboration of a deeper comprehension of general academic vocabulary words, which are usually daring together with technical terms (Ariss, 2016, 2019; Hooper & Harmon, 2015).

A word wall is a compilation of high- frequency sight words, which are age suitable, categorized into classes or groups, as well as is found on the wall of a classroom for students to spot then gain knowledge (Ariss, 2016, 2019; Brabham & Villaume, 2001; Cooper & Kiger, 2003; Jasmine & Schiesl, 2009). At the time, word wall activities favor the application of high-frequency words (Jasmine et. al., 2009).

Nevertheless, word walls serve as visual scaffolds that help learners recall connections between words (Ariss, 2016, 2019; Callella, 2001; Jackson & Narvaez, 2013; Jasmine et. al., 2009), keep information about the word, and in the end, read words with automaticity (Ariss, 2016, 2019; Ehri, 2005; Jasmine et. al., 2009).

Thereafter, the primary aim of a word wall is to assist learners in building sight words identification in order for them to identify these words at once (Ariss, 2019; Huebner & Bush, 1970; Jasmine et. al., 2009).

However, traditional word walls are instructor-generated, not in order lists of words, which are placed at the beginning of the school year then kept from touching. Therefore, these word walls are not valued by learners or contemporary with instruction (Ariss, 2019; Jackson et. al., 2013).

On the contrary, interactive word walls are an efficient instructional method because they introduce contemporary academic vocabulary though furnishing visual representations, which aid learners develop fluency in, as well as, comprehension of, major unit vocabulary (Ariss, 2019; Douglas, Klentschy, Worth & Binder, 2006; Jackson et. al., 2013).

Consequently, interactive word walls offer the visual aids, which help in illustrating word meanings, and conceptually set up words to extend comprehension (Ariss, 2019; Jackson, 2011).

Additionally, interactive word walls are planned by instructors, but created by learners at the time of the school day. Learners enjoy creating, writing, drawing, and contributing to the wall (Ariss, 2019; Jackson et. al., 2013).

Methodology

1- Research design

The aim of this research study was to examine the effect of the interactive word wall method, an instructional fluency approach, on the development of reading motivation in grade six students, in the P. L. private school, in Beirut, Lebanon (Ariss, 2013, 2016, 2019; Callela, 2001; Fraenkel & Wallen, 2010; Jasmine et. al., 2009).

To address that research question, the researcher used a mixed-methods approach combining both qualitative and quantitative methodologies (Ariss, 2013, 2016, 2018, 2019; Fraenkel et. al., 2010; Hanson, Creswell, Plano Clark, Petska & Creswell, 2005).

Moreover, the current mixed-method study was conceptualized from a pragmatic theoretical paradigm (Fraenkel et. al., 2010; Hanson et. al., 2005; Tashakkori & Teddlie, 1998) then devised as a primarily quantitative design with a later emphasis on the qualitative part to flesh out the results (Fraenkel et. al., 2010; Tashakkori et. al., 1998).

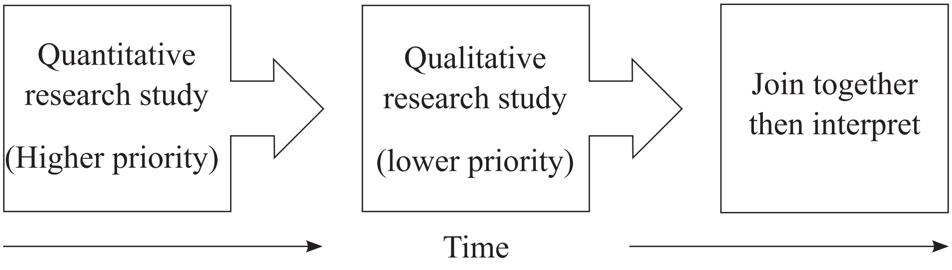

Figure 4.1.1: The explanatory design (Almasi & Fullerton, 2012; Ariss, 2019; Creswell & Plano Clark, 2007; Fraenkel et al., 2010).

4.2- Research question and hypothesis

This study was designed to discuss the following research question:

What is the effect of an interactive word wall instructional approach on sixth grade students' motivation to read (Ariss, 2013, 2016, 2019)?

Thereupon, the following hypothesis would be found in this research-based study because it joined qualitative and quantitative methodologies:

A literary alternative: An interactive word wall will influence the level of reading motivation in grade six learners (Ariss, 2013, 2016, 2019).

2- Variables found in the research

In the following study, there is one independent clearly categorical manipulated variable, usually referred to as an experimental or treatment variable (Ariss, 2012, 2013, 2016, 2019; Fraenkel et al., 2010). This variable is the interactive word wall instructional method. Subsequently, there is a need to compare the usefulness of an interactive word wall strategy in boosting the motivation to read level of the readers (Ariss, 2019).

Table 4.3.1: List of the independent and dependent variables found in the research study (Ariss, 2019).

The research study variables					
Independent				**Dependent (outcome variables)**	
Independent (experimental/treatment variables)		**Extraneous (independent variables not being controlled)**			
Quantitative	Categorical	Quantitative	Categorical	Quantitative	Categorical
	1. The interactive word wall instructional approach	1. Experience level of students	1. Nature of texts used	1. Students' reading motivation	
			2. Teaching methods of teachers		
			3. Subject taught		
			4. Gender of learners		

Thereupon, there is one dependent quantitative variable, known as the criterion or the outcome variable (Ariss, 2012, 2013, 2016, 2019; Fraenkel et. al., 2010), which is the students' motivation to read. The outcome variable varies with what the experimental variable does to it and how it influences it (Ariss, 2019; Fraenkel et. al., 2010). Farther, the degree of motivation is in fact quantitative but it is treated as categorical so that the researcher manipulates the amount of motivation (Ariss, 2012, 2013, 2016, 2019).

Nonetheless, there are four categorical extraneous variables in this study as well as one quantitative extraneous one. The quantitative extraneous variable stipulates the experience level of the students; whereas the categorical extraneous variables entail the nature of the texts used, the subject taught, the gender of the learners, together with the teaching methods of the instructors involved (Ariss, 2019).

3- Context and sampling

The study was set in two sixth grade classrooms (GSF & GSA), at a Lebanese private school (P. L.), over a period of twenty-four weeks. The convenience sampling included forty-eight multi-age learners from medium socio-economic status families who mainly spoke Arabic at their houses with their parents, but studied English at the P. L. school as a third language. They were further selected according to the results gathered after a multiple choice reading survey from the Motivation to Read Profile (Gambrell et al., 1996), which has been distributed prior to the implementation of the study so to ascertain the amount of the sixth graders' reading motivation (Ariss, 2012, 2013, 2016, 2019). Thus, an Experimental group with twenty-seven participants was molded as well as a Control group with twenty-one pupils.

4- Procedure

An informed parental consent form, approved, endorsed then signed by the headmaster of the private school was sent to the parents of each student from the two different sections of grade six, prior to the study, so to inform them about the nature, the purpose, and the duration of that research study. Afterwards, upon getting the parents' approval, all students were preexamined for their level in motivation to read prior to the implementation of the word wall instructional method (Ariss, 2012, 2016, 2019).

Thereafter, starting with a convenience sampling, the researcher turned to a purposive sampling. After the reading survey, the two sixth grades sections were divided into one Control group (GSA), which obtained no implementation of the strategy, and one Experimental group (GSF), which received the implementation of the interactive word wall instructional approach (Ariss, 2019).

Subsequently, learners in the Control classroom (GSA) persevered in getting their customary English language instruction, although they had twenty minutes, once a week for two consecutive weeks, and forty minutes, once every third week, of silent reading. Meanwhile, the students of the Experimental classroom (GSF) pursued the steps illustrated in the interactive word wall implementation cycle (Figure 4.5.1), earlier designed by the researcher, and according to the similar time schedule applied in the Control classroom (Ariss, 2018, 2019).

Thereupon, students placed the pre-selected vocabulary words in categories, and then played, in pairs, a vocabulary game called the "Vocabulary Self-Collection" where they discussed unfamiliar words, agreed on an appropriate definition then distributed the work among themselves to produce a symbol to represent each word (Figure 4.5.1; Table 4.5.1) (Ariss, 2019). Farther, they illustrated a situation or context for exploiting each unfamiliar word selected earlier, following a certain vocabulary activity (Table 4.5.1), during station time (Figure 4.5.1) (Ariss, 2019).

Nevertheless, the researcher observed the participants all through, took notes, in addition, filled up the observations checklists. Parents of the learners were interviewed towards the end of the study by the researcher. Equivalent surveys were given to the students in both Experimental as well as Control classes, at the beginning and at the end of the research study (Ariss, 2012, 2013, 2016, 2019).

A- Vocabulary Read Aloud:

Day 1

The researcher models noticing new & interesting words during the read-aloud then records them for the class.

B- Vocab-O-Grams:

Day 1

The researcher introduces the pre-selected vocabulary words & the learners place them in categories.

C- Word Journal:

The learner notes unfamiliar words as he/she reads, on his/her own, in his/her Word Journal.

D- Vocabulary Self-Collection:

Day 2

The learners, in pairs, recognize unfamiliar vocabulary words, discuss them, and then agree on a proper definition for each word.

E- Word Square & vocabulary activities:

Day 3

The learners, in groups, create a symbol to represent each previously chosen vocabulary word and illustrate a context or situation for using that word, following a specific vocabulary activity, during station time.

F- Presenting the Interactive Word Wall:

Day 3

Each group of learners represents the interactive word wall to the class

Figure 4.5.1: The interactive word wall implementation cycle in the Experimental class (GSF), in the P. L. School (Ariss, 2019; Blachowicz & Fisher, 2002; Brassel, 2009; Hoskins & Vannest, 2010; Liu & Hu, 2015; Mraz, Nichols, Caldwell, Beisley, Sargent & Rupley, 2013).

Table 4.5.1: List of vocabulary activities & days set, types of readings at the time of activities, and definitions of the vocabulary activities performed (Ariss, 2019; Blachowicz et al., 2002; Brassell, 2009; Gunning, 2003; Heinze, 2006; Hoskins et al., 2010; Johnson, Pittelman & Heimlich, 1986; Marzano, 2009; Porter & Herczog, 2009; Vacca & Vacca, 2005).

Vocabulary activities and days set	**Types of Readings at the time of activities**	**Definitions of the vocabulary activities**
Day 1: Vocabulary Read Aloud	Reading aloud	Instructors expose their pupils to new vocabulary through focused, embedded, or incidental instruction during a Read Aloud.
-Vocab-O-Grams	Guided reading	Instructor pre-selects 3 new words before reading aloud the story. Learners put those words in separate categories (Blachowicz et al., 2002; Brassell, 2009).
-Word journal	Silent reading	Learners are asked to keep a Word Journal where they write 3 unfamiliar vocabulary words as they read the story.
Day 2: Vocabulary self-collection	Paired reading	Learners identify the words they believe are significant for mastery, discuss them & set a proper definition for each one (Brassell, 2009).
Day 3: Word Square	Partner /Buddy reading	Learners construct a Word Square with the vocabulary term chosen.

-Visualization and drawing	Partner/Buddy reading	Learners create a visual image of the selected words through association with a drawing, a collage, a picture, or a symbolic representation (Marzano, 2009).
-Knowledge rating	Partner/Buddy reading	Learners place, in a three-part graphic organizer, "what they know", "what they want to know" & "what they have learnt" about the journey of the characters in the story read (Vacca et al., 2005).
-Vocabulary cards	Partner/Buddy reading	Learners construct a vocabulary card for each situation faced by the main characters in the story, citing the conflict they had on one side of the card & the solution they followed on the other side (Heinze, 2006; Porter et al., 2009).
-Word sort	Partner/Buddy reading	Learners sort vocabulary words into separate categories, such as "setting", "characters", "plot" & 'events", based on common characteristics and / or relationships (Gunning, 2003; Brassell, 2009).
-Semantic maps	Partner /Buddy reading	Researcher selects a concept to be taught, places it in the center of the board, then asks learners to put the words they associated with that term in a graphic organizer (Johnson et al., 1986).

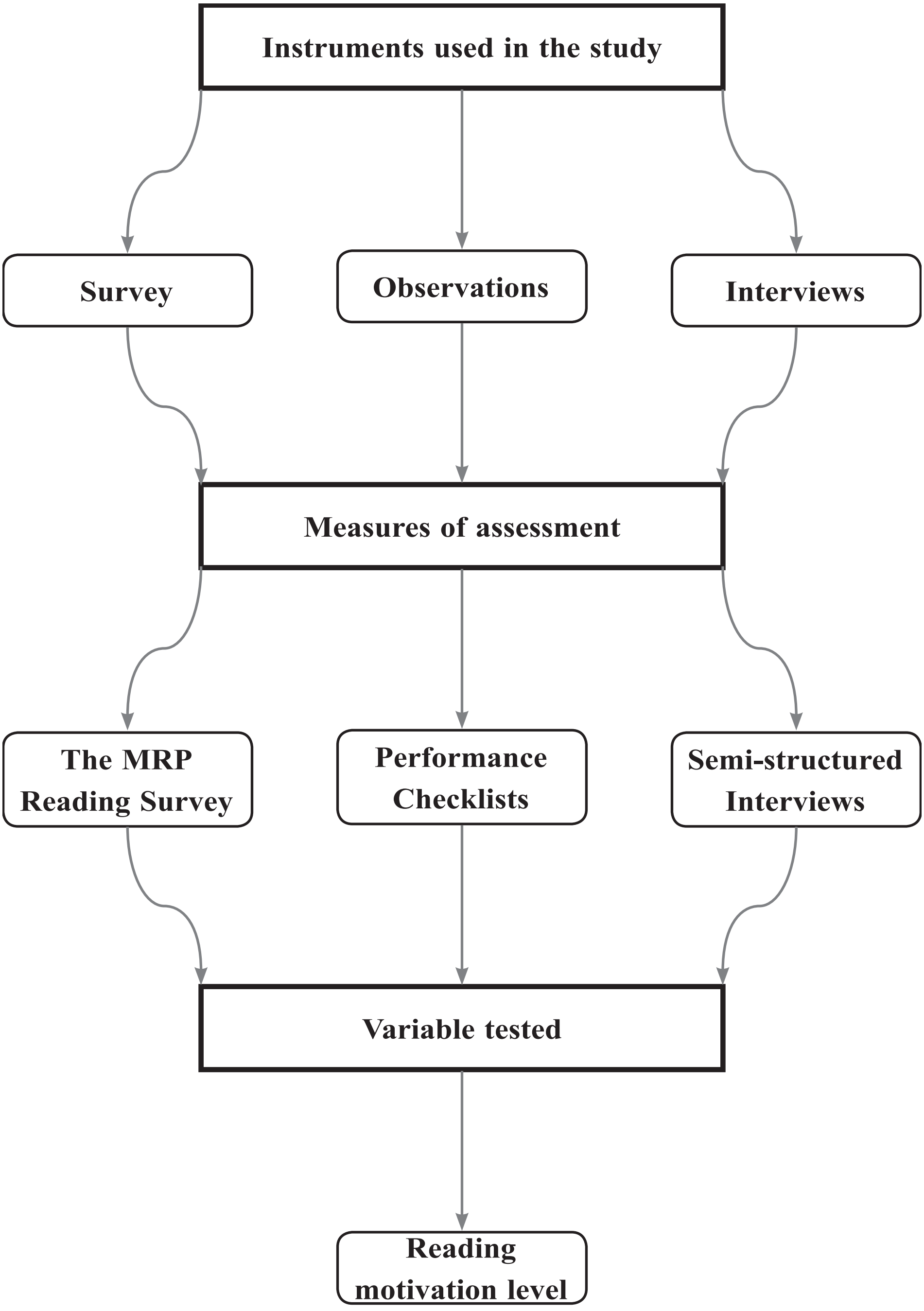

Figure 4.6.1: List of instruments used, measures of assessment, and variables tested in the Experimental class GSF, in the private school (P. L.) (Ariss, 2018, 2019).

5- Instruments used data analysis as well as measures of validity and reliability

There were three instruments put into practice in this study to gather data about the students' level of reading motivation (Figure 4.6.1), with the purpose of examining the alternative hypothesis, which stated that an interactive word wall would influence the level of reading motivation of grade six students (Ariss, 2013, 2016, 2019). These instruments involved observations, interviews, together with a reading survey (Ariss, 2013, 2016, 2018, and 2019).

Firstly, the main target of all surveys is to depict the characteristics of a population. As soon as a sample is surveyed, a depiction of the population is deduced from what the sample divulges (Ariss, 2019; Fraenkel et al., 2010).

Thereafter, the Motivation to Read Profile (MRP) reading survey (Gambrell et al., 1996) was a group-dispensed, self-report instrument, which evaluated two distinct dimensions of motivation to read, namely the value laid on reading and the self-concept as a reader (Ariss, 2012, 2013, 2016, 2019; Gambrell, 1996; Gambrell et al., 1996). Utilizing a 4-point Likert-type response scale, this instrument was composed of a sequence of twenty questions designed to bring out information about pupils' self-perceived competence in reading together with pupils' performance relative to their peers, as well as information concerning the value learners placed on reading tasks and activities (Ariss, 2012, 2019; Gambrell, 1996; Gambrell et al., 1996).

Secondly, when a researcher puts into effect an observation process as part of his/her study, he/she applies it for he/she requires reaching a generalization or he/she necessitates making a decision with regard to a focal issue (Ariss, 2012, 2016, 2019; Bachman, 2004).

Thereby, the researcher opted for the role of participant-as-observer because she participated fully in the activities of the Experimental group (GSF) being examined, but she also made it understandable that she was doing research (Ariss, 2012, 2013, 2016, 2019).

Thirdly, to turn to the interviews, they may furnish us with information evolving around individuals' values, attitudes, and around what they think they perform. Furthermore, interviewing is a meaningful way for a researcher to verify the accuracy or refute the impressions he/she accumulates through observation. One objective of interviewing the participants in a qualitative research-based study is to uncover how they feel or think about something. Another objective is to provide a check on the researcher's observations (Ariss, 2019).

In that manner, during the ten-minute semi-structured parent interviews in the P. L. School, parents were asked a sequence of ten questions discussing the issues related to the research study (Ariss, 2019).

6- Data analysis as well as measures of validity and reliability

Validity is the weightiest idea to consider when choosing or preparing an instrument for use. The drawing of sufficient conclusions based on the data obtained from an assessment is what validity is all about. The term validity, as exploited in research, refers to the usefulness, significance, correctness, and appropriateness of any inferences a researcher extracts based on data acquired using an instrument (Ariss, 2019; Fraenkel et al., 2010). Farther, the term reliability, as utilized in research, refers to the consistency of answers or scores supplied by an instrument. Thus, validity and reliability continually rest on the context in which an instrument is applied (Ariss, 2019; Fraenkel et al., 2010).

Nonetheless, Fraenkel and Wallen (2010) have explained that criterion-related evidence of validity refers to the relationship between scores acquired while utilizing one or more other measures or instruments as well as scores acquired whilst utilizing the instrument. As a result, this evidence of validity refers to the degree to which information furnished by an instrument agrees with information obtained from other, independent instruments (Ariss, 2012, 2019; Fraenkel et al., 2010).

In order to test the hypothesis that declared that word walls would enhance the degree of motivation to read of sixth graders readers, the researcher showed the differences among the results identified in the reading survey (MRP), in both classrooms (GSF & GSA), in the P. L. School (Figures 5.1 & 5.2; Tables 5.1 & 5.2). She, further, evaluated then discerned the results against the observations and the interviews that showed up in the private school (Ariss, 2012, 2013, 2016, 2019).

Therefore, by providing an equivalent-form pretest and posttest that entailed the MRP reading survey, the reliability of the study was secured. Moreover, separate arrays of scores were collected from both Control (GSA) and Experimental (GSF) groups to ensure the assessment of the reliability coefficient (Ariss, 2012, 2016; 2018; 2019).

Subsequently, the qualitative data collected from the classrooms observations and the parents' interviews were analyzed. The coded observations field notes were then contrasted to the semi-structured parent interviews as corroborating sources so to derive the qualitative study results (Ariss, 2012, 2016, 2019).

Findings and discussion

The objective of this research study was to inspect the level of reading motivation progression on two grade sixth classrooms, during a period of six months of reading practice, applying the interactive word walls instructional method together with word walls activities (Ariss, 2013, 2016, and 2019).

There were forty-eight learners and an ESL (English as second and/or foreign language) teacher who took part in the study. Farther, there were twenty-seven students in the Experimental group (GSF); by contrast, there were twenty-one students in the Control group (GSA) (Ariss, 2019).

Furthermore, the researcher applied a mixed-methods strategy, in the purpose of responding to the research question, while differentiating between one Control group (GSA) and one Treatment group (GSF) in the P. L. School (Ariss, 2012, 2016, 2019).

Thereupon, the qualitative results were analyzed using grounded theory; on the contrary, the quantitative results were analyzed utilizing means, correlations, and standard deviations (Figures 5.1 & 5.2; Tables 5.1 & 5.2). However, in the grounded theory, the researcher formed a theory inductively from the data collected as a part of the study (Ariss, 2019; Fraenkel et al., 2010).

Survey raw scores GSF \ Descriptive Statistics	Median	Mean	Standard Deviation
First Survey			
Self-concept as a reader raw score / 40	26	26.74	3.83
Value of reading raw score / 40	28	27.33	5.3
Full survey raw score / 80	53	54.07	7.69
Last Survey			
Self-concept as a reader raw score / 40	32	31.22	4.49
Value of reading raw score / 40	33	32.48	3.75
Full survey raw score / 80	65	63.70	7.51

Table 5.1: Descriptive Statistics: Scores of the median, mean, and standard deviation of the first and last survey of the Experimental group (GSF).

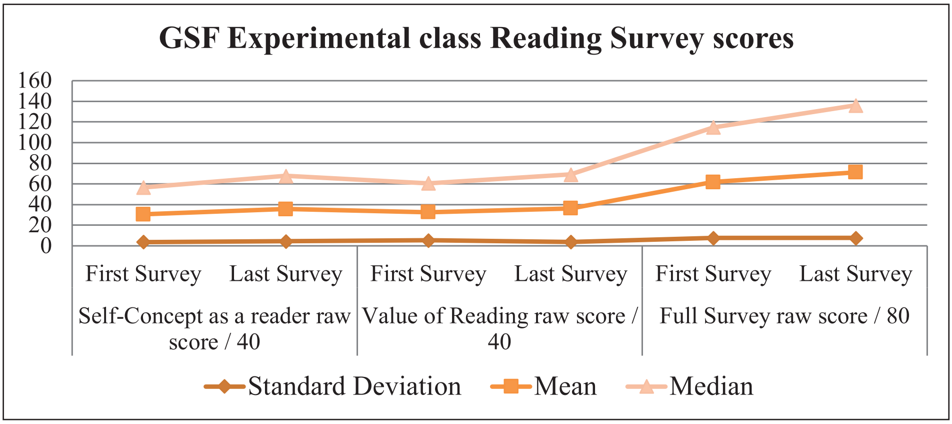

Figure 5.1: Descriptive Statistics: Graph of the scores of the median, mean, and standard deviation of the first and last survey of the Experimental group (GSF).

The outcomes of the self-concept as a reader subscale divulge that while a number of sixth grade learners have reported that they are "very good readers", meaningful numbers of pupils do not view themselves as competent readers. Several pupils have reported that they worry about what other students think about their reading, and a lesser number of learners have reported that when they read aloud they feel sad or embarrassed

(Ariss, 2019; Gambrell, 1996). The researcher has also identified, as have other various researchers (Ariss, 2019; Gambrell, 1996; Henk & Melnik, 1995; McKenna & Kear, 1990), that pupils' self-concepts as readers are connected to reading accomplishment, with less skillful learners having significantly decreased self-concepts than their additionally skillful peers (Ariss, 2019; Gambrell, 1996; Gambrell et al., 1996).

Descriptive Statistics / Survey raw scores GSA	Median	Mean	Standard Deviation
First Survey			
Self-concept as a reader raw score / 40	26	25.19	5.58
Value of reading raw score / 40	29	27.33	5.1
Full survey raw score / 80	54	52.43	9.1
Last Survey			
Self-concept as a reader raw score / 40	27	27.14	5.1
Value of reading raw score / 40	27	27.38	5.95
Full survey raw score / 80	56	54.52	8.34

Table 5.2: Descriptive Statistics: Scores of the median, mean, and standard deviation of the first and last survey of the Control group GSA.

Nevertheless, the value of reading subscale has disclosed that, ordinarily, sixth grade pupils value reading, though, various learners do not view reading as an activity of high priority or as a positive activity. Quite a few pupils have predicted that they would spend no time or very little time reading when they grow up and a lesser number of pupils have reported that individuals who read are boring (Ariss, 2019; Gambrell, 1996).

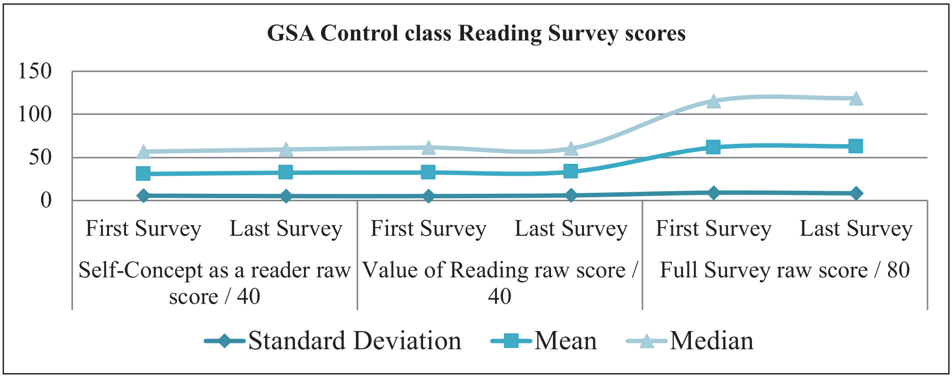

Figure 5.2: Descriptive Statistics: Graph of the scores of the median, mean, and standard deviation of the first and last survey of the Control group GSA.

Additionally, to turn to the observations findings, although there is not, essentially, one face to constructivism (Ariss, 2019; Dalgarno, 2001; Glasersfeld, 1996; Norton, 2015; Phillips, 1996), it is typically a classroom where the learner actively builds his/her own comprehension and where learning is pupil-centered (Applefield & Huber, 2001; Ariss, 2019; Norton, 2015). There is meaningful learning, stipulated by collaboration in the process of re-organising or organizing social interaction or knowledge (Ariss, 2019; Norton, 2015; Windschitl, 1999). Consequently, in the Experimental group (GSF), there is evidence of cognitive constructivism in significant learning, the processing of concepts, as well as intellectual problem-solving (Ariss, 2019). Learner group work has been characterized by fierce and spirited conversations, at times, as pupils debated word choices, discussed words definitions, or shared dilemmas about how to represent knowledge. As a result, dialectic, exogenous, and endogenous constructivism is obvious in the Experimental classroom (GSF), at the private school (Ariss, 2019; Norton, 2015).

Thereafter, when students learn how to self-select appropriate together with challenging words for study, they have longer-lasting and higher quality knowledge of vocabulary (Alvermann, Young, Weaver, Hinchman, Moore & Phelps, 1996; Ariss, 2019; Carr, 1985; Vintinner et al., 2015) together with greater motivation to learn (Ariss, 2019; Biancarosa & Snow, 2004; Vintinner et al., 2015). That motivation and autonomy may be included into interactive word walls by putting into action activities that encourage engagement for the growth and acquisition of vocabulary (Ariss, 2019; Brabham et al., 2001; Vintinner et al., 2015).

However, the word wall itself does not teach vocabulary. Yet, this literacy device holds potential for enhancing vocabulary learning with older learners when applied in conjunction with effective instructional applications, such as visual coding, collaboration, self-selection, and context practices. In the end, all of these instructional features guide to active engagement with the word wall, and it is through that active engagement that word knowledge is increased, deepened, and then valued. Therefore, the interactive word wall method illustrates the efficiency of word walls as a literacy tool for use with productive instructional practices to promote teaching and vocabulary learning in middle as well as secondary school classrooms (Ariss, 2019; Harmon, Wood, Hedrick, Vintinner & Willeford, 2009).

Lastly, to turn to the results of the interviews, it seems that several learners have seldom picked up books according to their reading level nor have they taken the initiative to independently choose English books or even spend time reading them at home or at school on their own. They have not been even adequately encouraged to read or speak in English, which led to their hardships in decoding then understanding (Ariss, 2012, 2019).

Limitations to the research study

There were some limitations to the research-based study. To start with, there was the fact that the researcher was also the English teacher, at the P. L. private school, of both sections of grade six. Therefore, the attitude of subjects towards the study might have created a threat to internal validity as well as the characteristics of the data collector, together with / or bias on the part of the data collector. Thus, knowing the different characteristics of each learner under study at the P. L. private school might have influenced the researcher's expectations of the pupils' behavioral aspect (Ariss, 2012, 2019; Fraenkel et al., 2010).

Furthermore, the issue of generalization was also a limitation to the actual study. The sample utilized in the research study might not be representative of the whole population of sixth graders in the private school. Further, the findings in the mixed-methods research study rarely have had a methodological justification to be generalized. Yet, other researchers might find the results of that study practical and beneficial if they were investigating a similar case study. Thereupon, these researchers might judge whether the findings could be applicable to the situation they would evaluate (Ariss, 2012, 2019; Fraenkel et al., 2010).

Additionally, the interviewer effect was another limitation. The presence of the researcher who conducted the interview with the parents of the pupils she taught at the private school at the same time might have affected the responses of those parents who aimed at giving the English teacher a positive view of their youngsters (Ariss, 2012, 2019).

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Test of Mechanical Properties of 3D Knitted Fabrics Manufactured by Robotic Arm

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Abstract

The research presented the utilization and employment of one of the most modern flexible manufacturing techniques, which is the Robotic Arm. The goal of this study is to develop new types of Three-Dimensional (3D) weft-knitted fabrics for the textile industry by using methods that are more modern, flexible and precise. The robotic arm (Mitsubishi RV-2AJ) provides great flexibility in production, fast-to-order, high quality of fabrics and it has five degrees of freedom. In this paper, Work was divided into several successive experimental stages on the robot arm to reach a computer algorithm on COSSIROP, the attachment control program. This algorithm is capable of controlling the production process and redirecting the robotic arm to move on specific steps at the target task by using the programming language called MELFA-BASIC. The focus was in the manufacturing novel weft-knitted fabric structures with analyzing the mechanical performances, 3D knitted fabric from different yarns had been produced and analyzed and at the end the researchers achieved great results.

Keywords: Flexible Manufacturing, Weft-Knitted Fabrics, Three-Dimensional Fabrics, Robotic Arm, MELFA-BASIC.

Introduction

Robotic technology presents the intersections between diverse branches of textiles and engineering knowledge for successfully expressing the motion of complex robotic-based systems. Nowadays, the incorporation of human in the production process is fundamental for rapid setups in programming and robot system maintenance (Ayob, 2015). Robots improve productivity when they perform more efficiently, (International Federation of Robotics, 2017).

Industrial robots had become a highly significant aspect in the manufacturing industry in the past decade, and they will increase shortly. The need for the use of robots originates from the flexibility of the machines, which can repetitively perform tasks at acceptable cost and quality (Zakaria, 2015). Figure 1 shows the worldwide supply of industrial robots during 2015-2020 (Au, 2011), as robots become more intelligent, they become proficient to do greater tasks which might be dangerous or impossible for human workers to achieve (Zakaria, 2015).

For textile-based robotic technology, it is necessary to consider the reachability, the order of path execution, and the possibility of interlocking. Moreover, if the fixed robotic arms will be employed in the construction site, the designers should consider the material properties to make a connection between problems and opportunities on the loading capacity. In addition to replicating conventional fabrication techniques, the flexibility of a 5-axis robotic arm offers new possibilities for manufacturing, with a minimal physical footstep; the workspace can accommodate parts larger than the arm itself and access interior regions that are not possible for a gantry-based machine (Oxman, 2013).

The experiment of the simulation work focuses on the application of tools, exploration of the technique, and subsequent development of an informed design intuition for generating the knitting pattern in a fabric, specifically, the design process, geometric articulation, and structural optimization will be explored.

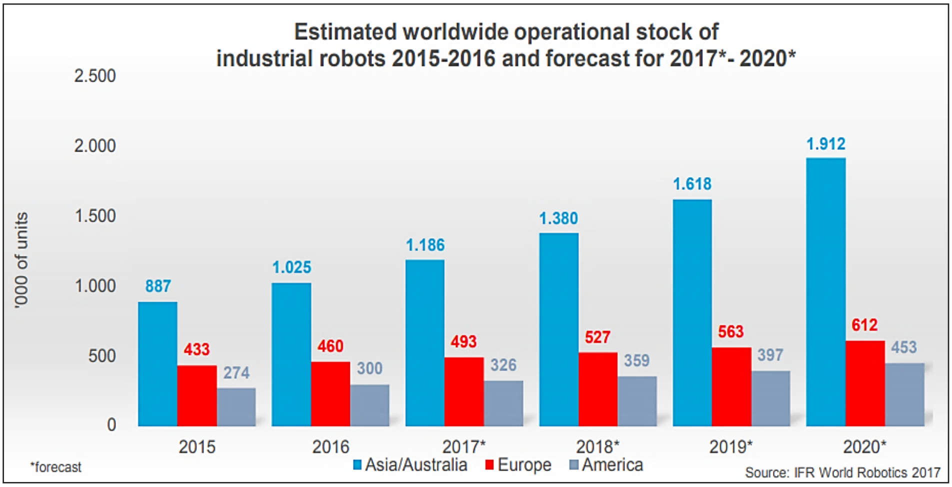


Figure 1: Worldwide Supply of Industrial Robots during (2015-2020) (Au, 2011).

Therefore, the paper studied the role and significance of structural performance-based tools in structural fabric design and it will present an automated process for determining yarn direction in three-dimensional (3D) weft-knitted fabrics. The developed process can be applied for quality inspection, process development and the validation of results. The traditional pattern method can be gradually replaced by the use of flexible textile and new 3D textile fabric integrated solution in the knitted fabric with particular emphasis on the convergence of robotics, textiles, and computation.

Literature review

Robotic fabrication and manufacturing technologies are traditionally known for their benefits in automation processes of full-scale design and construction, however, their value as design content and material generators has recently been explored (Tsai, 2013). Enhancing the correct fibre orientation in textiles and 3D preforms is one of the current challenges in the production processes of new textile fabrics, because small deviations in yarn properties during performing have a considerable effect on the mechanical properties of the produced fabrics, for example, the yarn properties variations occurred during spinning; yarn volume fraction and account are significant parameters to describe the performance of fabrics (Saboktakin, 2019). Knitting process is used in garments production to manufacture complex 3D structures (Saboktakin, 2019), it is the second most popular technique of fabric or garment formation by inter-looping one or one set of yarns so the continuous length of yarn is converted into vertically intermeshed loops either by hand or by machine (Au, 2011).

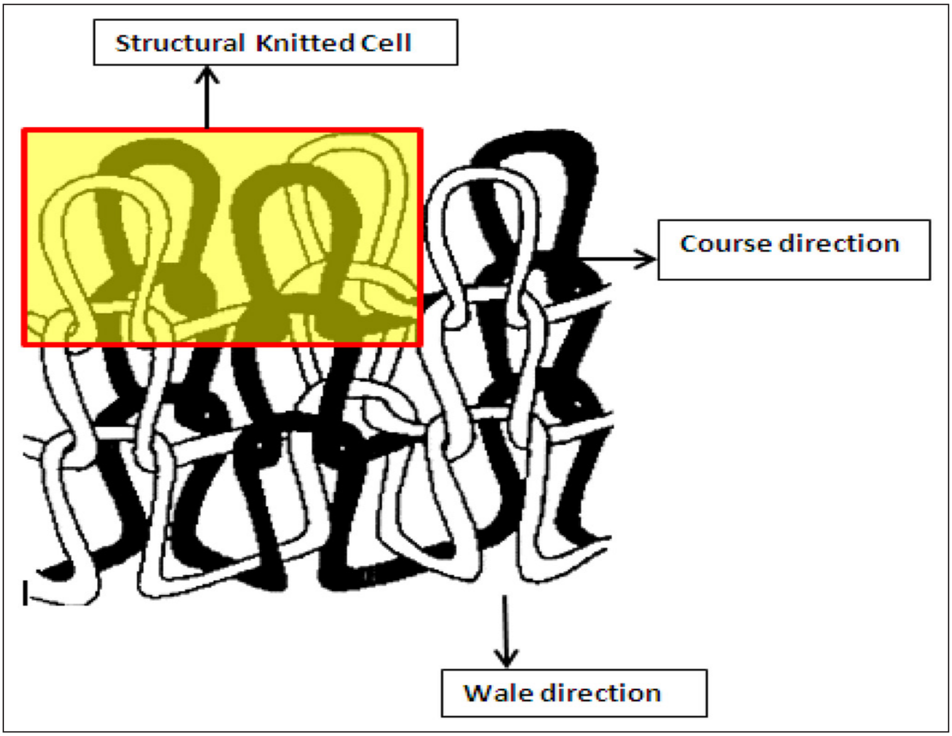


Figure2: Basic form of knitting fabric.

In knitting, the loop is the basic unit of a knitted structure is produced by bending yarn with the help of some knitting elements, the newly formed loop (NL) has been drawn through the old formed loop (OL); a matrix of rows and columns of loops is formed by creating a single element in each knitting cycle as shown in Figure 2 (Au, 2011). The target here is to create an interlocking structure based on knitting theory; this process has different methods and techniques to create knots and each of these methods can be available for industrial fabrication by using specific machines such as knitting needle to knit. Borrowing and learning these methods that already have been put into manufacturing can combine the simulation and fabrication tool repository combined to create new prototypes.

Researchers presented innovative preforming concepts based on 3D weaving and dry fiber placement in conjunction with joining techniques such as stitching and tufting in 2008, thick orthogonal preforms have been produced using alternate technologies based on multi-needle weft insertion systems. As an alternative to 3D weaving, robotic fiber placement around pin-boards has been developed; a 3D preform is constructed with the aid of metallic pins and robotic fiber placement combined with 2D/3D ply placement offers improved flexibility in achieving the desired near-net shape (Potluri, 2008).

A three-week old robot in 2012 MIT Media Lab is weaving a cocoon-like structure with a little programming help from humans, eventually it will be autonomous. Inspired by nature, the robot used yarn-like material that it placed around pegs and hooks on a cage built around it, it followed a predetermined course set by researchers, and it knows the positions of all the hooks and pegs, this method of construction offers an option to build a space within structural and environmental requirements, much like silkworms do (Powell, 2012).

CNSILK explores the nexus of digital fabrication and biomimetic design through the creation of fibers inspired by the silk created by Aranaeid spiders in 2013; it seeks to achieve woven architectural structures without seams that are continuous in morphology and physical property through the implementation of a multi-axes tensile digital fabrication platform. Recent proof-of concept tests focus on the use of a robot arm to test weaving capabilities through unique end arm tooling and, in parallel, the development of a larger scale proof of concept on the overall proliferation of the material system given geometrical constraints (Tsai2103).

Oluwaseyi Sosanya, a Nigerian American designer, has graduated from the Royal College of Art (RCA), he created a new loom in 2014 for his graduation project "The Structure of Protection", this loom can weave in three dimensions and used it to create a shoe sole; he presented it at the institution's annual degree show. The machine weaves interconnected layers of straight warp threads and intertwining weft patterns at different heights, providing the third dimension (Treggiden, 2014).

In 2015, footwear brand Keen introduced a sandal – called Uneek – that is held together by a single cord, the result of their collaboration led to a pair of robotic arms that could weave together a sandal in just six minutes–about half the time it would usually take a human, the system consists of two robot arms, a few custom fixtures, and a tablet that serves as the machine's remote. This revolutionary process makes production more efficient and more eco-friendly that means lower excess waste and almost zero fossil fuel emissions associated with shipping (Inigo, 2017).

For Basia Dzaman's graduation project for School of Form in 2015, she designed and 3D printed an end effect tool for a KUKA robot for weaving carbon fiber through an iterative design process, it is capable of holding a Dremel multi tool, which can be used to drill into a work surface for installing pegs, which make up the custom weaving jig. The pegs (nails) are then installed by hand so that the robot can thread carbon fiber-fed through an epoxy bath as it is dispensed onto the jig, once the epoxy cures, a strong structure can be removed (Hobson, 2015).

Adidas's pilot factory in Ansbach is an example of how robots are revolutionizing manufacturing in a small hall; about half a dozen machines are set up in two production lines: one is making soles; the other is making the upper part of the shoe, in total, the process of making a pair of trainers from start to finish takes roughly five hours, while in Adidas's existing supply chain in Asia, the same process can take several weeks (Shotter, 2016).

The NASA Langley Research Center is acquiring a state-of-art composites fabrication capability to support the Center's advanced research and technology mission, the system is called ISAAC (Integrated Structural Assembly of Advanced Composites). The initial operational capability of ISAAC is automated fiber placement, built around a commercial system from Electro impact, Inc., that consists of a multi-degree of freedom robot platform, a tool changer mechanism, and a purpose-built fiber placement end effector (Wu, 2016).

Atropos, in Greek mythology is one of the three Moirai, it is a new six-axis robotic arm born from the collaboration between Milan Politecnico's +LAB with KUKA, for the robotic arm, Owens Corning and for the glass fibers, it fluently moves in space depositing a continuous fiber of thermosetting composite material, instantly cured as it comes out of his head. The revolution of this process lays in opening to new possibilities in fields where both characteristics are necessary (Sher, 2016).

In comparison with what exist in literature:

- The current research is directed towards the use of robot in the production of human-friendly knitted fabrics. This style of products is similar to handmade woolen pieces made from ordinary yarn.
- It tends to develop tools and machines for the production of knitted fabrics, to work on the possibility of developing their specifications and make them more diverse, differentiated and competitive in quality and cost.
- Innovative products can be introduced through the proposed method without the need for a smooth preparatory and final process to which textile products are normally subject.
- Consider the above, It reflects directly on the economic costs of the product and the trend towards products less harmful to the environment.
- The use of robots in the production of knitted fabrics provides great flexibility in production, where it becomes possible to switch in the construction, design, and types of fibers to suit demand, thus achieving high productivity and yield while maintaining quality and efficiency.
- The research is a step towards creating new textile patterns completely different from the current ones, which are in line with modernity and development with other areas and to meet the general tastes locally and globally.

Materials and instruments

1- Yarns

The properties of yarns used in this study were shown in Table 1. The aim was to compare the properties of three types of Acrylic yarn knitted by a robotic arm in the textile and fashion industry.

Table 1. The yarns properties used in the tests.

Sample	**Material**	**Count** [Tex]	**Twist [TPM]**
A	Acrylic	67.425×4	65.3
B	Acrylic	80.085×9	65.3
C	Acrylic	85.600×5	106.4

2- Mitsubishi RV-2AJ robot:

The Mitsubishi RV-2AJ robot as shown in Figure 3 is an industrial manipulator (Wolf, 2005); it has been chosen in this case study because it technically offers the best performance as a small, compact and powerful articulated-arm robot in its class (Esa, 2011). RV-2AJ is 5-axis compact arm design coupled with its enhanced motion controller and servo amplifiers, Speed of 2100 mm/sec, repeatability of +/- 0.020 mm. The main bodyweight of less than 20 kg and AC servomotor reduces all axis outputs to less than 50 W; on 64 bit CPU RISC/DSP, that makes the robot ideal to work in small environments, academic and research practices; the high precision motors with integrated absolute position encoders consistently secure reliable and maintenance-free operation (Mitsubishi Industrial Robot, 2002).

The robot can lift 2 kg payload, and hence is particularly adequate for low payload handling, placing and separating small parts, another notable application that is worth mentioning includes quality control and handling samples in medical and other laboratories (Buitrago, 2011). Since the robot can cover horizontal motion of up to 410 mm (with the gripper pointed downwards), it is also ideal for applications where a small and compact robot needs to be installed directly next to or even in the system (Zakaria, 2015).

Every single joint has one freedom of rotation around its axis; the motion axes for the model are assigned with their nomenclature as follows: waist rotation for Joint 1, shoulder rotation for Joint 2, elbow rotation for Joint 3, wrist pitch for Joint 4, and wrist roll for Joint 5, taking into consideration the way the five jointed arm robot of the RV-2AJ is engineered, the mechanical structure is classified as anthropomorphic articulate (having human-like characteristics) (Haklidir, 2009).

Since the robot can cover horizontal motion of up to 410 mm (with the gripper pointed downwards), to enable the various functionalities, different end effectors were constructed, these effectors connect easily to the wrist faceplate of the robotic arm and can also be used in a fixed tool configuration, and for the additive fabrication techniques, three special print heads were constructed for three distinctive 3D printing systems covering different scales and materials.

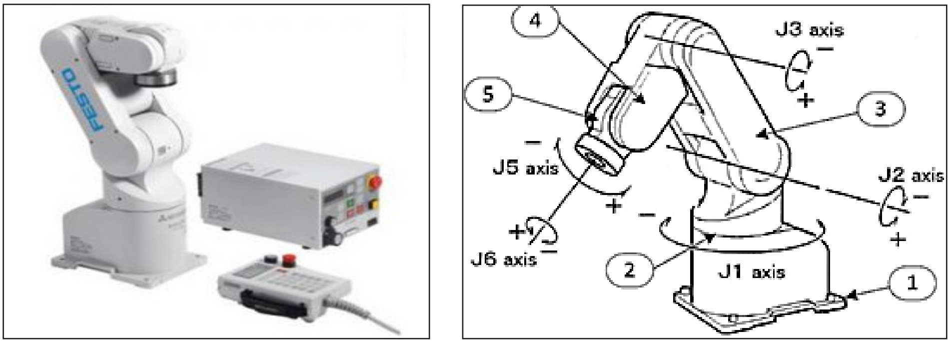


Figure 3: Mitsubishi RV-2AJ Robot & joints of RV-2AJ robot.

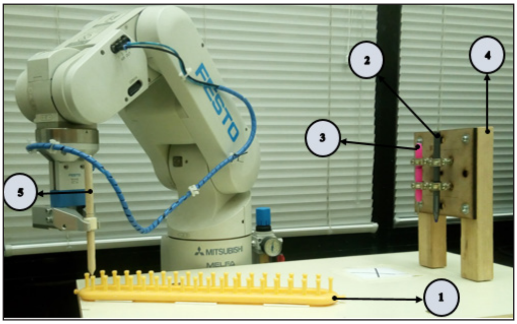
The Mitsubishi MELFA CR1-571 controller has a 64-bit DSP/RISC microprocessor, which allows the execution of 32 programs simultaneously in multitask mode. This controller communicates with the server through an RS-232 serial link (Mitsubishi Industrial Robot, 2006), the robot controller is the hardware interface between the server and the robot manipulator, data transmission between the manipulator and the server is performed through this device, allowing the user to send information to the manipulator and the server and to receive it from them (Buitrago, 2011).

3- Assistant tools:

For this research, a set of assistant tools were designed and manufactured:

1 Knitting Base: set of pins are used for making loops as well as inter-looping.
2 Feeder: a vertical yarn holder, which has to move for performing the loop formation by the robotic arm.
3 Needle: is the main element required in loop formation.
4 Centralize Pen: a single pen used to imperceptible robotic dimension.
5 Lateral Tablet: a side plate carries on the holders.

The design of these elements with proper dimension was done precisely as well as those that should be placed accurately to continue knitting smoothly, because of the gripper hand of robot and holders (needle, feeder) integrated into the fabric base are also thread-like in terms of shape, size, and flexibility.



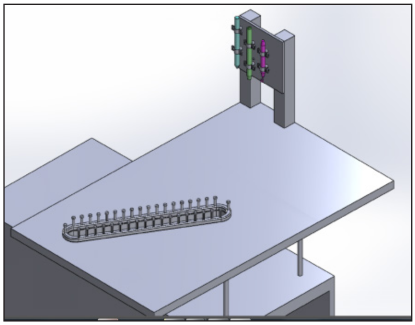


Figure 4: Assistant worktable in robotic production.

Methods and experiments

1- Simulation:

The simulation process is done using a software program attached to the simulation processes that are done on the robot used, it is called COSIMIR as shown in figure 5.

COSIMIR® Robotics provides one with a virtual learning environment in the field of robotics, step by step; it will be able to advance independently from very simple robotics applications right through to highly complex work cells in a highly realistic, simulated 3D work environment (Mitsubishi Industrial Robot, 2000).

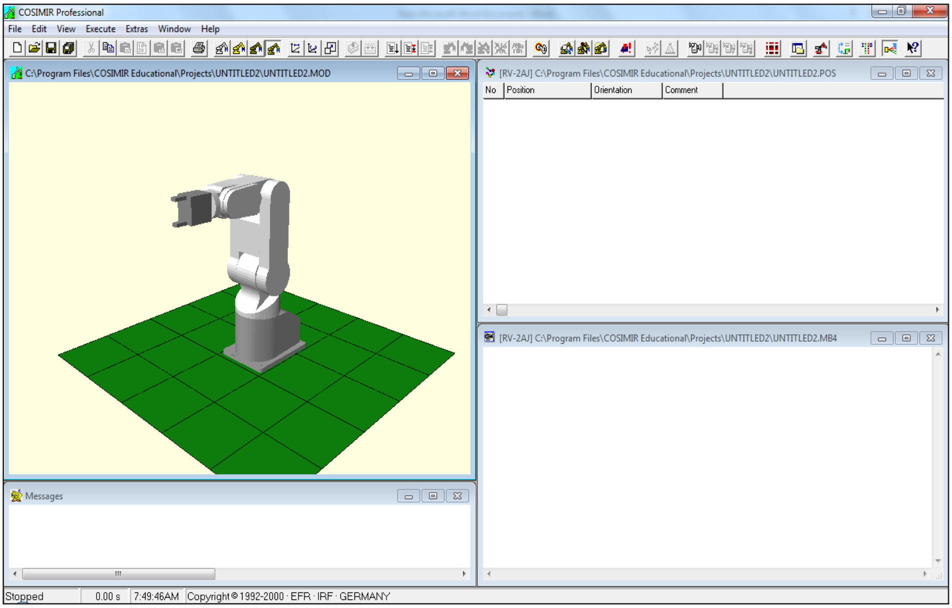


Figure 5: The main interface of the COSIMIR program

- COSIMIR enables one to write control programs for the Mitsubishi robot and the computer testing programs, the former allows one to download the control program into the robot control device and control the real robot via computer (Mitsubishi Industrial Robot, 2005).
- COSIMIR allows one to create new applications for the robot by using some robot simultaneously, devices/details, used to build models for 3D model applications of a new robot must not necessarily be those of COSIMIR Professional, but models created in other CAD programs can be used (Mitsubishi Industrial Robot, 2005).

2- The simulation of knitting steps:

The following figure(6) is a graphical model to explain the traditional knitting process, which shows the sequential action steps where the thread is manually wrapped in both directions and then tangled by the use of a special needle.

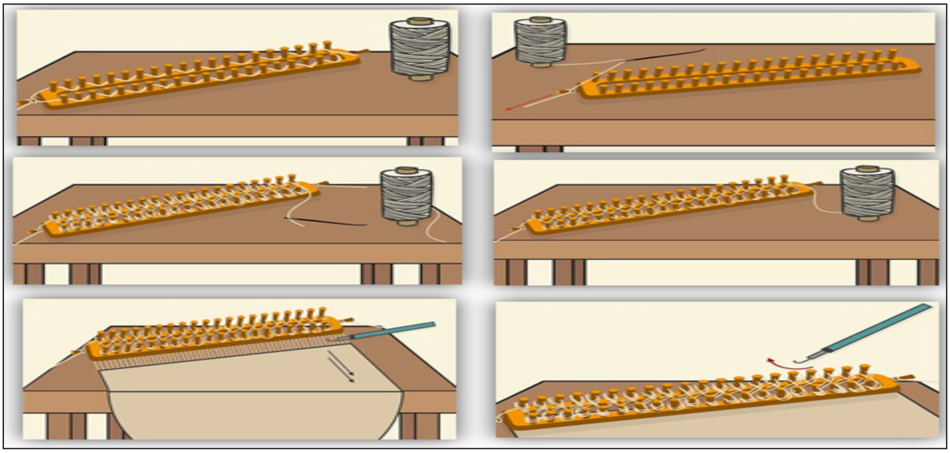


Figure 6: A representative model of knitting.

The study of the movement of the robot within the space specified by the coordinates is the most important point, so the simulation program was used to apply this movement (winding movement in figure 7 and 8, needle-stitching movement in figure 9) and to ensure the reliability of its performance. The following figures (7, 8, and 9) show a simulation of the basic movements performed by the robot to perform the knitting process.

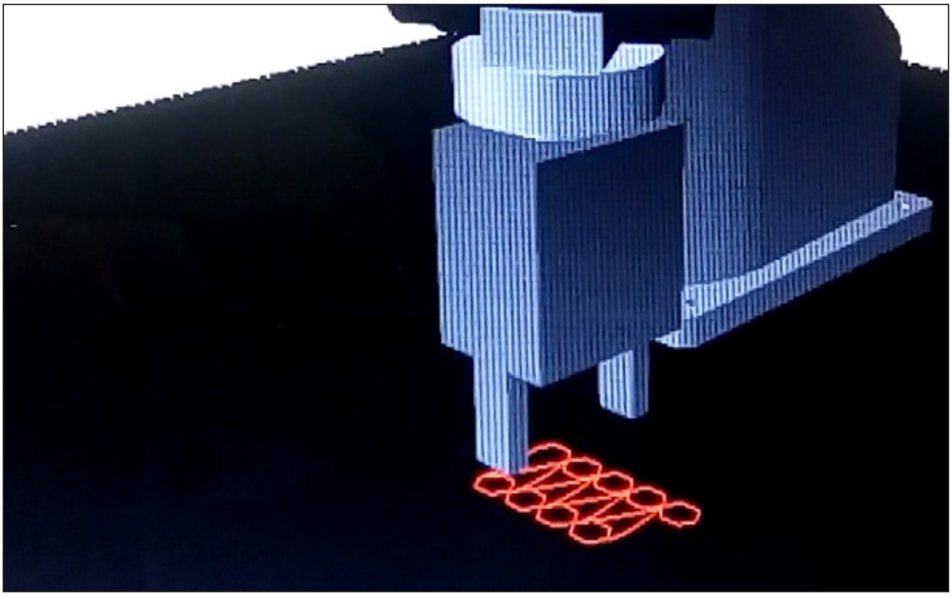


Figure 7: The simulation of first winding movement.

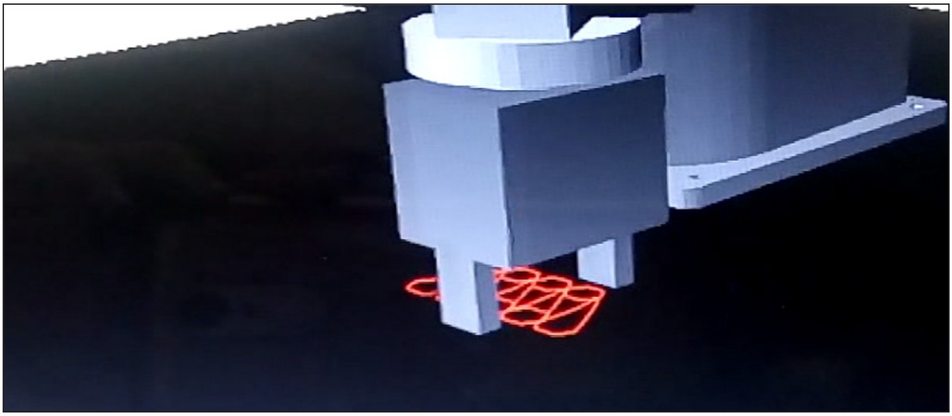


Figure 8: The simulation of second winding movement.

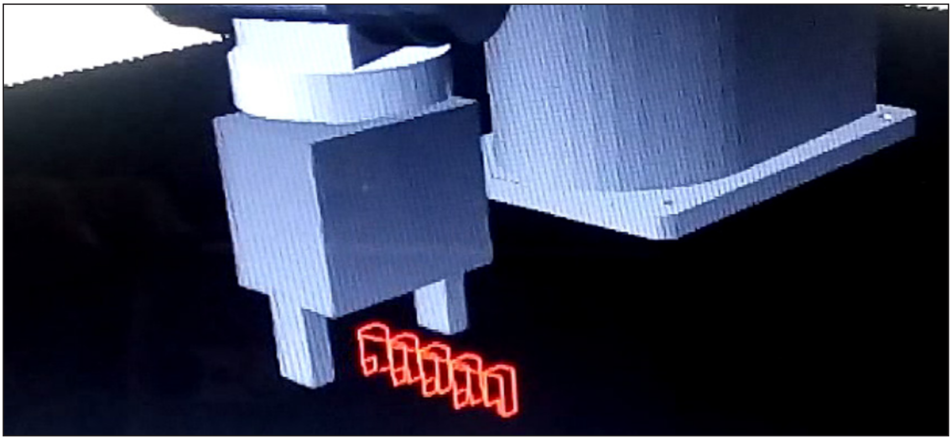


Figure 9: The simulation of needle stitching movement.

3- Motion algorithm for robot:

It is better to distinguish between the initial implementation of the robot movement and subsequent successive execution cases, which are repeating the steps as many times as the user determines. This frequency determines the length of the fabric to be obtained, figure (10), (a: initial implementation case, b: successive execution cases).

The application-programming environment has been augmented with MELFA Vision, which is the play part of the equation; in addition, configuration tools are built into the MELFA-Vision environment to perform adjustments, calibration, and registration of the work pieces.

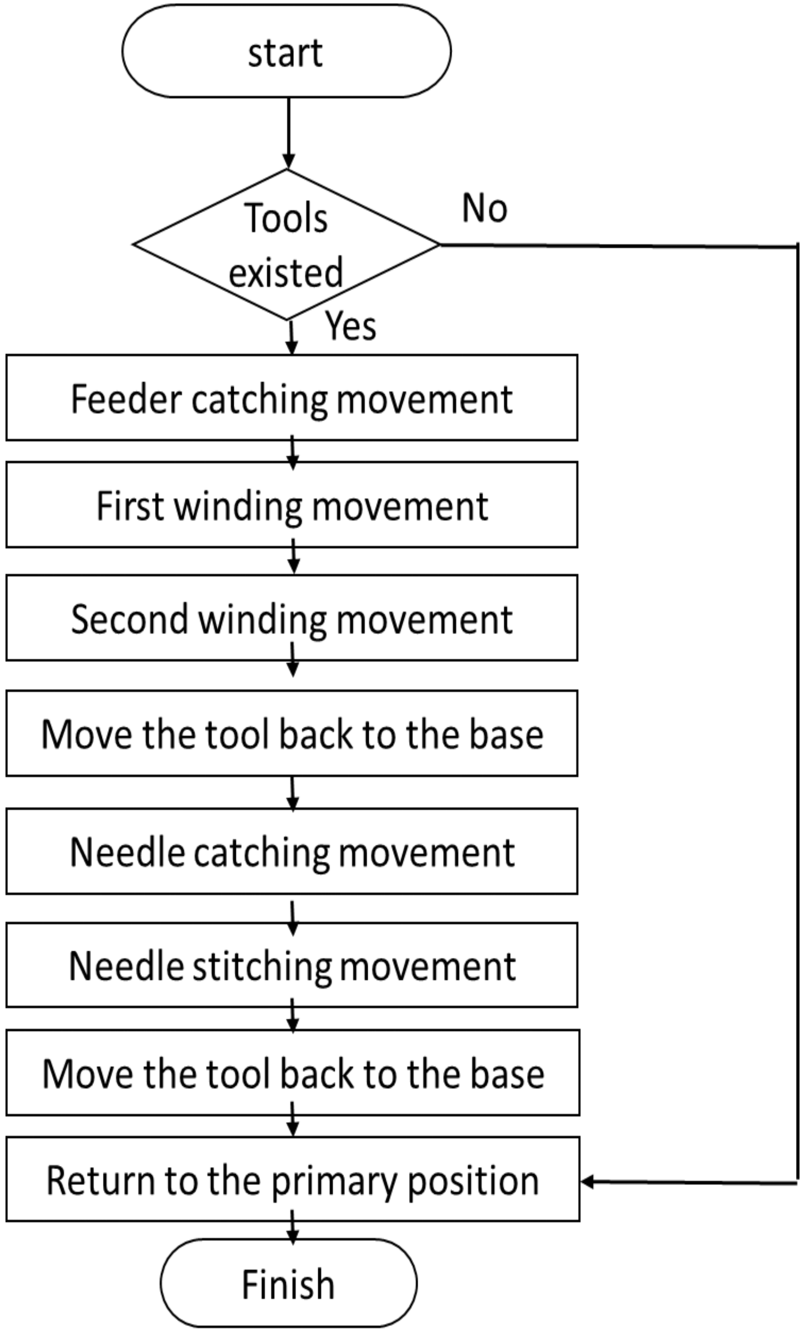


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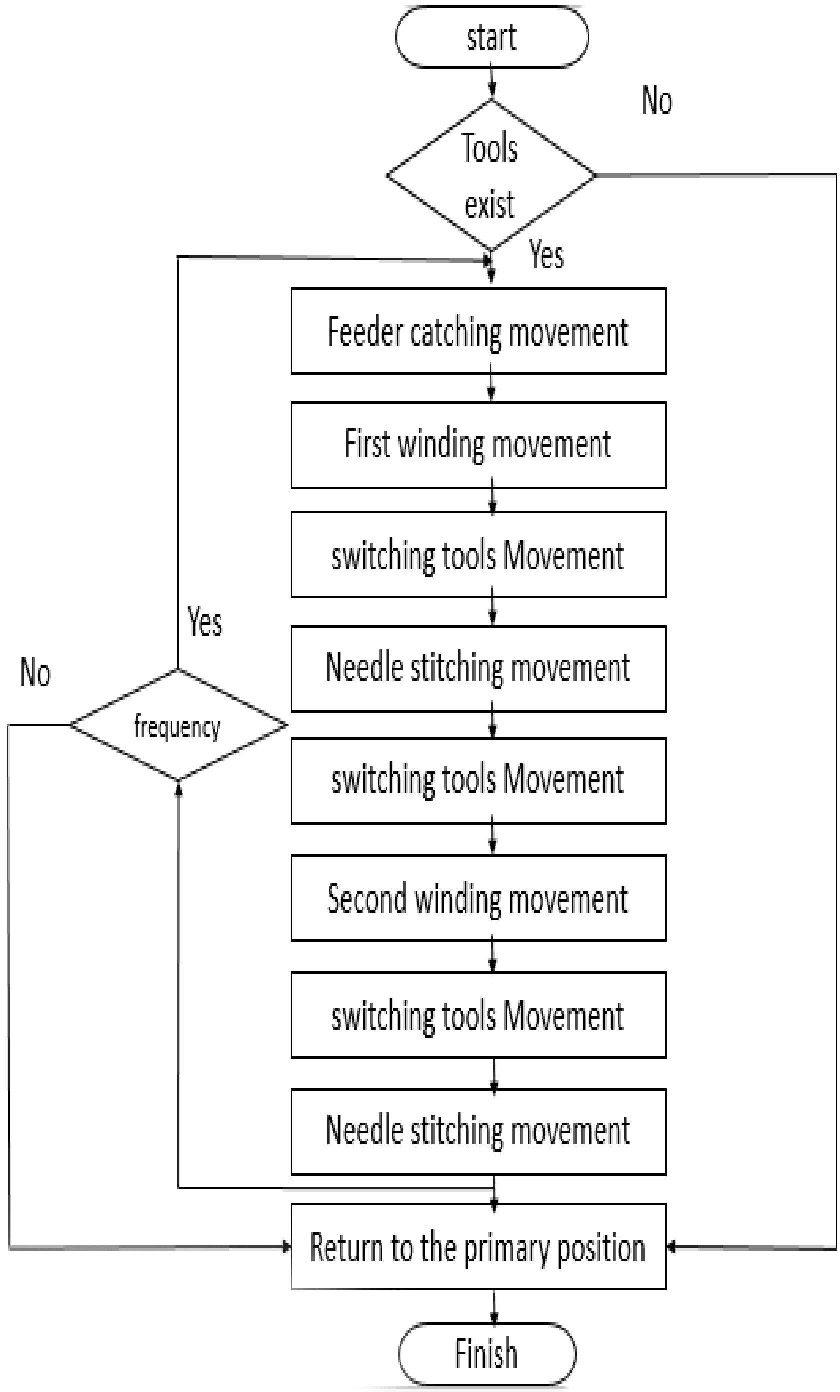
Figure 10: Motion algorithm for robot by flow chart

(a): Motion algorithm for robot by flow chart (Initial Implementation Case).



(b): Motion algorithm for robot by flow chart (Successive Execution Cases).

Table 4-1. List of items described

	Item	Details	Related instructions, .etc
1	4.1.1 Robot operation control	(1) Joint interpolation movement	MOV
2		(2) Linear interpolation movement	MVS
3		(3) circular interpolation movement	MVR, MVR2, MVR3, MVC
4		(4) Continuous movement	CNT
5		(5) acceleration/deceleration time and speed control	ACCEL, OADL
6		(6) Confirming that the target position is reached	FINE, MOV and DLY
7		(7) High path accuracy control	PREC
8		(8) Hand and tool control	HOPEN, HCLOSE, TOOL
9	4.1.2 Pallet operation	------------	DEF PLT, PLT
10	4.1.3 Program control	(1) Unconditional branching, conditional branching, waiting	GOTO, IF THEN ELSE, WAIT, etc
11		(2) Repetition	FOR NEXT, WHILE WEND
12		(3) Interrupt	DEF ACT, ACT
13		(4) Subroutine	GOSUB, CALLP, ON GOSUB, etc
14		(5) Timer	DLY
15		(6) Stopping	END(Pause for one cycle), HLT
16	4.1.4 Inputting and outputting external signals	(1) Input signals	M_IN, M_INB, M_INW, etc
17		(2) Output signals	M_OUT, M_OUTB, M_OUTW, etc
18	4.1.5 Communication	------------	OPEN, CLOSE, PRINT, INPUT, etc
19	4.1.6 Expressions and operations	(1) List of operator	+, -, *, /, <>, <, >, etc
20		(2) Relative calculation of position data (multiplication)	P1 * P2
21		(3) Relative calculation of position data (Addition)	P1 + P2
22	4.1.7 Appended statement	------------	WTH, WTHIF

Table 2: list of items describe of MELFA instruction, (Mitsubishi Electric Corporation Robot, 2011).

4- Fabric knitting:

A simulation process of manual loom knitting was applied; it is easy for humans to achieve knitted fabric because the flexibility of the human arm provides a large repertoire of manipulations. The main element required in loop formation is the robotic arm, which plays the role of the human arm. The small workspace and limited range of motion of the robotic arm restrict their affectivity but the motion can be performed within these restrictions (Yuba, 2017). This approach allows integrating many functions in a complex part to place yarn at specific locations. Furthermore, the use of a robot manipulator increases the flexibility of the yarn placement process; experiments begin by taking precise measurements of where the robot should move.

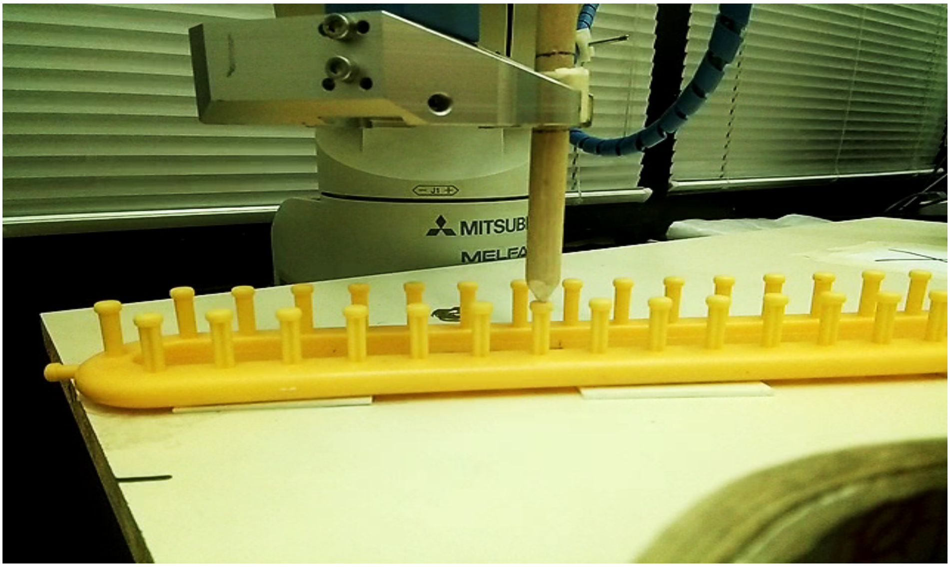


Figure 11: Concentrated stage and dimensional Measurement.

The experiment is generating double interlacing curved loops in 3D structure, these loops performed by overlapping loops from two opposite pins on knitting base; Knitting loop-performing starts when the robotic gripper holds the yarn feeder as shown in figure (12) for winding and holds the needle as shown in figure (13) for stitching.

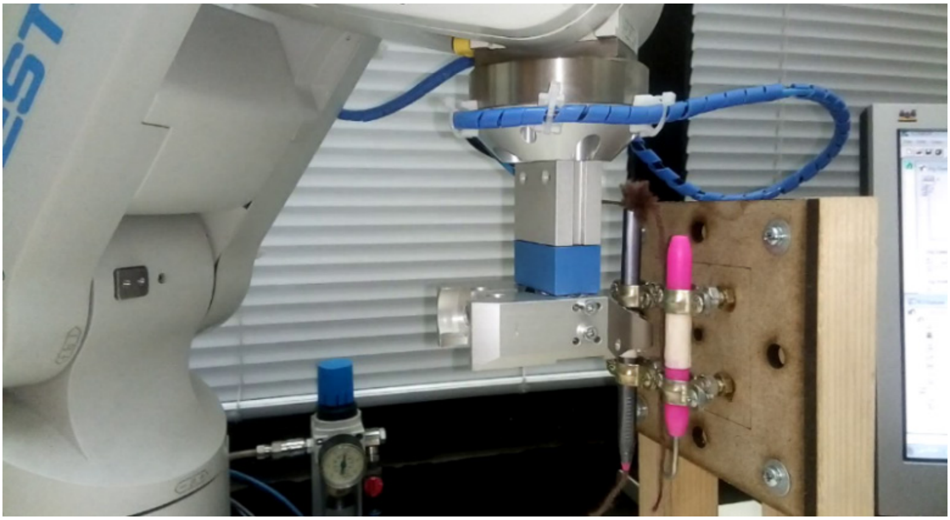


Figure 12: Feeder catching movement.

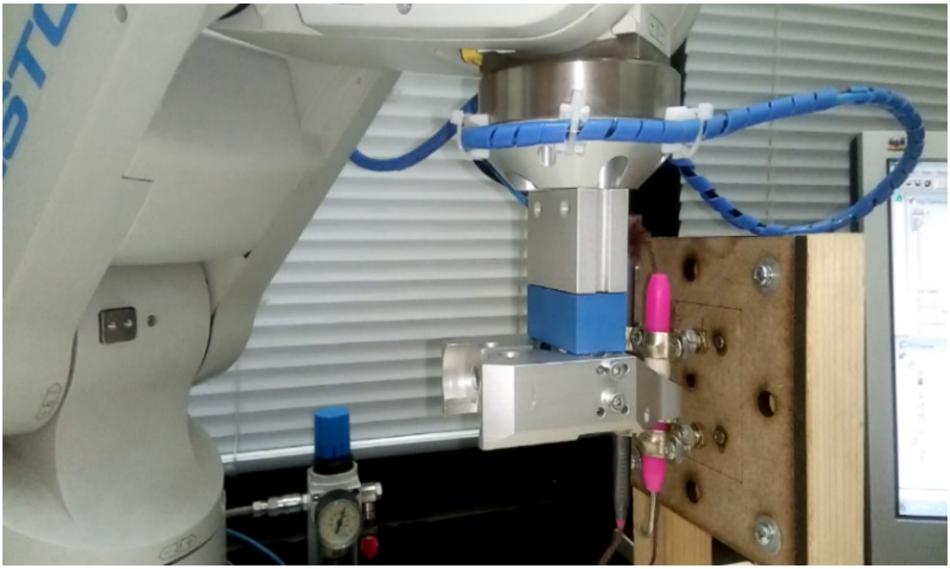


Figure 13: Needle catching movement.

The straight continuous length of yarn is bent into loops. Displacement resultant by robotic arm movement can create a slipknot on each pin. Working yarn transfers around the back of each pin, and move round to the front and then behind the pin again during winding movement as figure (14).

Figure 14: First winding movement.

This technique can keep the tension even and fairly tight and do not allow working yarn end to unwind. This accurate transmission is done at an appropriate speed fit to hold the working yarn on the pins. Warping the yarn around the pin can be in a clockwise direction, and then continue wrapping each pin along the loom a second round as shown in figure (15).

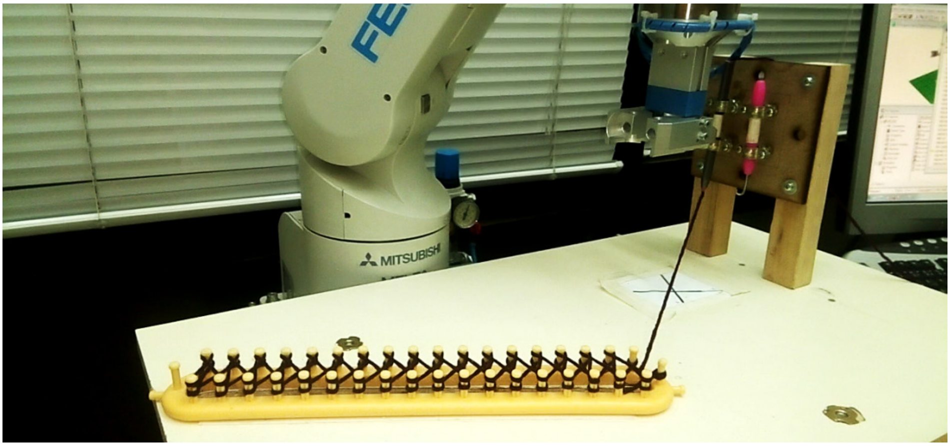
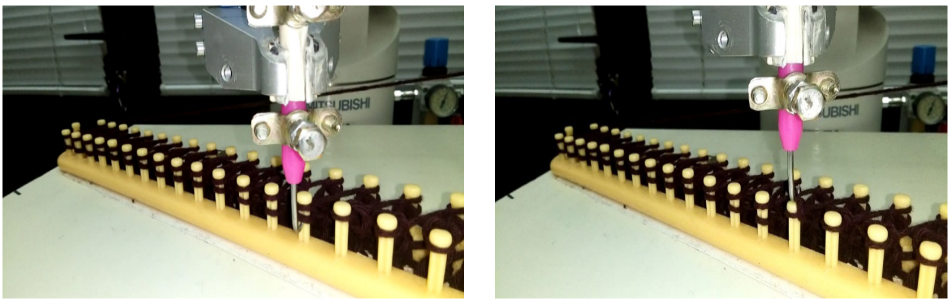


Figure 15: Second winding movement.

The next step is the essential one, in this stage, loops are interloped for fabric formation, an independently controlled needle is employed for loop formation, it moves on a preprogrammed transmission path for performing loops. The process has been done by picking up the first loop on the front board and pulling the front loop on the hook through the back loop as figure (16), the new loop passes from the back to the front of the previous loop made by the needle during interloping. Making loops and pulling the existing ones over the new loops are continued as shown in figure (17). Each time, a row of knitting fabric is made, the knitting will hang down the middle of the loom; the bottom row is the first row of knitting.



a b

Figure 16: steps of needle stitching movement (a: Needle-down, b: Rise up with thread).

The resulting fabric:

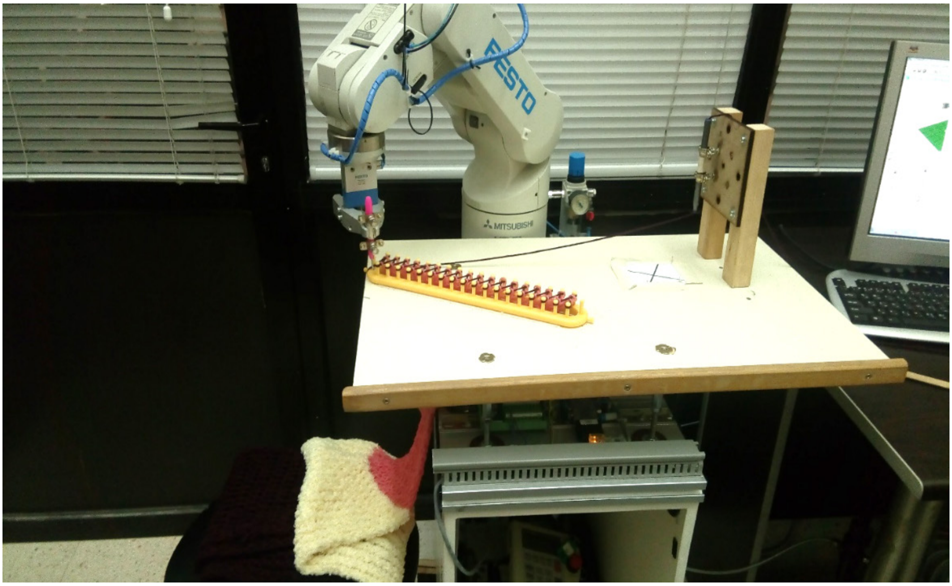


Figure 17: fabric produced by the robot knitting process.

5- Speed of the knitting process:

It is known that the speed of the robot movement is a direct reflection on the process of knitting, molding, quality and specifications of the product. It should initially fit the type of yarn and the method of interlacing and positioning between the yarn material and the guide material used.

High speed is considered a hindrance in the forming process because it causes the thread to be strongly pulled, loss of elasticity and low length required to form the pole, consequently, the threads are severely cut when the stitches are formed, while low speeds cause looseness in the threads and cause them to fall below the required level, since the process is pre-programmed, the locations of the threads are fixed, the knitting needle will rise without threading, thus losing the pole and gaps. Accordingly, several speeds were tested and applied to reach the optimum speed (10-15% of the maximum speed) that would ensure a smooth, safe and continuous formation process without breaks or gaps in the structure. The current values of speed have been determined experimentally, are related to productivity, and can be increased through the related control instructions: SPEED, ACCEL, which can reach 2mm/min and accurately 1micron, which is the accuracy of the robot used. In addition, the maximum load of the robot is 2 kg and the positioning system is absolute encoder. In practice, to produce one row of knitted stitch using the ideal speed, it was founded that the run time is constant whereas the needed yarn length is changeable by kind of knitted yarn. Hence, the change of yarn kind makes no different in robotic technology, while its effects on the rate of yarn consumption. It is worth mentioning that the length of the productive knitted cloth depends mainly on the length of the loop, although the program itself is used to produce the three varieties, the length of the loop varies depending on the type of yarn used. Therefore, the most important element of the quantities produced is the amount of consumption of the raw material as a required length.

Table 3. The productivity of the three knitted yarns.

Manufacturing Of knitted yarns			
Type of yarns	**A**	**B**	**C**
Time of knitted yarns Manufacturing [min]	11.30	11.30	11.30
Length of yarn [cm]	282.8	316.8	326.8
Productivity (yarn consumption rate)[cm/ min]	25.03	28.04	28.92

Experimentation results

The following parameters have a significant influence on stretch and recovery property of weft knitted fabric, with note that this research aims to find an automated machine capable of producing the specific structure of knitted fabrics. These patterns are very similar to handicrafts that are still based on human skills and are not produced by machines, with the difference that replaces the human hand with a robotic arm and includes some tools suitable for the work within specified space. The research is not intended to compare them with traditional knitting structures or patterns, but to clarify the disparity in the properties of fabrics made of yarns from different count.

1- Thickness testing:

Fabric thickness is an extremely important parameter for a variety of reasons:

1- Determining fabric stiffness and hence the extent to which the fabric will drape and conform.

2- Determining the rate of heat transfer, and hence the so-called ‘warmth’ of the fabric.

3- Affects air permeability and moisture absorbency and also has a great influence on the abrasion resistance (Au, 2011).

For the majority of simple knitted fabrics, the fabric thickness is very close to the sum of the yarn diameters in the warp and weft. In contrast, when a cross-section through a plain knit is examined, it is apparent that yarn curvature out of the plane of the fabric contributes to the effective fabric thickness such that the thickness is greater than twice the yarn diameter, (Au, 2011).

The thickness was determined following Test DIN EN ISO 5084 (measuring face 20 cm^2/pressure 0.1 kPa and 1kPa). D2000 Thickness Gauge is used to determine the thickness of various woven and knitted fabrics under a certain pressure available with two unit mode in mm and inch (European Committee for Standardization, 1996).

2- Stitch length testing:

Stitch length is a length of yarn that includes the needle loop and half of the sinker loop on either side of it. Generally, the larger the stitch length, the more extensible and lighter the fabric is, (Spencer, 2011). Stitch length was measured through the following ways (Tamanna, 2017):

a) 50 loops were counted at the edge of the fabric along the course direction; the start and endpoint of the 50 loops were marked on yarn.

b) The 50 loops were then unraveled and straightened to yarn, the straightened yarn length was measured in mm. Finally, equation 3 is used to measure stitch length: **Stitch Length=Length of yarn (50 loops) /50 mm**…………… **(1)**.

3- Grams per square meter (GSM):

The other important parameters of a knitted fabric which are considered for assessing the quality of the fabric are Courses per Inch, Wales per Inch, Stitch Density, GSM and Tightness Factor (Au, 2011).

The property is self-explanatory which indicates the weight in grams of one square meter fabric. Fabric's GSM is directly related to stitch length.

The loop size can also be decreased, but if the distance increases, the loop size increases, and hence the GSM decreases [18]. Sample fabric GSM was measured by using equation 4 (Au, 2011): **G.S.M= [s × l × T] /100……… (2) Where T= Yarn count tex, s= stitch density, and l= loop length in mm.**

4- Loom gauge (E):

It is as the gauge in knitting machines, which here denotes the number of pins per inch arranged. The higher the gauge, the higher the wales achieved; more wales increase the elastic property of the fabric. In this state, the products are the woolen scarf, so the gauge value is too low because of the spaced-out pins, which designed to fit the needed fabric (Tamanna, 2017). The used loom gauge is about 1.5 pins / inch.

Loom Gauge, E =25.4 Pitch/mm……………………………. (3).

5- Courses, wales, and stitch density:

Courses per inch, wales per inch and stitch density are the most important parameters of knitted fabric and are set before and calculated later very accurately for determining the quality of the knitted fabric (Ray, 2012). A course is a horizontal row of loops produced by all the adjacent needles during the same knitting cycle; it is expressed as courses per inch (CPI), or courses per centimeter (CPCM). Knitted fabric is produced by making courses in consecutive order; the number of loops in a course is equal to the number of pins in operation.

A wale is a vertical column of loops made by the same pins in successive knitting cycles. It is expressed as wales per inch (WPI) or wales per centimeter (WPCM); the total number of wales in a fabric is obtained from the total number of pins in operation. Stitch density is the total number of loops in a unit area such as a square inch or a square centimeter, it is obtained by multiplying the number of courses and wales per inch or centimeter together.

6- Courses length:

Course length is the length of yarn required in the production of a course; it is obtained by multiplying the stitch length with the number of pins involved in the production of the course, and can be measured at a yarn feed during knitting or by un-roving the yarn from the knitted fabric (Ray, 2012).

Analyzing and Discussions

At the present work, the focus is on the manufacturing novel webbed fabric structures with optimal mechanical performances using the potential of advanced processes using robotics.

1- Thickness Analyzing:

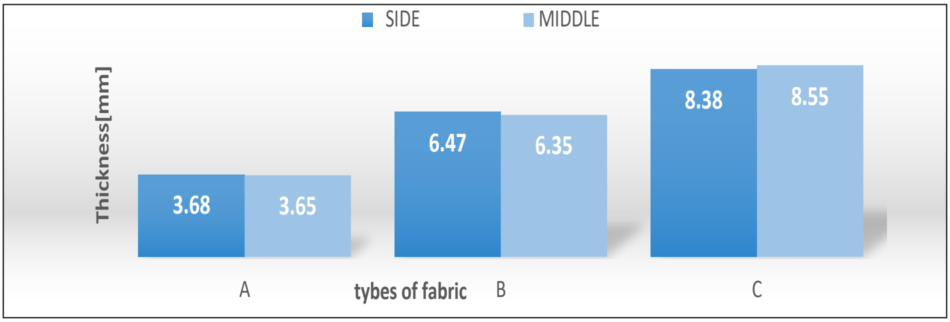


Figure18: Thickness test results of the fabrics

In comparison between knitted samples concerning side and middle area, note that the smaller the count of yarn, the smaller the difference in thickness concerning the middle of the fabric and the side, and the more the thickness of the yarns or the number of fibres forming one yarn, the greater the likelihood that the fibres will be spaced and placed in several places on the triple space, especially since the forming process is vacuumed on the three Cartesian dimensions.

However, there are no significant deviations in thickness values between the three threads. The surface of the pattern forming by the robotic arm has a regular form and equal dimensional. That is, it is possible to use multiple counts of yarn while maintaining dimensional stability and making sure the thickness is equal between different areas of the fabric.

2- Stitch length analyzing:

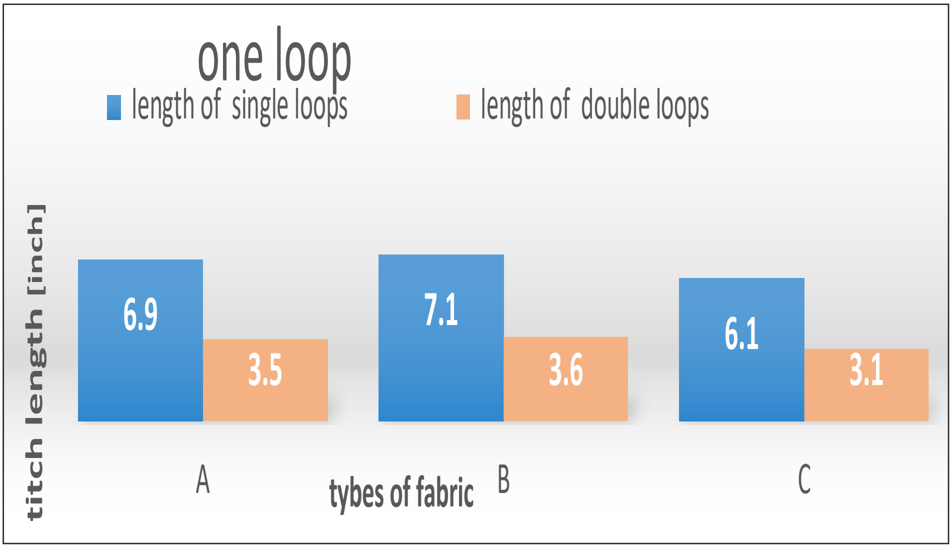


Figure19: Stitch Length values of the fabrics

As can be seen from the previous figure (19), the thicker yarn gave the lowest value of stitch length compared to the rest, and the greater the number of yarn count formed for each type of yarn, the greater the elongation values obtained. However, when comparing the first and last cases, the number of twins plays an important role: the greater the number of twines, the less elastic they are, so the stitch length values of case A are higher than C.

It can also distinguish that the stitch length is almost constant in robotic knitted fabric. Small differences emerge between three types of fabric. An acceptable variation was made from the different of elasticity and reasonable elongation of used yarn during formation procession, besides, the long-distance between pins at the loom.

3- G.S.M Analyzing:

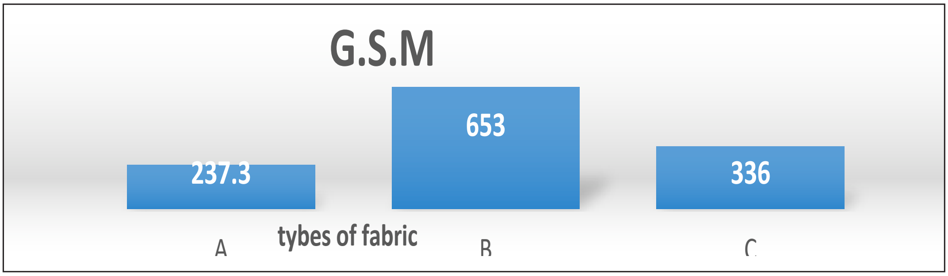


Figure20: G.S.M values of the fabrics

Figure (20) shows that the G.S.M is very high at that second type of fabric made from yarn (B), on the contrary of courses length values on states B and C, fabric made from yarn C score higher point than fabric made from yarn A; this is attributed to the linear density (Count) of yarn C. It is normal that the values of G.S.M increase when increasing the fiber content by increasing the number of angled yarns of one yarn.

4- Courses, wales and stitch density analyzing:

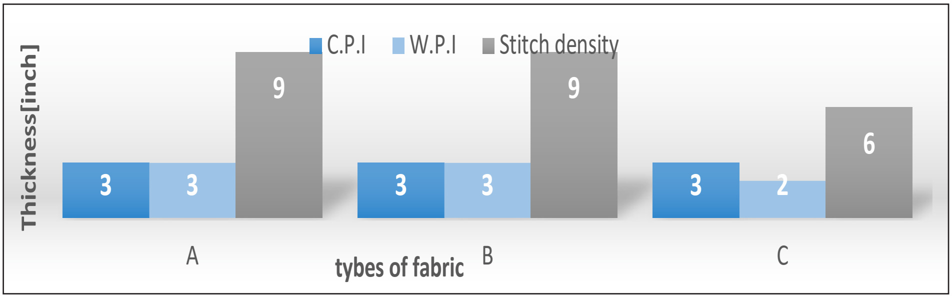


Figure21: Courses, wales length and stitch density of the fabrics.

The result showed in figure (21) explains the course, wales and stitch density of knitting fabric, these values are the same even if the yarn was A or B, it relates to the constant distance of pins and the reliable forming of the robotic arm. These values decrease in the state of fabric made from yarn C because of its specific properties, as known, this kind of fancy yarn occupies more space and it gives a high fill rate.

5- Courses length analyzing:

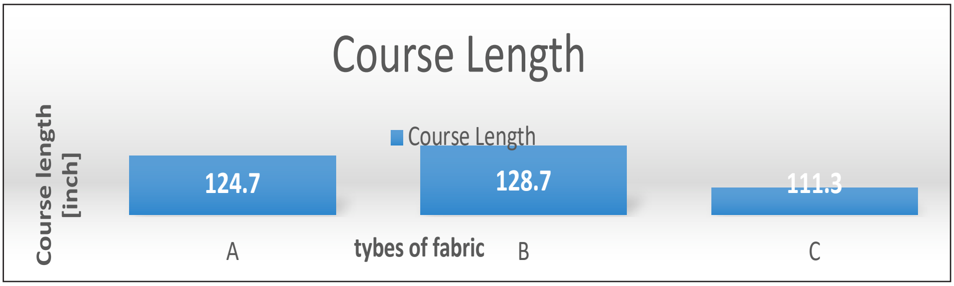


Figure22: Courses length values of the fabrics

Courses length depends on the stitch length, because the course consists of many nearby stitches, so that the Courses length analyzing is same to the stitch length values analyzing. Subsequently, fabric made from yarn B consumes more amount of fiber length, whereas the fabric made from yarn C still has the lowest.

6- Dimensional change (fabric width) analyzing:

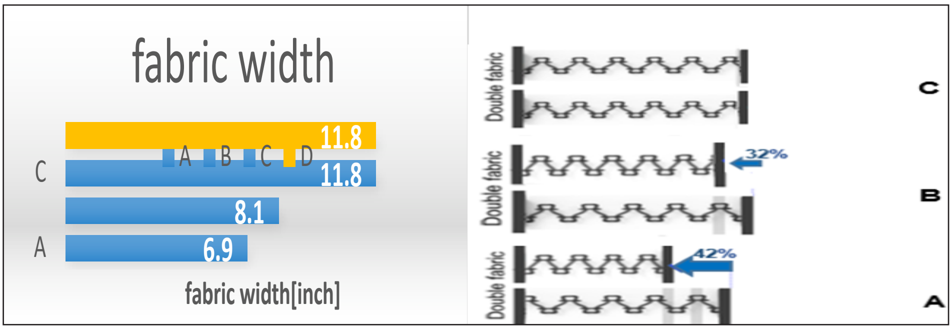


Figure23: Fabric width (A: Fabric width made from first kind of yarn, B: Fabric width made from second kind of yarn, C: Fabric width made from third kind of yarn, D: Loom knitting width).

Figure (23) shows the change in the width percentage of the test samples, in normal width of fabric decrease after pulling it off, the structure shrinkage according to the forces of interlocking shape. The higher change was sample made of yarn A; it was decreased in the width direction with ≥ 42%, whereas the sample made of yarn B had lower results with ≤32%, even so, the sample made of yarn C was maintained on the preforming width.

The result of the knitting of the samples showed that the choice of using a robotic arm to make a knitted fabric is very effective. The robot can be able to knit many types of yarn of different count and materials. The working table had a crucial role to ensure the knittability. The change of using tools and the compliant programs that have completely different processes and it is enough to produce a varied collection of knitting types and structures.

Conclusion

To improve quality, and to control the final mechanical characteristics, the main advantage being to realize 3D structures from different yarns and higher performance could be achieved; taking the solicitations of the final part to design the preform, without being constrained by the available 2D architecture of fiber mats.

For designing the geometry of a knitted formwork within given design constraints of dimensions, material, and structural loading, scientists also envision the future robotic production of such constructions will further reduce costs and increase the quality by tapping into the numerical control precision of robotic fabrication.

By using a robot arm in the knitting process, many aims have been achieved:

- Fabric can be produced from the minimum number of yarns, as only one yarn.
- Yarns generally unsuitable for knitting can be use.
- During knitting, loops can be transferred from one pin to another.

- Loop size can be varied to a wide extent easily.
- The extensibility and stability of the knitted fabric can be engineered. The desired porosity or compactness of the fabric can be achieved easily.
- The total number of pins for loop formation can be varied from the knitting cycle to cycle. Besides, Yarn can easily flow from one loop to another.
- Textured and many other fancy yarns can easily be knitted and converted to lightweight fashion garments. Seamless garments categorize change can directly be made in knitting particularly robotic, knitting patterns can produce in various types of stitch (shapes, dimension, density, multiple alternations).

Future work

- Concentration on using robots to produce the desired formwork in the actual fabrication and developing a validation framework for the evaluation of the knitting techniques.
- Improvement of the base and needle motion using sensor feedback.
- Using the robotic knittability in the textile industry with high/low-quality different kinds of yarn.

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