FUTURE ENTREPRENEURS DESIGN A WAY: SUPPORTING PRODUCT INNOVATION WITH A DESIGN THINKING APPROACH IN A CHILDREN'S EXTRACURRICULAR SEWING PROGRAMME

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ABSTRACT

Entrepreneurship as a possible solution to unemployment in South Africa and can be promoted through entrepreneurship education. The two distinguishing skills of entrepreneurs as opposed to small business managers, who are not necessarily entrepreneurial, have been identified as: creativity and innovation. This paper reports on a study undertaken in response to a real-life problem in a children's extracurricular sewing programme offered for a period of one year to improve children's technical sewing skills. Parents of the children who participated in the programme voiced a need the following year to have an extracurricular programme that supports their children's entrepreneurial skills in addition to developing technical sewing skills. An action research process was followed to 1) explore the role of an intervention aimed to support product innovation of the participants and 2) explore the design intent of participants during the intervention. The qualitative methods implemented were visual analysis of participants' products resulting from a design process and documents where they had stated their design intent. The intervention aligned Design Thinking principles with the dimensions of creativity and in essence supported participants to design solutions for a particular target market. Findings suggest that Design Thinking principles aligned to the dimensions of creativity can encourage product innovation and enabled participants to experiment freely with product prototypes that have an entrepreneurial design intent.

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INTRODUCTION

Creativity, or the act of being creative, has been identified as one of the top three skills for individuals who will be able to respond to future challenges (Geisinger 2016; Gemmill 2011; Sica, Ragozini, Palma & Aleni Sestito 2019).

Creativity as a thinking skill can be viewed as an ability to present novel ideas that are highly valued by people (Lan & Kaufman 2012). Proctor (2018) agrees with this view of creative thinking and adds that creative problem-solving results from creative thinking and enables individuals to create (design) products and services that fulfil the needs of a particular group or market (Carlgren, Elmquist & Rauth 2016). In this regard, creativity can be viewed as a skill for product or service creation or a skill for abstract problem solving (such as creating value for a particular market) (Proctor 2018). Most children are born with a sense of creativity and experimentation as part of their playfulness (where they solve hypothetical problems), but this is often lost as they grow older (Leverenz 2014; Oduho & Ogutu 2012). It would therefore be of importance to develop and support creativity as a problem-solving skill in order for children to learn how to solve the complex real-life problems they might encounter as adults.

One example of a complex problem in the South African context is the unemployment rate of 29,1%, identified in the last quarter of 2019 (Stats SA 2019). The need for entrepreneurship has been identified as a possible solution to this high and persistent unemployment rate because the assumption is that entrepreneurs are able to solve problems like unemployment by creating jobs for themselves and others (Ncanywa 2019). The relevance and importance of creative problem-solving skills within the entrepreneurial realm has been acknowledged (Kim, Sung & Park 2017). In fact, the two distinguishing skills of entrepreneurs as opposed to small business managers, who are not necessarily entrepreneurial, have been identified as: creativity and innovation (Chen 2007; Geisinger, 2016; Nguyen 2013). Scholars concur that without creative problem solving, innovation is not possible (Wijngaarden, Hitters & Bhansing 2019). However, all that is creative is not necessarily innovative (Joly 2019:26). Skills important to entrepreneurship are therefore, amongst other things, creative thinking through problem solving in order to be innovative (Kirjavainen & Björklund 2011). An argument for enhancing children's creativity as a problem-solving skill in order to be more innovative is thus relevant to development of entrepreneurship in South Africa.

Contextual Background

This article reports on a study undertaken in response to a real-life problem in a children's extra-curricular sewing programme that was offered for a period of one year to improve children's sewing skills. Parents of the children who participated in this programme suggested the need for an extracurricular programme to support their children's entrepreneurial skills in addition to developing their technical sewing skills. The owner of the micro business that offered the extracurricular sewing programme to young children (between the ages of 7 and 12 years), saw the need for developing entrepreneurial skills in children as an opportunity to register for a formal research study to improve the existing sewing programme. The study involved a larger action research project but this article focuses on the intervention developed to support participants' 1) creative problem-solving skills in order to support product innovation and 2) intent to solve a real life-problem with a product and in this way add value for a particular user or market. These two objectives were set with the underlying assumption that creative problem solving and innovation offer at least two important building blocks for future entrepreneurial skills.

This article commences with a literature review of the relationship between creative problem solving and design thinking. The research methodology is then outlined and involves a concise overview of the first research cycle with an emphasis on what the problem was with the traditional training programme followed by the findings of the second cycle. A discussion of whether the intervention supported more intentional design and product innovation is presented in the findings and conclusion section.

LITERATURE REVIEW

Creative thinking for problem solving

Boden (2004:112) refers to creative thinking as

a person's ability/skill to produce new or original ideas, insights, inventions, or artistic products. She goes on to say that the value of these ideas, insights, interventions or artistic products (collectively referred to as products or ideas in this article from this point onward) can be scientific, aesthetic, social or technical, and that this value is judged by "experts". From a product or idea development perspective, experts are viewed as the users or interpreters of products or ideas because these users or interpreters understand the significance of the value of the products or ideas (Flint 2002; Magnusson, Wästlund & Netz 2016). Such experts are thus the ones who understand the needs or problems that underpin the significant value add of ideas and products. Therefore, from the experts' perspective, creative products and ideas might be viewed as solutions to the real problems that they experience. In such an instance, creative thinking is necessary for creative problem solving.

Creative problem solving can be viewed as an ability to produce new or original ideas, insights, inventions or artistic products in response to solving an existing problem or need (Finke 2014; Sternberg & Lubart 1999). Creative problem solving as a creative thinking skill might be better conceptualised by unpacking the dimensions of creativity and highlighting their relationship within the context of creating new ideas and products that add value to particular users. These dimensions of creativity are often presented as the 4Ps, namely: creative **p**erson, creative **p**rocess, creative **p**roduct and creative **p**ress (environment) (Becattini, Borgianni, Cascini & Rotini 2015; Pfeiffer & Thompson 2013:232; Rhodes 1961). Each of these dimensions is unpacked to highlight their importance in creative problem solving.

Creative person

People with particular creative ability often have personality characteristics or illustrate behaviour (including skills) that is associated with creativity (Gemmill 2011). One such behaviour involves being solution focused as opposed to being problem focused (Pan, Kuo & Strobel 2013). This implies that the creative individual is inclined to come up with several solutions for a problem as opposed to finding more problems. Another characteristic is an ability to draw inspiration from everything (Eckert & Stacey 2000:524). Finding inspiration in everything links to an individual's mindset and involves being open-minded and creative (Aspelund 2010:7).

Open-mindedness in the context of creativity means to be able to think beyond one's own frame of reference (Pan, Kuo & Strobel 2013). One could argue that being open-minded allows the creative individual to draw inspiration from several sources and, in this way, have reference to several possible solutions to problems.

Moreover, open-mindedness could enable a person to take on another person's perspective and is associated with an individual's empathy. Empathy can be defined as the action of understanding, being aware of, and being able to relate to the problem, circumstance or situation of other people, and so to be able to take on someone's perspective (Pfeiffer & Thompson 2013:240). It is therefore an important ability when a person creates something for others. In this context, Pfeiffer and Thompson (2013:240) highlight the importance of empathy, particularly with regard to creative problem solving, as this allows a new perspective that might go beyond one's own frame of reference and in this way enable a person to come up with a novel solution (Cross 2011:23). A creative person can thus undertake a creative process to draw inspiration, to be more open-minded and empathetic.

Creative process

A creative process allows the progressive and iterative way of thinking about problems (Pfeiffer & Thompson 2013:232). The creative process is often equated to a problem-solving process that allows several iterations until a suitable solution is found to a problem (Botti-Salitsky 2017:17). The creative process allows experimentation and iteration so that suitable solutions are found for problems (Carlgren, Elmquist & Rauth 2016). "Solution finding" and "a problem" are typical constructs relevant to a design process (Aspelund 2010:8). Thought leaders in the design discipline, such as Kees Dorst, have compared the creative problem-solving process

to a design process, particularly from a viewpoint where new ideas and products are created to solve problems or meet user needs (Dorst 2011; Dorst & Cross 2001). The design process therefore could have relevance to creative problem solving.

Although there are several design processes, the three universal skills relevant during the phases of the design process are analysis, synthesis and evaluation that happen in an iterative manner to create ideas or products (Tselepis, Mastamet-Mason & Antonites 2015). The result of creative thinking by a creative person during the creative design process can be a creative product. The term product from a design perspective could be a physical product, but also a service or a system (Rampino 2011; Lindsay 2004;). The following section is dedicated to unpacking creative products (including services or systems).

Creative product

The application of creativity to realise creative products is referred to as innovation (Baldacchino, Cassar & Caruana 2008; Day, 2011; Gemmill 2011; Kelley & Rayala 2011; Ogunleye 2016; Stricker 2011; Warner 2011;). Innovation is also viewed a solution to a broad set of problems that can manifest through current product offerings (Carlgren, Elmquist & Rauth 2016). Rampino (2011) states that innovation is the ability to go beyond creativity when products are being developed and she mentions the notion of a so-called "creative leap" to yield innovative products as there is an unknown factor. Correspondingly, Frese (2009) highlights the importance of the development and implementation (testing) of new ideas when innovation should be an outcome. Innovative products can therefore be defined as imaginative products that have an element of novelty in a particular context that offer new solutions to existing problems (Pfeiffer & Thompson 2013:233). This implies that not all creative products are innovative, but that all innovative products (or value offerings) require creativity. The argument is made that an innovative product not only reflects the creative design process, but also the creative problem solving and abilities/skills of the creative person (Pfeiffer & Thompson 2013:233).

Innovative products can be conceptualised by referring to the four dimensions thereof: aesthetic, mode of use, meaning and typology (Rampino 2011). This conceptualisation is illustrated in the following figure:

From Figure 1 it is apparent that innovative products can be yielded through a new aesthetic (the appearance of the product can be novel in the context), a new use (a different use in the context), a new meaning (as opposed to what it meant traditionally in a particular context) or a typological innovation (carrying a totally new

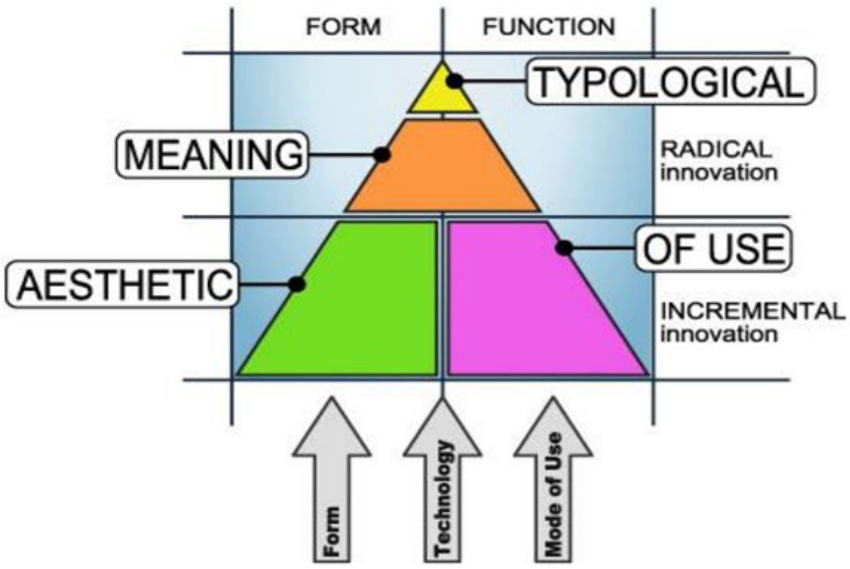

FIGURE 1: RAMPINO'S (2011) INNOVATION PYRAMID

form and hence having a different function than usual). These four aspects are viewed as the four dimensions of product innovation in this article.

In order to support the creative problem-solving skills of a creative person where innovative products should be an outcome, the importance of the creative environment (press) should not be underestimated. In this regard, Bell and Ternus (2007:15) and Linn (2015) assert that the creative environment contributes to the creative process and hence indirectly influences the possibility of an innovative product (outcome).

Creative Press (environment)
Bell and Ternus (2007:15) argue the importance of a creative environment when a sustainable creative process is concerned. Similarly, Meinel and Leifer (2014) refer to an "Innovation Eco-system" as the ultimate creative environment. The attributes of a creative environment can be summarised as: 1) a positive environment in the sense that it discourages any negativity (Bell & Ternus 2007:15), 2) an environment that is safe in the sense that it allows failure (Linn 2015); 3); the fostering of exploration and experimentation (Linn 2015); and 4) interaction with others through collaboration, especially with others with different points of view (for example from other disciplines) (Mohutsiwa 2012). On this basis, the creative environment is argued to be an important dimension in the development of creative thinking and creative problem-solving skills and, ultimately, the development of innovative products.

These four dimensions of creativity are relevant to creative problem solving and innovative product creation, particularly if a Design Thinking lens is applied[1]. The following section illustrates the links between creative problem solving and design thinking for innovation.

The role of Design Thinking in creative problem solving

Design Thinking can be seen as an approach, a way of thinking and a methodology to find solutions to complex problems, and thus it requires creative problem solving (Dorst 2011). Moreover, Design Thinking is not only applied to creating products but also allows the creative development of a strategy or system that is innovative within a particular context (Brown 2009; Carr, Halliday, King, Liedtka & Lockwood 2010). At core, Design Thinking always calls for a human-centred approach, which means that problem solving can be applied by including the people for whom the designed solution is intended (Brown 2009). Therefore, Design Thinking can offer a suitable approach to enhance design intent and product innovation.

The principles of Design Thinking can be used to guide the transformation of needs into demand and in this way problems can be solved in a creative manner (Brown 2009). Each Design Thinking principle also guides an approach to the design problem (Meinel & Leifer 2014). Design Thinking principles as summarized by Jobst and Meinel (2014), as well as by Meinel and Leifer (2014), are illustrated in Table 1 below.

From Table 1 the various ways to think/reason about a problem can be applied to come up with innovative solutions to problems simply by viewing the problem with different underpinning principles or by using a combination of the principles.

A question that arises from literature reviewed up to this point is: can the four principles of Design Thinking, the 4Ps of creativity and the application of creativity to yield innovation be linked? The following table illustrates the potential articulation between creativity, Design Thinking and innovation.

Table 2 illustrates a possible articulation between the various principles of Design

[1] The applicability of Design Thinking became apparent after the first research cycle in the action research study (an inductive approach was applied), yet it is offered in the literature review in this paper for clarity and flow of the arguments.

TABLE 1: PRINCIPLES OF DESIGN THINKING SUMMARIZED (JOBST AND MEINEL, 2014; MEINEL & LEIFER, 2014)

Principle	Description of the principle
Human Principle	Design activities are essentially socially based (i.e. human-centric, aimed at satisfying human needs or adding value to people)
Ambiguity Principle	Designers should maintain ambiguity since experimentation nurtures innovation
Re-design Principle	Designers should use previous problem-solving experience and foresight to solve/predict future problems (learning from past experience)
Tangible Principle	Designers should make ideas tangible (i.e. employ prototyping) to help to communicate the idea

TABLE 2: POSSIBLE ARTICULATION OF THE 4PS OF CREATIVITY TO THE PRINCIPLES OF DESIGN THINKING AND THE APPLICATION OF CREATIVITY TO ENHANCE INNOVATION (AUTHOR-COMPILED)

Design thinking principle	**4 Ps of Creativity** (Rhodes 1961)	**Key aspect from literature that could be relevant**	**Application of creativity to add value to products or ideas** (Boden, 2004)	**Yielding innovation** (Rampino, 2011)
Human principle	Creative Person	Empathy, solution- focused, open-mindedness Ability to draw inspiration	Insights	Aesthetic dimension, Use dimension Meaning dimension Typology dimension
Ambiguity principle	Creative Process	Experimentation and iteration Finding solutions	Interventions	
Tangible principle	Creative Product	Novelty and innovation	Artistic products Services Strategy System	
Re-design principle	Creative Press (environment)	Positive, Safe (to fail) and enhances collaboration	New or original ideas from environment and others	

Thinking, the 4Ps of creativity, the application of creativity for value add and innovation as a possible outcome on various levels. The conjecture in the table suggests that applying Design Thinking principles could support innovation through the 4Ps of creativity. This conjecture, however, would need to be tested in the study.

RESEARCH METHODOLOGY

Research paradigm

This article reports on a section of a larger study that included several research methods. All the research methods in the study were qualitative. According to Babbie and Mouton (2001:53), a qualitative research paradigm takes an insider perspective as the point of departure. The researcher was interested in how participants responded to an intervention to support their product innovation and design intent.

Research design

This article offers an extract from a larger study using an action research design. This was deemed appropriate since a primary aim of action research is to improve a situation and introduce change through intervention (Mertler & Charles 2010; New South Wales Department of Education and Training 2010; Norton 2009). The action research process revolves around the application of a continuous spiral of cycles that involves implementing and refining an intervention for a next cycle of research that was based on findings from the previous cycle. Four stages within a cycle of action research were acknowledged: planning, acting (devising and implementing an intervention), observing and reflecting upon the effect of the action for further refinement (Mertler & Charles 2010; New South Wales Department of Education and Training

2010; Norton 2009). Although two cycles of the action research were implemented, this article focuses mainly on the intervention cycle that supported innovative product creation and design intent. As discussed in the literature review, the multi-dimensionality of creativity is acknowledged, however, only two of the Ps of creativity are highlighted in the particular objectives that are reported in this article, namely the process and the product, as these two Ps were sufficient to answer the objectives of this article.

The objectives of this article are:

1) To explore the role of an intervention aimed to support product innovation by participants in an extracurricular sewing programme.
2) To explore the design intent of participants during the intervention for an extracurricular sewing programme.

Sample

Participants in this study were between the ages of 7 and 12 years old. Male and female participants were involved in both the action research cycles. All participants were from a Creative Sewing and Design programme offered in the Gauteng province of South Africa as this programme required intervention on parents' request. All the participants were on the same technical level of competency, even though their ages differed. The programme was offered as an extra-circular activity and participants, as well as their parents, consented to taking part in this study: 14 participants took part in this follow-up intervention cycle out of the 18 children that had taken part in cycle 1.

Research methods

Although several methods were applied in the larger research study, this article reports on the visual analysis of products that resulted from the training sessions as well as the documents where participants had written down their design intentions for the products (for whom or what purpose it was designed).

The objectives were operationalised as follows:

To explore the role of an intervention in product innovation of the participants of an extracurricular sewing programme, a visual analysis of the products participants created was applied. This is a qualitative research method that allows the researcher to analyse the artefacts that were created. Visual analysis is is based on the notion that visual material encapsulates meaning that can be understood and uncovered through a process of critical analysis and interpretation (Rose 2014). Such an enquiry should incorporate principles and practices that require a strategic consideration of criteria to critically assess each artefact so that the researcher is consistent and free from bias (Barnard 2002; Gaimster 2011; Helmers 2006; Rose 2014; Van Leeuwen & Jewitt 2007). Visual analysis as a method involves: 1) identifying the guiding principles of the visual analysis; 2) critically analysing the physical elements of the products; 3) interpreting; and 4) drawing an informed opinion and evaluating the representational relevance of the products (Rose 2014).

For the visual analysis in this part of the study, a three-point rating scale was used to evaluate the level of the creativity reflected in the products produced by participants where: 1=Predictable use, 2=some applied creativity, and 3=A lot of variation and novelty (Very innovative). This scale was applied to two of the four dimensions of Rampino's (2011) product innovation pyramid. The two dimensions of the product innovation that were applicable were: aesthetic dimension of innovation and use dimension of innovation.

Also, to explore the design intent of participants designing products during the intervention a document analysis was undertaken. A question sheet that was given to participants contained questions about the intended function of and for whom the product was to be created. Each participant submitted their documents to the researcher when they had completed their prototype product and wrote down their design intent on the question sheet.

Quality of the data

The importance of combatting possible error,

particularly relating to possible bias, in this qualitative study was important with the visual analysis and document analysis in this study. Trustworthiness was obtained through credibility (the extent to which data rings true) and conformability (to which extent the same process was followed) as recommended by De Vos (2003:352).

In this study, the researcher was the person who did the intervention and video recorded the session. She also made use of two peers who were asked to independently rate the products on the visual analysis scale after they had been made. The video recording was used for observation of participants' process and is not discussed in this article. The peers who were asked to validate findings about the visual analysis and design intent of each participant were academics and regarded as experts: one in creative visual analysis, the other in entrepreneurship for creatives. In this regard, both peers understood Rampino's (2011) innovative product dimensions and used the same scale and process to rate the product creativity. Where discrepancies were evident, the researcher provided more background information as to why the ratings were deemed appropriate. With two products, where discrepancies were detected, the discrepancies made sense against the background that the two products were in fact regarded as less creative because the ideas were copied from a social media platform (Pinterest) and not from the participants' original ideas. The peers therefore agreed with the researcher's ratings in these two cases.

It is also important to note that the quality of the data could be influenced by the age differences between participants. However, the level of the participants was the same regarding technical ability, but to prevent any bias regarding participants' ability to innovate and the possible role that their ages could play in this regard the participants were also measured against themselves as opposed to each other. In other words, participant A in the first cycle was also participant A in the second cycle. This was done to ensure that the role of the intervention on each individual could be observed.

Moreover, the researcher presented the intervention in the programme as she had built a relationship with each of the participants in the previous year that the programme was offered before the intervention. Knowing participants does not present a problem in qualitative studies as the participants are comfortable with the researcher and this might enhance the credibility of the data. Yet, as discussed above, the role of peers to validate findings was important to address any tendency of bias in this study.

Research ethics

The protection, safety and privacy of participants were maintained during this research study and therefore the principles of Munro (2014:112), as well as those of Fouché and Delport (2011:63) were followed. Participants were made aware of the purpose of the study, and what they were agreeing to when approving to participate. In this study, participants' parents also had to be consulted and informed at an information evening where clarification could be provided, as well as via written correspondence with parents to obtain permission for their children to take part in the study. Parents could consent to their children taking part in the study or not, but in addition they were also involved in one part of the study where participants were asked to prepare for the design session.

Written consent to let participants take part in the study was obtained through a letter that every parent completed with their children in an information session. The researcher's affiliation with the University and the approval from the Ethics Committee that endorsed this study was communicated in the consent letter. Furthermore, participants were reminded that participation was completely voluntary and if there had been potential participants who did not want to participate, separate sessions would have been organized to ensure that participants who preferred not to partake would not be affected in any way. The participants were aware of the video recording and were asked if they wanted to have their faces blurred afterwards when the validation took place. None of the participants requested this. Instead, participants seemed proud of their video

TABLE 3: RESEARCH FINDINGS OF CYCLE 1 (AUTHOR-COMPILED)

Participant A	Participant B	Participant C	Participant D	Participant E
				
Participant F	**Participant G**	**Participant H (Front & Back)**		**Participant I**
				
Participant J	**Participant K**	**Participant L**	**Participant M**	**Participant N**
				
Participant O	**Participant P**	**Participant Q**	**Participant R**	
				

recordings which could be viewed by them and their parents at any time. Those who were not comfortable with the study did not participate.

At the beginning of each training session, children were reminded of the safety training prior to the onset of sessions, and standards as are applied during all normal training sessions were implemented. It is also a standard procedure that all parents sign an indemnity form when their children are enrolled for the extracurricular programme. No financial gain for the sessions that involved the intervention was sought from the researcher.

FINDINGS OF RESEARCH CYCLE 1

In order to put the research problem on product innovation into perspective, a concise overview of the first research cycle is provided, together with the problems that were identified by the researcher who was also the person who offered the programme and intervention.

In the first cycle the "training techniques" were focused on enhancing technical skills. This implied that a traditional method of instruction was followed where step-by step demonstration by the trainer was the main technique. The outcomes were therefore linked to how well (in terms of technical quality), the participants could replicate the example provided. The following images show how the participants were able to replicate the bag that was designed by the trainer.

From Table 3 it is apparent that all the products have almost the same appearance and that the aesthetic aspects of the bags are similar. The functions of all the products were guided by the instructor and there was, therefore, limited scope for innovation. The products illustrate how well the traditional techniques of instruction for sewing enabled the participants to produce products that seem technically sound.

The design intent of each participant is provided in the following table.

In Table 4 the product seems to be predominantly for self-use or for a family member. Although two of the participants made mention of a general consumer market, it is evident that the instructional approach in the programme did not foster a more creative product or suggest a design intent.

One can derive from the products and the training techniques that the outcomes of traditional training techniques were successful as quality of products was the focus. However, the problem with this training technique regarding entrepreneurial skill is the lack of product innovation which might have been on an aesthetic level, the use of the product or the meaning of the product (see Rampino's (2011) product innovation pyramid as referred to in Figure 1). A lack of product innovation could present a problem that is twofold: firstly, the lack of applied creativity that is important for innovation; and, secondly, the lack of innovative

TABLE 4: PARTICIPANTS' INTENT WITH THEIR CREATED PRODUCT (AUTHOR-COMPILED)

Participant	Verbatim from participants when they were asked what they will be doing with their product	Who will use the product
Participant A	"To put stuff in it."	Me
Participant B	"To carry things."	Me
Participant C	"To put stuff in it."	Me
Participant D	"To carry things in it."	Me
Participant E	"I will be keeping it."	Me
Participant F	"Present." [Gift]	Family member
Participant G	"For fun to use to carry thing." [*For fun; to use to carry things*]	General consumers
Participant H	"Uh…to carry random objects around? Or wear as a hat? Skirt? Diaper?"	Me
Participant I	"Put stuff in it. So that I can use it."	Me
Participant J	"Bag for books."	Me
Participant K	"Use it for carrying random stuff around."	Me
Participant L	"To carry books around."	Me
Participant M	"To carry things in it."	Me
Participant N	"Boeke." [*Books*]	Me
Participant O	"Dit sal in my kamer wees om boeke in te sit, want dit lyk mooi." [*It will be in my room to put books in, because it looks beautiful*]	Me
Participant P	"To carry my grandma's phone, glasses, purse, etc."	Grandma
Participant Q	"To carry stuff in. It must be practical and have a style anyone can use."	General Consumer
Participant R	"To go shopping."	Me

products could be problematic if adding value to markets (in terms of entrepreneurship) is an aim. Monotonous products also reflect instruction methods that were directive and did not encourage participants' design ideas in new ways and, as such, failed to support a future entrepreneurial mindset.

INTERVENTION TO SUPPORT PRODUCT INNOVATION

The original (initial) sewing programme was not underpinned by Design Thinking principles. The rationale to enhance the programme with Design Thinking related to: 1) a need to support more innovation as all participants had some competency with technical skills; and, 2) design intent that could link to entrepreneurial thinking. Design Thinking approaches as discussed in the literature review are suited to support product innovation and design intent. Moreover, Design Thinking is often associated with an entrepreneurial mindset (Von Kortzfleisch, Zerwas & Mokanis 2013; Brown 2009). Entrepreneurial mindset was an indirect goal of the entire study. The researcher conjectured about the possible relevant aspects for the programme (Table 2) and used it as a tool to brainstorm with two peers (both in education) to come up with strategies to use during the presentation of the programme to support product innovation and design intent. The following intervention was implemented:

FINDINGS OF RESEARCH CYCLE 2

For the visual analysis, a three-point rating scale was used to evaluate the products produced by participants: 1: Predictable use; 2: some applied creativity and 3: A lot of variation and novelty (Very innovative). Table 6 summarises the research findings of phase two after the training intervention.

From the findings in the above table it is evident that participants who were used to following instructions to make a pre-decided product were able to come up with a diverse range of prototype products. The tangible principle of design thinking is thus evident (all products realised within two sessions). The application of creativity (a score of 2 or 3) is apparent and it seem that participants were able to respond to the challenge of starting to think like designers as opposed to only using technical skills to sew products. The application of creativity is therefore supported by the techniques implemented during the design process of participants and the principles of Design Thinking seemed to support a process that is aimed towards product innovation.

It seems that the principle of ambiguity - being reminded that experimentation is allowed and iteration can take place - allowed participants to apply their technical skills to the design of creative products and even innovative ones. Only one participant (M) could not come up with something other than a bag (the same product as the previous round). However, the participant seemed to have realised this and attempted two other products that could not be completed in time.

Innovation in terms of mode of product use seemed to have transpired for four of the participants. It is fair to say that typological innovation and innovation is still not evident, but this is expected given that the intervention was for children younger than 13 years, i.e. participant cognitive development is taken into account.

Participant O was able to not only be innovative with use of product but also used aesthetics in an innovative way (Table 6). It is important to note that the participants who scored 3 in the category (innovation) were not among the stronger candidates regarding the technical skills in the first cycle. Design Thinking therefore promotes an opportunity for thinking beyond one's technical abilities and, in this way, it supports product innovation. The importance of the Re-design principle that was linked in this study to promote a conducive creative environment could have had a positive effect as intended.

Nevertheless, three participants had low scores on creativity in terms of use of products as they

TABLE 5: INTERVENTION IN THE PROGRAMME (AUTHOR-COMPILED)

Design thinking principle	Aspect of creativity	How the techniques were implemented	Aim of the educator with the technique
Human Principle	Creative person to learn about: empathy, solution focused, open-mindedness, ability to draw inspiration from others	Asking participants to think about the purpose of the intended product function and speak to potential end users to ensure end-user (market) needs are considered Individuals could collaborate on ideas during the construction sessions and to ensure that there was still respect for each other's time and creative flow, participants could raise a sign to notify others they no longer wished to collaborate	To support thinking about intent of the design
Ambiguity Principle	Creative process to promote: Experimentation and iteration, Finding solutions	Brainstorming outside in a garden as opposed to in the class with friends Reminding participants that what is designed is merely a prototype that can be changed Freedom to choose materials from a large table with many options	To support product innovation
Re-design Principle	Creative environment that is: Positive, Safe (to fail) and enhance collaboration with others	Allowing time for sketching during planning and allowing time for prototyping Incubation time (thinking time) at home between sessions	To support thinking about intent of the design
Tangible Principle	Creative products that are: Novel and innovative	Existing product to incorporate into the new design Element of surprise during design process (existing product hidden under tablecloth that was given to each participant to incorporate into their designs or swap with other participants)	To support product innovation

could not view their products from a different perspective for another use. However, in the next section, where these participants were asked about their design intent, they showed great insight and this could be seen as an improvement in the application of creativity in an abstract way.

From these findings it was apparent that participants were able to think beyond their own needs and that the human principles of Design Thinking, particularly that of empathy, transpired through the design intent of the participants. The open-mindedness of some of participants who did not do well in applying creativity to product use (participants E, J & M) was also apparent. The Design Thinking principles, especially the Human Principle, therefore seem to enhance creative thinking in every instance in this group.

The limitations of these study are acknowledged. The first limitation is that not all the participants who took part in the first research cycle were involved in the second research cycle. Secondly, the first research cycle is merely provided as background here in order to show the contrast in instructional approaches. Another limitation is the reference to only two of the research methods used in the larger study, and this article therefore offers a "snapshot" of a much deeper enquiry. This means that this paper's findings are limited to exploration. It should be stated that the larger study includes other methods for triangulation, and that these other methods answer other research questions relating to entrepreneurial thinking beyond innovation as well. Critical visual analysis and document analysis of participant design intent were, however, deemed appropriate to determine whether the intervention supported a process towards innovation.

TABLE 6: RESEARCH FINDINGS OF RESEARCH CYCLE TWO (AUTHOR-COMPILED)

Participant	Prototype product	Creativity/ innovation in terms of Form (overall appearance)	Creativity /innovation in terms of mode of use (function)	Type(s) of innovation on Rampino's (2011) innovation pyramid
Participant A		2	2	Mainly aesthetic
Participant C		2 (Pinterest product)	2	Mainly Aesthetic but elements of use
Participant D		3 ("plag" pillow bag)	2	Use
Participant E		2	1	Aesthetic
Participant G		2	2	Aesthetic and use
Participant J		1	1	Aesthetic

TABLE 6: RESEARCH FINDINGS OF RESEARCH CYCLE TWO (AUTHOR-COMPILED) - CONTINUED

Participant	Prototype product	Creativity/ innovation in terms of Form (overall appearance)	Creativity /innovation in terms of mode of use (function)	Type(s) of innovation on Rampino's (2011) innovation pyramid
Participant L (b-Sock bun)		3	3	Use
Participant M (bag was evaluated)		2	1	Aesthetic
Participant N	 	3	2	Aesthetic
Participant O		3	3	Aesthetic and use (to be hung against the wall for craft products)
Participant P		2	3	Aesthetic and use (the pillow can be used to store pyjamas)
Participant Q		2	3	Use (a square becomes a skirt)

FINAL CONCLUSIONS AND IMPLICATIONS

This article reports an intervention to support product innovation resulting from children's creative design/problem-solving processes. From these findings it can be concluded that the intervention did support the participants' creative problem-solving and a process towards innovation even after one intervention cycle. The value of this study should be viewed twofold: 1) the objectives of the article were met; and, 2), the intervention, as such, could be of value for educators who want to promote creativity as a skill in their various subject fields, because, as stated in the introduction of this article, creativity has increasingly become more relevant for the future and everyone should be creative, at least in the way that they think about problems.

The intervention that was designed from the literature by linking the 4Ps of creativity with aspects that seem to link with the principles of Design Thinking offers a possible strategy for **how** the principles can be implemented. The techniques offered in this article may be explored further as they provide examples of how the principles of Design Thinking can be brought into any educational setting. The framework derived from the literature that links the four dimensions of creativity to principles of Design Thinking, does seem relevant in this context and might have relevance to other contexts as well. The implications of this intervention are that it could possibly be explored in different scenarios by educators where creative thinking or creative problem solving is required, for example in offering creative writing, art or engineering-related subjects, such as technology.

Another conclusion is that the visual analysis in this article seemed appropriate in this context where product reflected the participants' creative process and the creation thereof was supported in a creative environment. The reference to a prototype was an important way to allow participants to experiment and use iterative processes to get to a product that required less technical precision. The assessment of the prototype products reflected the criteria of an existing innovation framework.

The approach to instruction described in this article, supporting creative application of problem solving, therefore does seem to support a journey to innovation. There are no "quick fixes" for developing people's thinking because only four of the participants could be viewed as very innovative after the intervention. Nevertheless, the findings do show the difference between a step-by-step demonstration approach to instruction that focuses on mastering technical skills as opposed to design skills and the more creative

TABLE 6: PARTICIPANTS' DESIGN INTENT (AUTHOR-COMPILED)

Participant	What will you be designing	For whom?
Participant A	A T-shirt for girls that want a personalised own t-shirt that's their own design that can also be plain or very colourful.	Girls my age and a bit older
Participant C	A 3D flower pillow	For small kids' rooms
Participant D	A Pillow/Bag. "#Plag!"	For kids for their rooms
Participant E	A camo hat	For kids who like recycling
Participant G	A phone case	For young people that don't carry a handbag
Participant J	A creative jeans short	For girls younger than me
Participant L	A pencil bag	For school kids
Participant M	A headband	For going out to a casual place
Participant N	A colourful hat	For young kids
Participant O	A mat made from lots of offcut material. In different shapes to put craft materials in.	For any crafter
Participant P	"I will be designing a denim pillow which says: 'Keep on dream-ing'."	For a room
Participant Q	"I will be designing a skirt with flowers and buttons."	For teens
Participant R	"I will be designing a seatbelt pillow."	For moms and their kids

approach in the second research cycle where technical skills are applied more freely. The proposed approach can be adopted for products that not only reflect innovation, and, in addition, allows the participant to be more open-minded, take on the viewpoints of others, collaborate, experiment, and create prototypes that meet specific needs.

In addition, the approach proposed in this article has the potential to support a relationship between entrepreneurial thinking skills that include creativity and innovation in the sense that it incorporates creativity in order to add value to end users or a target market. In the literature, creativity and innovation had been identified as important skills for future entrepreneurial thinking, and it was evident, especially in the intent of the participants' designs, that they do think about a typical target market after the Design Thinking principles were introduced to their programme. Therefore, it is concluded that encouraging the development of creativity and innovation may well be the first steps in developing entrepreneurial mindsets.

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