



A n u n p l u g m e i c k u l t u r e a p o n s i v e
c o m p u t i e n a g r c l h y i l d e h d o u o c d a t i o n

Frank Harper | James Selinger | Marguerite
LoCaudle | Bethany Keiser | Ami Sradovnik
The eRRAP Partnership

¹University of Knoxville,
Tennessee, USA.

²Appalachian Investment Corp., North Carolina.

³Tex A & M Univ C o l l S e t g a e t i o n
Tex A U S S A

⁴OAR ID# Gæt ilobad r@ar i g e
Tenne l S A e .

Correspondence

F r a r KcHear, u n r i v e o r T s i n t y 1 s 2 e 2 e
Vo l u n B t l e v e d i , a x 4 t 4 o 6 n - T P K T n E o , x v
T N 3 7 9 U 6 A .
E m a i l h a r p e r 1 @ u t k . e d u

Funding information

Directório de Educação Agrária / AN
Número 2031/84 - 15 de Maio de 1984

Abstract

[illegible]

KEYWORDS

[illegible]

This is a pre-proof of the manuscript "Cer e a Q oim n e A n t s r i b u c t i o n s i n s t r a n d p r o d u c t i o n a n d i m p o v i l o e r d i o n r a k e r o p e r t l e d ."

© 2024 Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).



1 | INTRODUCTION

Computational thinking (CT) is a process of problem solving that involves using a systematic approach to analyse a problem, design a solution, and implement it. This process is often taught in schools and universities, but it is also a skill that is used in many other areas of life. For example, a doctor might use CT to diagnose a patient's condition, or a chef might use CT to create a new recipe. In this paper, we will explore the concept of CT and how it can be used in a variety of contexts. We will also discuss some of the challenges of teaching CT and how these can be overcome. Finally, we will provide some examples of how CT can be used in the real world.

The purpose of this paper is to provide a comprehensive overview of CT and its applications. We will start by defining CT and discussing its components. We will then explore some of the ways in which CT is used in different fields, such as education, healthcare, and business. We will also discuss some of the challenges of teaching CT and how these can be overcome. Finally, we will provide some examples of how CT can be used in the real world. This paper is intended for anyone who is interested in learning more about CT and how it can be used in a variety of contexts.

We will start by defining CT and discussing its components. We will then explore some of the ways in which CT is used in different fields, such as education, healthcare, and business. We will also discuss some of the challenges of teaching CT and how these can be overcome. Finally, we will provide some examples of how CT can be used in the real world. This paper is intended for anyone who is interested in learning more about CT and how it can be used in a variety of contexts.

2 | CURRENT STUDY

The purpose of this study is to explore the effectiveness of a new CT program in a primary school. The program is based on a set of principles that are designed to help children develop their CT skills. The program is being evaluated in a primary school in the United Kingdom. The study will involve a series of lessons that are designed to teach children the basics of CT. The study will also involve a series of assessments that are designed to measure the children's progress. The results of the study will be used to determine whether the program is effective and whether it should be used in other schools.

(RQ1) What are the key components of CT?

(RQ2) How can CT be used in the real world?



FindwengheseeddvaarttheoCRDCEhadnttridnnderssta
o howsupbdlaackdatliexrChTalsngsèdaasèmosbee lonigiomg ut
science.

3 | BACKGROUND

Webri s f y t l a s t s u i d t y w o e s e a r r e a s r c h y i l d h o o p d u e t d i u n g a n d r e .
Weconcedalec b j d o e n s c r t i h b e l e g r f e r t a i n c e a w l r d t c g t u e i d d h e e s a g d
develoopimhCARP rog araths e r a v s a l y l e n s a s .

3.1 Computemugaitreiaomlhyi l d h o o d

Tech n o h a g l o e s s p p d r e a n c i a n d e r o m a i i n a s r c h y i l d h o o p d u e t d i u n g a n d r e .
S a r a a n o , b u i t n c r e a s h i i n g l i p e r s i t a i s o m e a d t i o t r e s c h n o d b t h y a s
c o n s u m f e r C h e n a g 2.0, 1.8 h s s p a v t e h e a f o e r d u c a t e o h a d s l p o e g c i e f s -
i c a d l e s y i g o e a d r l e y e l o o p o n t e i n t c l u (d f t) a g g o i p h y e s t i c o l e s . g o . b . o t s
w i p h y s i i n c a u b t d ; c a g d 2d) i g d s a t l e a s a e p d l i c a t d i g o r a i s t a a n (d 3)
h y b s y s t (e m . s g o . b p r t s g r a m i n t e l i d g a p a (s M) a c r e i a d l 2.0, 2.0 E a r c h y i l d h o o
e d u c a t f d f e r s a m c e d o p g o g r a a n s h i p a r g o c o e p s r s o v i s d - b a s t e p s t r u c t i
f o a r n i n t a n (g e i . d g i l . g . c h a i l a o c t t a e n r g) (i e b . f g e . b o t t) e p e r s o n n o v o e a c t .
C o d i i m g o a v o m p u (e e t g a . b r l e t i o s t p) l u g g v e d t h a c o m p u t t h e r o d i e s s
“ u n p l u (g l g e e d) u n 2.0, 1.0 c L e n 2.0, 1.0 F i g 1 s e o w x a m p a h e d s o m p a r e s
b e n e o f f t p s l u g g a e n d d u n p l u a g g p e r d b e b l i e n d a y e e n e f e m g a g i v a g t h
t a n g t i o b d l e s f b r a n s i t t o l i o g n o i n a g l e a s a e p d l i a a t t h i o t t e v e (d e p s
O l m o u n e a 12.0, 2.0 a v i e g a n 12.0, 2.0 P r o g r a m m i n g s p e c a p a r l o y a n d a t e
e e f t f i v e e n g a g y o n g h i l d i c e (n F r i e y e r s c h a e r B e n A r 2.0, 1.0 S u l l & v a n
B e 2.0, 1.0 l e a 12.0, 1.0 i a Z h o 2.0, 1.0 B i k e w i u s e p l u g g l e d h g e c s t u i p v p e o l r y t s
C t d e v e l o p m e n t o u n e a 12.0, 2.0 i t h a e d d b e e n e o f t a s s e m p l e m e f n o t r a i
e d u c a t a d f i s d a t f o s r i c h t o y o n t a m i w l i i t e l i s m f t h a d r e i s a o l (G e e 2.0, 1.0 g

P o s i t e i c h e n o l D o e g v i e c l a o l p m e n t d i e t v i e z l e o s p r a e p r a p l o y s a i e t e i p v e e r
e n c a e n s d h i l d h o e r g r s o i a c h t e r a s s o m m b n a m e f w o r e l a c h T i (M g a c r i c e
e t a 12.0, 2.0 W e u s a P o s i t e i c h e n o l D o e g v i e c l a o l p m a m e t w a l r k e w e i r d e a s
f o C r T .

3.1.1 Powe i r d e f a c r T

P o w e i r d e f a c r T r e p r e s e n d w l e n d g e r , s a a t l d i i m s g k i , i o l g l i s l d d e v e e n l o p
a s h e n g a g o m p u r t a m e a l l y g o r d i n t s o l u c t e u b r u e g s h i d e e s p g o c e s s
m o d u l , a a i d w a r e a s d e f p w a s e r t h e a p b w e o n e s o t n p o r t e t d . i . a l
a b f n d e w a y o s f t h i n k . p o g k i n n o v l e o g e a p d . . . m a k e n s a m e p l i s t e m o
l o g i c o a h e w i b b i n d s o m a o i n s o w l e B e 2.0, 1.0 91 0 3 A) l g o r a i r a d m o s f t
s t e f o s r o m p l a t t a s s e p , q u e i n a s e p l e c o i r f d e e l a , t c e o d o l y r t r e a t r u e h e
b u i l d l i o n g l o s o g r a b e n d a t u s e e d o l m p u w t h e e n s l o w e a r o r u y t h i e n -
s t r u c t a i n o h g s o r F i o t e r k n a m p l l e d e a d s m p u t r e e p a s a t t e p a (s) n d i t i o n
c o m m u n u a l e v e r a s t i r c u m s p a e n d a e a m t (i o i n d h a p p t e m e s e r f y o) r m
W h e a n c h i a d g s d b e s i t u n c a s i n o n e o d e d u d s e e r o u g t g o i d e g n w t h i y f h y e
p r o g r a m a l n e t t e t e r h n o i n d e x t h p e r o b l e m .



Plugged-in Tangible



Example: Child uses coding blocks to write a program for Kibo & scans those blocks to execute the program.

Improved academic & linguistic skills

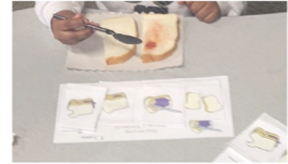
(Toh et al., 2016)

Unplugged Tangible

Example: Child use images to write a program for making a peanut butter & jelly sandwich and acts out their program.

Greater CT gains than plugged-in group

(Del Olmo-Muñoz et al., 2020)



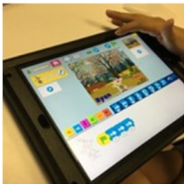
Note: Not used in the CRR Program

Lower motivation among girls

(Del Olmo-Muñoz et al., 2020)

Example: Child uses Scratch Junior to write a program for their own interactive story.

Photo credit: Fryer (2016)



Plugged-in Intangible

Avoids cultural biases embedded in novice programming tools

(Litts et al., 2021)

Example: Children compare stories with linear & non-linear sequences & write their own stories with a character and sequence of events.

Unplugged Intangible



FIGURE 1 Plugged-in and unplugged tangible and intangible learning experiences in the CRR Program

Three program experiences are presented in this figure. The first is a tangible, plugged-in experience where children use coding blocks to write a program for Kibo. The second is a tangible, unplugged experience where children use images to write a program for making a peanut butter & jelly sandwich. The third is an intangible, plugged-in experience where children use Scratch Junior to write a program for their own interactive story. The fourth is an intangible, unplugged experience where children compare stories with linear & non-linear sequences and write their own stories with a character and sequence of events.

3.4 Culture as a byproduct

Research has shown that children's cultural background influences their learning experiences. This is particularly true for children from diverse backgrounds who may face barriers to learning. The CRR Program aims to address these barriers by providing culturally responsive learning experiences. The program includes a variety of activities that are designed to be culturally relevant and engaging for all children. These activities include using coding blocks to write a program for Kibo, using images to write a program for making a peanut butter & jelly sandwich, and using Scratch Junior to write a program for their own interactive story. The program also includes activities that are designed to be culturally relevant and engaging for all children, such as comparing stories with linear & non-linear sequences and writing their own stories with a character and sequence of events.

Heriata, a digital platform for children's learning, is designed to be culturally responsive and engaging for all children. The platform includes a variety of activities that are designed to be culturally relevant and engaging for all children. These activities include using coding blocks to write a program for Kibo, using images to write a program for making a peanut butter & jelly sandwich, and using Scratch Junior to write a program for their own interactive story. The platform also includes activities that are designed to be culturally relevant and engaging for all children, such as comparing stories with linear & non-linear sequences and writing their own stories with a character and sequence of events.

computatitudenuntisritiuntes,esabshvirothmappsoabuhil d
 andusteanigragemaldtriensesqutihtriotugahn sf a ppar to i vedscso&t t
 Whi 2 0 13 by con netcti unde on n s u nain thie v se rlaogkian low laendprea cti e
 t f o sctœnned tci on p s u (t Liang, Breen y e t l 2., 0, 2 1 a c h, E g y æ s t h l 2. 0, 2 1
 L a c h e n æ 12. 0, 2 1 B o s t e n g a g e m i e t h m u a n i f a y m i i k i e e y s E C E A. c c o r d
 i n g w l e s e l e t c t f e o d l l o t w h i e r g r f e a i n c e a t w o k i t h e u r r i d e w l e a l r o a p m d e n t
 t e s t i t i n g i s u b d e y c a o u f i s t e n p i g i r o a h (L i e n g 12. 0, 15 c o t w h i 2 0 13 n
 c u r r i d e u s l u l m a t i o n v i e t r i n z a c s u p l e a d t u s l t u r e .

3.2 | **E i t e n f e o C r S C**

Sc oetatl(2.0)f r o p o s e e l n e e C C o n f o h e s o f n e a n i o g n p u e t x i n g
p e r i f o r s t e u d f e m d n s s t o u r i c a l l y p r o r o s t e r e s d e m e a t i n t t a h a r t s
s t u d e n t a s p a d f i l e g i i t a b v . C o m p o e d o g a n t u i s e t x t o r e d y o l n e d a r n i n
f o u n d a k t n i o w n l a e h s t k e i t l o t a s t e e x p y e r a e n d d e s i m a p t p e o l r y t f u o i r i n i o e s
v a t a o d r e a T h e e c d r e d s e t t a t t l e s d u c a n t u o s o r t i s e a l t e a r c o m t e h x a t t
s u p p l i t e r s a n s f o u n e t i e o h a t h e l e g a r n o i m t e r c e h s a r a c b t y i g b e d
e x p e c t a u t t i o o n s o m p y a o n d p o r t f u o a r t o d t e o a n d s e r a n t p a u n d i r e u h e n s i
l i m i t o a f t i o m p u s t e e a m d e c h n o l o g i e s .

Te n et thsraend o,ur ie s p e c s t u i g v e t h s t a r a b i o n g t e s ' e s l f o v n a g r i i o n t s e r -
s e c s o i n g o c l u i l a t e d u r f a u l e c h i n i n c a v a n t t h o a c h n s o h l o b g e y d e h b y l o
w h i s h u d e r f e a n t d e m o n s u t n r d a e t r e s t o a f n d e i i m g e r s e d e i n d T a k e e s
t o g e t t h e s e e n e a t k s t e h c e a s h a R O n u s (t 1 s) u p p l o e r a t r a n b i o n g t u n d e r s t a n d
m u l t i a p y l o e f s u d e l r e n t (2 h) e i s p u d r e a n v t i s i g s a s t o e f s u , e q y a a l n i s t o y c i a m l
j u s t a i n (1 3 c) h a l s e u g l e o n a t n s i p d i l g n i t e d a t i l c a r e a o t e m t o e r m a i m i a v o e s
t h e m s t e h f r e a d e m e a t i n t a l i a b o n e t f e o t r e s c h n o s l o u g e s i s s a s h o d s w i l d e r
c e a t f e o v r h o r a p d o w h a e t n d s a t h e a v h e n d e u s r o c i a a n l d l u y l t u i r e a l l e l y a n t
c u r r i t b l i t e m e n t s u t r h e a s t t r f i o e r s a l u c a o t m i p n u g t e i e e r d u e c a f t o d r o v e r s e
s t u p o e r p u l a e a l h i n g s t a n f l o r e c h r o n u i t n o g d r h a s t s o n s s i t u e d e m p b w e
m e r a t n p a r t i c i i s p o a c t i i a s l r t i c e .

4 | METHODS

[illegible]

This paper presents a novel system for generating synthetic speech data, which is designed to be used for training deep learning models for speech recognition. The system is based on a deep generative model, which is trained on a large dataset of natural speech data. The model is able to generate synthetic speech data that is indistinguishable from natural speech data. This synthetic data can then be used to train deep learning models for speech recognition, which can then be used to recognize natural speech data. The system is designed to be scalable and efficient, and it is able to generate large amounts of synthetic data in a short amount of time. The system is also able to generate synthetic data that is tailored to specific tasks, such as training models for speech recognition in noisy environments. The system is a significant advance in the field of synthetic speech data generation, and it has the potential to revolutionize the way that deep learning models for speech recognition are trained.

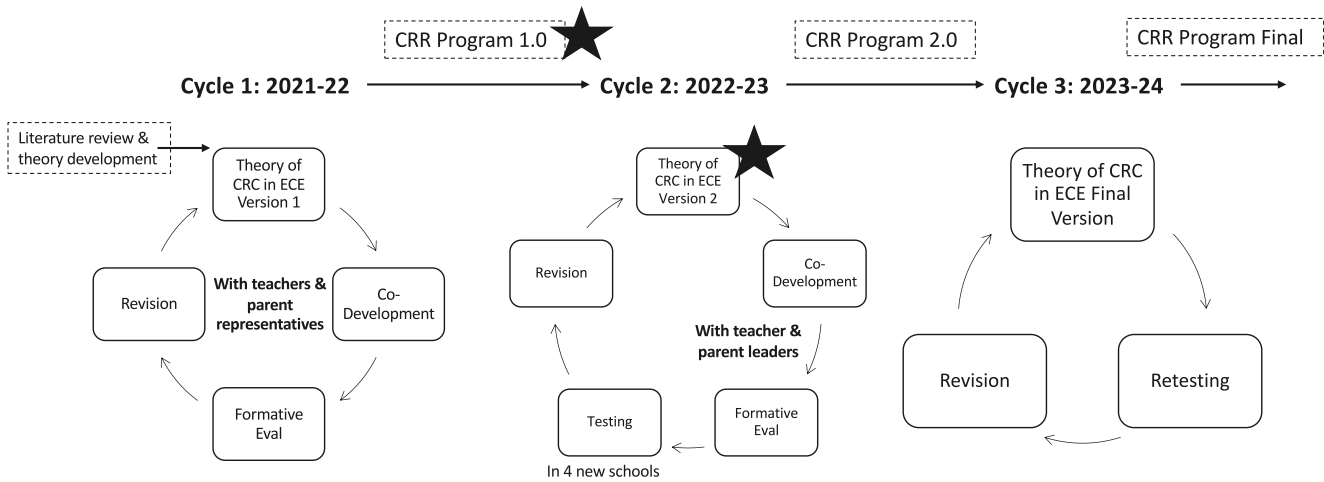


FIGURE 2 Overview of the CRR Partnership.

4 . 1 D B R c y c l e

[illegible]

Par a m t l e a c h f e r e s g o i i m p u e t n s s h e r r e t s , p o t h s e i p v r e g c f t e i e c d e b a c k
l o o t h s r o u t h f e r D B R s t a t g h e e n c l o s i o p h a r e m t l e a c w h a e i m s p o r f b a n t
t w o e a s (o l h) s m g t u e d a m t r e a n s t h a e t o i n C i b e C E C E n p o a c e t x i i c e t (\$ 2 ;)
s u c c e i m s p f l u e m e o n S t a E M e a r n i e a n g l h y l d e t u o c d i b a s e o d l l a b o r a
a m o p a r a m t l e a c (h a e a s t & D e m i r c a 2 0 2 1 p r e i t e l 2 . 0 ,) P a r e n l t a s e d
c r u c i a t e s C T n a g s a k h s o m t e p r o v f i e d e d b a c k u m m e a t e v e l o p m e n t
t e a c p h r e o r s f i e d b a c k h b a s t e e d s d u n g h a c a d y r a i t h r o u D B R u t
C y c l p a r e o i v c a e s s e f d a i d a v l a n t h e n g t r u e r s a p l o n s o i f t v a e s g l e s s t h m a t
p a r a m t l e a c p h r e i r o s r d i i t f i z e r d e l o s t R C E C S . p e c i , p a a r s l a y e m p u t i n
e d u c a t s a i n o p p o r f o p r i t y r i c i l z a i n n d o l m m u r a t p a e d h i l d s r e e l n f
e x p r e s s i t b e a , c h a e v r u s l t r u e r l a e l a z a m e a t h n a k c e o m p u n t o i n a e g c e s s b
(s h a r e a t 2 . 0 , 2 3 b r e t a b o p s r t o c a s e l e s l i e n d e v e l o p m e n t) .

Then iwt oiraktihgo C R C I E C E V r s i n g 2) was a r t i c u l a t e d r s
p a r t n i e f s b r y e d l e v a t d a s o t w t r l e i n t h e a c k g r s e u n t d i r o h e v i s d
t h r o u d g h P C y c l i b e a s o e n d e a c a m p l a r f e e n d C R P k r o g r a o n s d e v e l o p e
t h r o s u g h o r t e r c a y t c i l w e s f n o g r m a v i a v e a d t e i t o e n r t n h i e m r e b e f i r t e r a t d i o n s
c y c l (N s e & F o r m 2 e o r) 3 u n i v e p r a s i t n e l r e s t c h e e d p r i a s t a n d e s p u t i n
t o o b l a s s e n d x t l a i n t t e t g t u i t d h e n i c t d e v e l o o p t m a e n k t e a t h e l s d t u e r d i n g
m e e t w i n g t e a c a h n e d r a s r e t n t h e s e s e t a e r a n d i d m e d f i e a e t d e b a c t r e a c a h n e d r S
p a r e t o e s t i l h e e r k t i h n e g e r t y w r e e e n t w i n g i s r h f o t h u e d s p i g n n a i n p l e s
d e v e l o d p u m e i n t m u e e t U n g s e p r a s i t a n y e r b a g e r d u c o i a t h r i d t g e i a n g h e r
a n p l a r e o n i t i e h c e d e v e l o o p t m e e n t o r C R P r o g r a o n i v c h r s e c e s s i a e y d
d i f e r p e m i t o a m o n i e a c a h n e d r a s r e f o r C C I E C E T e a c a h n e p l a r e p r i t l s a t n e d d
f o r m a t i v a d l p y r t o e d r a s i k r s l a s s a o b o m b e s t w e e n t a n d i d e n t i e
n e c e s s a r i y s a o m s i d h e e r e a o t C R P r o g r a o n r r i d o u l a n t e y t h e
u n i v e p r a s i t (n s e d r a s e a l 2.0.2.3

4.2 Materials

[illegible]



Document f u d e c t (i b a n i s n : t r o p u a g a b o o t u y C e R R A P t a r t n e (2 s h i p t w p a g v e i s t r l e i v r a f n o t r a a b t u l e m p h a s o v e C T i u d e a s u m m a n k y e y c o n c e p i d r s f o r m a b o n i a o t n e r (3 a p l n s p a g e s s b a n a r f o c a x p e r a n e (m 4 c) e t w o t h p a e g w e i s b l n d e s c r o p t t a o n s w h i t e a s c h o e u l s d e a p p r o p r W e s e l e t c h s e e d a n d h i s e d t h o m s e r f e o f r e t h a s e o n M a t a e r l o c a x l p e - r i e , m a e n a l f y o s r e s e e a s t o h n e s s e c v a c h s e a n a c r p h s a s a p s r o v r i d e i n f o r m a b o u p o p n o r t t u e n n i g t a g e s h r C U R G C h f e o u s e t h p o o n t e a d a h n e d r S p a r e n o p s t i p n e a x l i , s C t t a o g i v a n d i r e s a n t i g r m a t v a l e v a e k i n e n v , t h r a d s o t t h a s e t i w e n o u s s e o g t e a c o h p e a r s e C r o t n s s . e q , t h b e l y n d o j t n f o r m o u f r o r m a t v a l e a a n t d i e v r i s d b e . 5 i g 3 p r e o v a i n e a m p r l e n h a l s o e t h e F r d m a t t a e r l o c a x l p e r i e n c e .

P h a l s h e i g h l a g g d e t d h t h o a u s g h u f i o r c e a l p e r a i n a h r o p e t i c o m e a t l h e o p t i e o x n p a e l r s i e u n d a e n p a l s y g o r t i o t h o n s s a w r u i c a t t h e d l o a s v e n q u e t b e d a i s l c y h e d d h r e e . q u e i x r p e d r i l e n b o o r , l e l n a b o d p a r t o i g v h e a n g c t h o e r a a c h t a e r t t o a i t h o e l a s s u r s o i n n e d i r e c a t r i r o t n o w l d c i a n r g d l 5 l g 4 u r l e p h a 2 s , e c h i l u d s r e d d e s p i g o e t s o s o n s a i p d e e r r c e p i r v o d a l t e n h a c h l o m a n d y t h e c o m m u , a i n t l y i a p d o t f b a y p c e o m m u r r o i b t y s d l t v h p e r o b u l s e i o n r g a f a t n i d n r e c y n c a l t e e d (F a g 4 b T . b e h a 3 s f e o c a x p e r e i n e c n o c u r a d u e l s a s r h i t l o d u r i e n d a n i n t e r r a o c b o i t v g c l p d a m g h i c e i g d y v i u d p a n l u i l d a i m i g a u r o s t f s h e c i , c y m b i t n h i o a s g e m p o n a e n d l e s t e r r h o w h r e e g b (o i t k e b v o i) i l r l t e v r i a t t h t e c i . C h i l d o r e h a b o r a g t e h a e o b t o o t a v i a g r a i t n e t e v r i a t t h t e i i t g o l t v h e e p r o b (l f e i n g 4 u) F e n p l h l a y s e m p h a s o o e s r e o t h u i r g h l i t g n s e i t n i n b a r i t b e t w o e c d a n g h p e r a c o t w i c a e v (i e n g g a . t , t a e d r m o s p i s g 4 u) e

4.3 Analysis

We u s e t h r e e t h o d s a l i c t a n t t a e n a t l s y s e s i , a d a l e a p t e r d o a c o m t e a n a l y s i s a p p r o v h e s a t e e k t i o n a g l i d r a x t e h e o c a r 1 1 9 9 A s t h e p r i n c i p a s t h a g a p c e a r u s d a l n e Q , u i w e r i e n t i m i a n t v e o l l y n t h d e s a g u d d e v e l o p m o e a e l s o s n g t s e i a c h e r p a s r e p n r t e s s , e a n t e i t n g o d o d h a g l i k e a n l o e a v o i d i d m f r m b a i t a i s o u s a , r P e a r r , k a e s l a d o v o b a k e a d d e r a m g l a y n s d i i n t e r p t r b e t r a p t i t o t g h a i t s a l I E e a n a g u e t . a b l s o o u i g n h p t o e k a p e t r d i n s e r m t h a e n a l y a m s i l n y h i d l e d v e l o a p m t e a n a t r o u i t h g u r e a l e f o a E a , n d o m p u t e r s c i d w e e s E d e o a l (2 0 1 4) h e c k e d c e s o b u a r i a e y t r i u s a w o r t h i n e s s

4.3 | Conceptual analysis

C o n c e p t a l a y s i s q u a l i c t o a n t t a e n t l a y s p i r s o a c l e n t t i f i e d i e a g e s i e a n t t e x e f i t e x p r l o d i m p l l y (C a t r 1 1 9 9) W e w e r i e n t e r i e s t e e n d t i h p e r i e s g f n c e s p e c c i o f n c c e p t a t o e u d r h e o o r C E a s n C R C i r t h e u r r i m a u t l e a b r e a a t s h s e e c u r r i c a u f l a u c m i t l i n e a d t i e t a o t a i m t o r o n f s a r t i c t i h p a t e a p t p e o r t t u o n i t l e a (i g r e 2 e 0 , 1) a r p l e a r r P e a r r , k a e s l a d o v o b e g t a h e o d p m g d e y s e a a t n i d n g a p p l y e i n g r c i o p d t (e e s v s e h . d , r o t p b a a S s a e l s d 2 0 1 1) a t 3 p h a l s i e d e d o 9 s e . 5 4 . W e b e g l a y o r e a a t p i r n i g o r d i f e o t r h s e e v p e a n w e r d e o a C s t (B e 2 0 1) , 9 s i e n x g t a n t l i t e t a r t r u c t o e d e f n i a t n i c b o n d s e p l i g u a i t d e a h n i c h e e l s i n e d e x p e r i t i e c o m p s t e a m d e i e a r c h y l d h o d e d i m i p f l o y c c i u t r o d h o c c o s n c e p v e n t h u e n d e e x r p l o i r m a i c h y l d v h e d e d i t d e r d e c a o t d e f e d S R Q n d u c , t e v p h y g o o u e x p e r i e a s o d h y l d a m c l o u d t u r e a s p b o n d s u i o v a l t r i b h v e o r r e a g a l u t h o r c r e a h v e l d o d t e e f n i a t n i d p p s i g u a i t d i e d i d i r e n s e s r c i o p d t t e h s a n d i t l a t e o p d i c s

Phase 1: Algorithms

Program the Teacher

Children put the large coding cards in order to program the teacher to move from Point A to Point B on the carpet.



Phase 2: Design Process

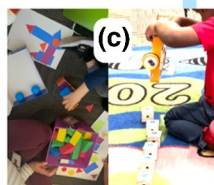
Community Robot

Child's plan (i.e., drawing) and prototype for a community robot built from loose parts.



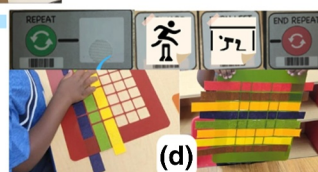
Interactive Robot City

Child uses blocks to build their part of the city according to their design; Child programs Kibo to navigate their part of the city. **Pha**



Weaving & Coding

Child learns about loops (i.e., over, under, repeat) using Kibo blocks to program weaving.



Phase 4: Control Structures

FIGURE 1 | Illustration of the experimental design.

and on c p p e s i n t h e o c u m a s e v e r s e v i e w e d A a c o m b i n a f i t n i d u n a t i d v e
d e d u c b d i v e e n e w a t t e t i n g e a s e x p a n d e f e n x e i s t t h i e n o g r l a e s d e 9 8

Ac r o s s r a a t u i o d e s d w e d g i , s c u i s e e n e e r g o d g i n g e m e e a , c h o e n d e n s u
a b o u t d e e f n i a n d o s l a p o d e e p a r a n d h i c l o d d e i s . s a u , b , c o s i a h g
d a 2 a 0 , 1 B e c a C t e o n c a p i e n s t e r d e i s a t u e s t e f f o s u o n e d s t i n g u i s
c o n c e p t i s e i s u i l a t e d d i g i d e f l o a r o e p l i (c a p p e n A d i o e r x a m p l e s
W e a l s e f n t e u n o i n a l t y d i s h e s c t l e o f o t l r h F e r d n a t t a e t h p e a r a g l e a p e h
(i n d i b c a s t p e a d e t h) F e o c E a x l p e r T e g n e c t h e a p p l i t h e e d d e b t o h k a t e
r e a c h i n g s e t n e s s u o e s i s t e m e p l i c a t i o n .

Nexatc, rō sē rā dū i n dō sō d i h n a g r, p a n d a r s v e r n k s e e d p a r t a c t p e p t l y e
d e s c r i p t i o n o f h e a 2 s a n p l a r a k s i a d o w i r k s e e p a r t a c t p e p t l y e s c r i p t
c o d t e s h a 4 s e a c a l u t a n d d e r v i c s c l a s s e c e s i a h e w e t h a t t o p i c o n c e p t
w a s o r t e p r e i s t h e x e i d s c t o i d n e g a n d t h o c u m e t h r e a t d i b a i r l e a c h o e n d e n s u
o n t h o e d o r e g a r l e s p e c h t a i s v e d h l e g e g r o n e p t f u r t l e t h e o d e b o o k
F i n a l l y a e r l a r a p p l t i n f e r a b d e t (A p p e a n) d p h a 3 s e r s e p a r a n t d e t y
t h e h a d d r e d s i s i m e n t h r e c u o g n h s e n s u s .

4.3 | Relatıonlaylıs

Relatainoinlaydualictioantieretaypsirsoadentrieflyainigocentwitehens
concpesiante(Car1997)ostadrets,crdpdveibeinkdisepecic
themofstheeo(riitasee,vpeonwirdofst;thfeveenoeCRCT)hgoathis
stavgasoidenctoinfyenacredlige nacerpasstierhosesdeads eatndoncept s
ortenientsexistthienogrdihesdmigdotnferxnp,aonpdr,opansewheoCY
thrCuRgChearclhyld(Lay,de98)ald201aB,ORQlw,erevievewedbryptcs
descricpofkpearaemthilledanlvi ewedaisp(lea.veg.c.curoeT)ce



concepts. The concept of design thinking is a process that involves a series of steps: understanding the problem, defining the problem, ideating solutions, prototyping, and testing. The process is iterative and non-linear, allowing for flexibility and adaptation. The process is also collaborative, involving multiple stakeholders in the design process. The process is also user-centered, focusing on the needs and desires of the end user. The process is also interdisciplinary, drawing on knowledge from various fields to create innovative solutions. The process is also iterative, allowing for refinement and improvement over time. The process is also non-linear, allowing for flexibility and adaptation. The process is also collaborative, involving multiple stakeholders in the design process. The process is also user-centered, focusing on the needs and desires of the end user. The process is also interdisciplinary, drawing on knowledge from various fields to create innovative solutions. The process is also iterative, allowing for refinement and improvement over time.

Next, we will discuss the findings of the study. The findings are organized into five main sections: (1) Power of Design Thinking, (2) Design Thinking in the Classroom, (3) Design Thinking in the Workplace, (4) Design Thinking in the Community, and (5) Design Thinking in the Future. The findings are based on a review of the literature, interviews with experts, and a case study of a design thinking program in a school. The findings show that design thinking is a powerful tool for solving complex problems, fostering creativity, and promoting collaboration. Design thinking is also a valuable skill for students, as it helps them develop critical thinking, problem-solving, and communication skills. Design thinking is also a valuable skill for professionals, as it helps them develop innovative solutions and improve their work. Design thinking is also a valuable skill for the community, as it helps them address social issues and improve their quality of life. Design thinking is also a valuable skill for the future, as it helps us prepare for the challenges of the 21st century.

5 | FINDINGS

The findings of the study are organized into five main sections: (1) Power of Design Thinking, (2) Design Thinking in the Classroom, (3) Design Thinking in the Workplace, (4) Design Thinking in the Community, and (5) Design Thinking in the Future. The findings are based on a review of the literature, interviews with experts, and a case study of a design thinking program in a school. The findings show that design thinking is a powerful tool for solving complex problems, fostering creativity, and promoting collaboration. Design thinking is also a valuable skill for students, as it helps them develop critical thinking, problem-solving, and communication skills. Design thinking is also a valuable skill for professionals, as it helps them develop innovative solutions and improve their work. Design thinking is also a valuable skill for the community, as it helps them address social issues and improve their quality of life. Design thinking is also a valuable skill for the future, as it helps us prepare for the challenges of the 21st century.

5.1 | Power of Design Thinking

A powerful tool for solving complex problems, fostering creativity, and promoting collaboration. Design thinking is also a valuable skill for students, as it helps them develop critical thinking, problem-solving, and communication skills. Design thinking is also a valuable skill for professionals, as it helps them develop innovative solutions and improve their work. Design thinking is also a valuable skill for the community, as it helps them address social issues and improve their quality of life. Design thinking is also a valuable skill for the future, as it helps us prepare for the challenges of the 21st century.

5.1.1 | Contextual Issues

Table 1 describes the contextual issues that influence the design thinking process. The issues are organized into five main categories: (1) Power of Design Thinking, (2) Design Thinking in the Classroom, (3) Design Thinking in the Workplace, (4) Design Thinking in the Community, and (5) Design Thinking in the Future. The issues are based on a review of the literature, interviews with experts, and a case study of a design thinking program in a school. The issues show that design thinking is a powerful tool for solving complex problems, fostering creativity, and promoting collaboration. Design thinking is also a valuable skill for students, as it helps them develop critical thinking, problem-solving, and communication skills. Design thinking is also a valuable skill for professionals, as it helps them develop innovative solutions and improve their work. Design thinking is also a valuable skill for the community, as it helps them address social issues and improve their quality of life. Design thinking is also a valuable skill for the future, as it helps us prepare for the challenges of the 21st century.

Original Tenet	Primary Findings from Content Analysis	Corresponding Codes
1	All children are capable of creative expression through the use of non-digital technology and CT skills	Unplugged Student-Directed Design Process Project Ownership
2	The learning contexts supports the transformational use of digital and non-digital technologies and CT concepts	Play-based Collaboration Purpose Plugged Unplugged Student-Directed Project Ownership Design Process
3 & 4	Leveraging children's funds of knowledge while supporting their developing sense of self and others allows for meaningful connections to computer science	Funds of Knowledge Collaboration Design Process Computer Science Coding Hardware/Software
5	Unchanged	Funds of Knowledge Project Ownership Purpose Problem-Solving Design Process Hardware/Software

FIGURE 5 Map of Design Thinking context issues

a l g o r i t h m s i i , n v b r y a k e i s m i m p r a p l i d e s p i r o c a e s t e p s r s o i b n l g e n s
 t h a r t (s l e b u g a n i d n g e g c r a n t d i n t g e o i g a r t a s i t h s e , h) n a t s o e q u e o c c e t r o
 s t r u c t u r i j e u s o n t i e l l u s e t x r a a m p i u v e f i n s d w a s o n s i a s t r o p h a s e d ,
 t o a r y d i e m g r a e l e s w e r d e a s .

5 . 1 | B m p h a s i n s p l u a g g t e i d v i t i e s

We categorize the data into two groups: **plugged** and **unplugged**. The **plugged** group includes all data points where the system was connected to the network during the test. The **unplugged** group includes all data points where the system was disconnected from the network during the test. The results show that the system's performance is significantly better when it is plugged into the network compared to when it is unplugged. This is likely due to the fact that the system can access the network resources when it is plugged in, which allows it to perform more complex tasks. When the system is unplugged, it is limited to its local resources, which results in lower performance. The data also shows that the system's performance is more consistent when it is plugged in, as there is less variability in the results. This suggests that the system is more reliable when it is connected to the network. Overall, the results indicate that the system is designed to work best when it is plugged into the network, and that its performance is significantly degraded when it is unplugged.

[illegible]

5.2 Tenenot CSR C

We found live *CRP* re-sheerwater, and isuggs and the dc ions said and t
 nece sadyt a piroancst CR C in g ET. he e s c r i p t e f o n d s i a n g e s a g i z e d
 basend urritue has resp CR C ien de f i s 4 u r e

5.2 | Unplugged relevant information

Ther sw bene e speantaiwnet laya ls It u daerctasp aobfl ieg i na d v i a n t i o n
 lea r n o i m t h e a t t p b h t e r s a n s f o u n c e f t e o h a w d f o c u g u a n d n i f y t i e n g e
 a c r t h e s e e n t e x t e n t d t i e n g b e e t y s d t h o b i i g f i r m a n w i a n g e c e s t s a c y o m a p a s
 b r o a d a n o g f e o m p u e t x i p n e g r i E C E s e p s e c i f t C a R I P y o g p r a o m o t e d v a t i
 a n t r a n s f o u n c e f t i i g n t a d l g a t h a l p l u t g o g e l s k i W e l f s o u e n d i d e n c e
 o b p p o r t f u o t r e a i r e e s d r v s a f n r c d e n a s f i o u n d a k t n i o o w n l a e t s k e a t q u i t s o i t i c
 m a s t i e n n y o v a n t d r o e n a (t e i n o n) T o t h e i r s d h u e s e p l u g i g a e d u n p l u t g o g e l s
 f o c r a t e i w e s s e m o r a g a n o v e r a t t e l e i n n e g o b e v i f r g a t u c e o n d t d y r r n
 c o d e a m e u l n y p l u s g t e d l e e n c t t e e d a t i e n a g s h e e i r m p v a n p l o j e o w n t e r
 s h i F p e r x a m p l e p e p a f a t t h e b a 2 s f e o e a x l p e r (i b e u n i c e d o i m g u n o b y t)
 c h i l f d r r s e u n i a p d o t a n y l p r e a d f e e v e a n y s o s t e l m e a t e r [i S a t l u d l e i n e t c t e d
 U n p l u g g e d l m e a g N r e x l t h e s h a w d e s c r i p t i o n t o t t y n e l t s b e l a s
 " i m a g e v i d e e t s t e l r u o i w a n y s t d o i n t h i n [d j n ' p l u P g r g o e D e v o n t e r S h a p e
 I m a g l i m p e r o v e] .

Regardhse g d e dweef q uenvdi d e f e e w a y t f o s a t l e a r n o i m t g e x a t t
e n c o u s a g e s o f m a k e c h n o d l o w g i a t h e v a n t t h e m o d o (f n e t , S c o t
e a 12.0, 1 p 4 2 E) x . p a n t h i t i n e g t e m p h a e s x i p z l e i e a r d o i m t e x p t p s o t r t h e i g

[illegible]

5.2 | **I n t e r s e a r c h i d o e m a t i p p y r l a t o c o n g l i a b a n r d a t n i d o n o f k n o w l e d g e**

Ten et hshraeneflo,ur es p e s c t i a v t e l e y a r a b i n g n t e s ' e s l f o v n a g r i i n t u s e r s e c i t o c l u i a t u s r f a u t e c h i n i c a v a n t d i n d a c h n s h l o b g y d e h b o v l h e i c h s t u d r e f i e a n t l e m o n s u n d a t r e s o f a t h d i n n t g e r s i e d e n i t f i e a d i e t s d a t e s o t e n d e i n d m t a p e a d n l t y b C e R R u r r i b u t e u a n a p f t e r d E S p e c i f i c a o l t l e y d t w o i g n i f f n o d a i n n t g e s l a t t o i h c e n e n f e i s s t i t h d a d e p o r t t u d n e i a t r i n e a n t d f o r m o n a e n o t a h r e s r e c o d n i d v e e r p u s s e n t i a o t o i m p r e t e d e r e v e i c a n g e e n d f u s n d s o k n o w l e d g e f u e n o d f s n o w l a e r d e n e h i s t a r i c a n a l l y a t u e d u e a e l l y p e b o d o k n o w l a e r d s k e i e l s l s s e f d h r i o a u l s e o h r i o n d i v f i u d n u c a t l a o w d e b e i n g (M o e l a l l 1.9,9p21 3 B) y b r i d t g h f e a g n i t l o i h a e r w u n o d f s n o w l i e n d u g r e r i a c n u d l u m i n s t r u a c t u i p p o r t h r i t l d e a n T o s i g n e g t t h e e f s n e d i e n x g t s e h d i t h e a f s y r o u n g c h i l t d o r l e e a b r o u n t e a d b v f a g r i i n t u s e r s e c i t o c l u i n t e (S S a b a t 12.0,1p5. 1 2 a) n ' t l... d e m o n u s n t d r e a r t s e o f a t h d i n n t g e r s i e d e n i t f i e a d i e t s d a t e s (12.0,1p51 5) .

This text is the reverse of the document's title page, which reads: "CompuScience [a Clo] Laboratory".

For Phn alseed uc a tenrcso ut r e e d g insetzree h g a u h l s t d u i v a e l r s i i t t o y s
t h d e i g w o a t l h r o c u o g l h l a b l o e r a a r t i n i v t h e s e f m a t e t h a d p r e b s e n d i
i d e n b i f s t t i u e s e n t h e c i l r a s s S p e n s i f e d a u l c l a y t r e n s o u t a g h e d u t e
c e l e b a t t h e e t h a d i t i c o m i s l d a h e e p e r i i e t h o e i d m a s c o m m u n i t i u e
[C u l a t A s s e c u s t P u r r a c l t H i c g e h s l] i c g u h l t t a u n d e s m u n a i s t o i s e i c t o i n v t r i b
u t o t r o s o m p s t e e r o m e t i t m u r e s i t h c a u r t r i a c u e l l v u m l i n e t s o c h a p d r e x -
p e r i e F r o e x a m p l h a 4 F e o c E a x l p e r h i e g l e t i h g e l i g s i b o v a r a c v e i n a g t i n
A m e r i c u a l t a u n d e o s w h i s t o w r e i a c v a e l m s p m o e f t h f e r s o m p u t r e o g r a m m e r
[C u l a t A s s e c u s t P u r r a c l C o m p s t c e i r e v h i c a l] f e o c b i m a g r e p o r t o n t
p r o d u h c e w p a t t w e a e d n a f n t t s c o n h e p s a e t a e n r c h o s n d i t t o i n t s i n g
l o o a p n s i d / t h r e m a f n d K r i b b C u l a t A s s e c b n i S r t o r l u c H t a u r r d e w s a r e / S o f

5.2 | Barometereersch n o s l o g i e s a s l

The first set of the above mentioned technologies should be a test for, who and what is the new end user actually trying to be a part of.



ana l p y r s c æ v e i d i e d e s t e a h i g g m m i e t h v e a l o u t e u e s t b i a n o m o g f t e r s e s s
 W e f o u n d t h a t o v i " c a l i e n a g r o i d m t j e w h t i f b h i l a d p r p e r n o] p h t e a c t h e a n d a l
 r e s e s a k i d l l o l i s s m a t h s e y l e t e (n a . n " 5 \$ c o e t a t l 2 . 0 , 1 p 5 4 2 & a b n e d o n i e o t h
 a g æ p p r o p a n d i a l t e u r e a l e v w a y s t p e c i , f w e a d e y b p p e d t t u o n d e p e s f
 d i s c a u n s s o , l p w e l e n r e s a n i n g d f u d i g i e l n s , u a l i s s t u r e s x p e r a i t e n h c e o
 i n t h o e l a s s a r m o i n t h , e b m m u n i t i e s .

F r e q u e n c y c o d r e s l a t a p p r o p t r e i a t k i n g w l a n d s k e i i l o c m -
 p u t s e c r i e i n n c e l b d e v d f s o e f a t m d a r r i d o i u n s e n s i t o h n e s s p g o e s e
 o c c u r c r o i d n e s l a t o e n d p o w e h r i i s n t g o m a g r i a n l a l y h i z i e l d i m e h p d b d e m
 s o l v p i u n r g p , p o s j e e o v n e r , s m t l p n o d f s n o w l . E d e g x a m p l t t h e h a 3 F e o c a l
 E x p e r i c a m c a d r a e s k t e d e f o e a t n d a k c e o n n e b e t w e e s o n h n u o s l a n g l y a l
 w o r p l r d o b s l o e m v E i d n u g c . a g t u o i o d h e i l i d r d e i n s c t u l s e i t a i n g e s m m u n c i h t i l e d s r e
 l i v a n t h p e r o b t e r b f d s u s l o d l y l e u r p o r s o d s e m v f u n g d k n o w l e d g e
 R o b o s t i s m] i . , e a l u t y a s q u r e s s t i u a r s H o w a n e u s r e o b o t t o [a s k] e i b f e e t f t o e r r
 t h p e o p w h e l i v e o u c i t y P u r p F u s n e d , k n o w l e l d m a e g , R o b o p t r s o , j e
 O w n e r S t h i i p l i e r e v i n d p t r o b e s n w s t i p c h o b w a m s a n l v a i n d g w e o l v e
 t h e m .

6 | DISCUSSION

T h i s s u d d y e s e s v e o a t r i t b o u t h e a o r p y s a c i t a i a c r e h y l d h o m p d e t d i u n c g a t i o
 N o t a v e c y o n t r e i x a u m t p e l h e s o p h u g i g a e r d u n p l u a g g t e i d v a s t u i p e p t h r e t
 p o w e i r d e o a t s T , w h i s l i e m u l t a l n e e v o e u r s a l e g y i f e n t g o n R C B . e l , o v e o u t k e r y e
 p r a c a t r i t t h a e l o r i e n t p i l c i a d a n f l u o d i s r e e c t i o n s .

6.1 Power i f l e o a t s T u n p l u g g e d

T h e d e v e I C R p e r d o g e r m a g a c h e i d l w i r p e n w e i r d e a t s b y i n t e g n u a l t t i n p l
 p o w e r i f l e a c o s n c u r n e d n o t n l s y i s l t g e e n l t y l i y o u n g p h l u a g g t e i d v R Q I t h s i s
 f n d i c o n g f r h i e n t e r r a t i o a t e (d w n 2 0 0 6 v e r n e c n u r r i d e s i s a n g b t
 d i s t i k e g y u i n s c h e p i t s r o e u n r t r p t u a k a s a p . r a c i t m p c l a i l o a s f t i n g e o w e r f u
 i d e f a r s a m e a v s o c r u k r r b o i u n s a t r u g u t i d o p p a o l s e s e f i s u a p p o a r t a i n g t e
 C T s k i a l s l o w p r e v r i e s e s (a e r R g . l , k a n 2 . 0 , 2 E v e r n e w n e s o u g b n b r e
 n a r r o w c o y n a p o w e i r d i e a p h a w e i , n a d v e a r t t e e n t o l l a y d n c l o p l e d
 p o r t u f n o e r n g a g w n t h i l t p i o p w l e e i r d e s i s n u l t a r n e e g o a u r s d l l y a e s u g i g n e d
 o u n p l u n g g e a d W e f t y u e n d i d e f i s i e g n i a f t c t a e n t o i l b o u r t t w p o w e i r d e a s
 (d e b u a g g d e n g r e s e t h r a t u i g t h o u) u r t r i t b e a n o l a t t e t h d e b o g v a i s n o
 e s p e c s i u a r l p l r d i e s b i u n g g . l i a a g s r i t r o d a h r e e s e a n e a l c h l y i l d h o m p d u t e r
 s c i e n t e a c h o n 2 0 0 v i e n d 2 . 0 , 2 H o a s s e a n f e e 2 . 0 , 2 K o i e a 1 2 . 0 , 1 A s a
 r e s w e d t o , n d e t r o e h d a e x t e l g t u i d p i o n w e i r d e f a r s a m e w a y n a v i e n f u e n c e
 c h i l d e a r n h p i n g r t b u e n i o t h e x p l o i n c o i t t i c i e m a p l b i y c e i s t e f i d e i a t s h e
 w r i t b e n u m e n t s e s e a o r u l l o d a k h o w h i l e d n r g e a g e t h e c s o e n c e p t i s n g
 i m p l e m e n t a t i o n .

T h i s s u a d l y s o n f r m e s d u c a t i o b a n p e a r t i s u l f a c p d y m a c t i d o g o
 t h c e o n c p e a y a n d a p o r p p o r t t u h n a i t f i (d f s r i e y e s o n a r B i e n A r 2 0 1 8
 S u l l i & B e a r s o , 1 T o h e a 1 2 . 0 , 1 X i a Z h o 2 0 1) M u c h f t h s i s p p o r r e t s i a g r c h
 h o w e , v e c w e e d s u c a p i o g b a n a s b u s p e o p i r f o g r a m a n n g u a n g l e s l s .
 O u s t u s d h y o w l s a h e t n e a c h e p r a s r e n l t a s p e d o m i r n o e l n e t d e v e l o p m e n t
 r e s u d u t r i n g a c l u l l a f w o e r d l t r i o p l b e r a m p e d b y M a t u a e k d i b t a k . i t n e g a c h e r s



an plar eprntsef'e i r e a c e s i u s m t p o b e a r t u e s s e a h a v i e u n d i x e e s u n t s
t e r o n f a r e a n t t s e ' a c b e r s e p f u i s o i m g b a n t e c h n w i l y o y o b i l d r e
(G o v e i n 12.0, 20 K o n e g a 12.0, 19 M e r t a 2011 a t h e 12.0, 1 B a r e n i t e s u c a t i o n r
r o b b a s o , b a u t a y k a n f d i e n s c i e n t i n g e m i t h e c h i l d r e a n 12.0, 1 B i k e w i s e
t e a c h a e n s k e p t f i e a l n d o n g y o t h i l a n d e n c , i a l i o t u e s c h n o s l a o r g e y
s h a p e y d n u m b e f c o n t e k a t u t e r . s g , u c a p o d n i a p l e s e n a p e r i e n c
M e r t 2011 a 9 .

Re la, tgeidvle n d s eotutt d e v eal r o p o t p i r o s g t a d o, m i n a f i o p l u g e
a c t i v i s d t i e v. o n t r a s a e u m b e t r o n c s u a s i, n t e g t h e r o n g v i a t h e
m a n d a t t i e s d u i r r t i d a b l e x p e r w i e t e d e c a t o b o a r d o s s e t n s c, o u r a g e
t e a c h r e p r a s t e r f a s v u o n r p l u a g g t e i d v e t f i n e l s i n h o s w t e h d a r t p l u a g g t e i d v i t i
h o p o t e f i d a r d a l r e a s k s i f h p g o w e i r d e a d C S t a n a l s e s e s a u r g g h e s y e n p r e
e f f t a i s u e p p o c h t i i n d t e n d v t d e l i n m u ñ e a 12.0.2 0 p r a c e d u c e a t o r
c a d e v e c h o i p l C T e n t a n y o b o o r i t h a o n u t e c h n a d a d a g l y o n g t s h i e d e p e r
c u r r i g u i d a n c e .

[illegible]

6.2 CRCi DE CE

CT le arwai n g a n e s O R C i s e v e r a y (s R Q 2) l h i g h l i i g h m t o i v a g t i r v a e n s o -
f o r m a t i s e f f a c h n t o H o o p u l g u h g i a e n d n p l u a g c t e i d (2 l t e i a e s a n p i o a u g t d
f r o m a e n o w t h e i l l e e v e r d a i g v i e n s o e f s n o w l a d (3 e) p l e n t d f y c n a s d i n g
s o l p i r o g h e a s i n g o f w o l l i l o u r f e n d . i i n g d s i t c h a e t t e n h i n m o o r d i f c a t
t h t e e n p e r t o s p b y s e c d e t a t l (2 . 0) 1 . 5 a s n e r a v e p r a c s t i a p t o i i f m o t r e a l O R C i n g
E C E I . m a n w a y o s u a r n a l d y e s n e o s n b o w a n t e d i C R C d e n a e s a t a n a e c e d e
f o t h e R C t e n g l e s a f n e o r e s e v a i r t o l l d s e t r u d p a t s j , c f o t r a d e l s y a g d
d e v e l o o p O R C t u r r i c u l u m .

As pre v id i u s s c l u s s e d , h a s i n s p l u a g c t e i d i n t h e P e r s u r r i s c u l g n e s t :
c h i l d a d o l e s c e n t e c o m p e t e n c e s a t t e s t i u t h e s o u p t h i s d i t t i g t a t t e d i c h . T h o s y
d e v e l o p m e n t a t P R Q i t h e a r c h y l d h l a c c s s r h o i b f f i e s c f u r s d n h i e n n o
v a t a i n t e r a n s f o u r n (e f n i e l a n s d l) s p e q i r f o g r a m n n i g u a g v e n s a d t e r y
i n n o v a n t i o n s f o u n s e f r e n a t o i n s i s t e i e k m o e v l a n d s l e i (l i l s e
C T) A c c o r d i n g n l o y i C P R C e a s e a m l i e n s t s e l g y r i a t t h e d w e i r d e a C s T t o
e n s u e r e r y i e l x p e r i c o m p e s t d i n g a a t s s o m u l t a n e l o t u r e a s p l o y n s i v
d e v e l o p m e n t a t i n d a t h e r e h f e u n s t i c h u e r n a l p y s o i s e d e d e h a e
c o m b i a m e d r o a c h l t r u e r f a e l r u e n i d r o s t l e r n a a c n u l l e a r r i a t p a g r e o a E g e s h
e t a l 2 0 1 3 s o s s w b t l e u n b i l f o e x a m p h a s e o a k v e r n a a n d a r



transfapapabvaskölmgltdreefraper obtlhantlcwuslodlsviem, t h a w
adolegichansides echntsd eigdyenstoicfiayadlommunisayrepsresont
lut (6 nea12.0,15 contPraasues ed hnoccomport riveratvfi mdgra t i n
Ameritcrand it toiodnKsri dsoi, mit thaon i gtr h s o u d h e a v i e s e l d d i g e n o u
knowlælg eis magnienvee colcompendei tnghoE l g s leas12.0,20

Th ER Rp r o g r a m s i p t r e s t e t h y e v e r i d e o h s T i w a y t s h a e v e r a g e
chil d r a e n i f u s e d i s n o w l A d a g e o n o r e o p r f e a m i t l e a r c h y i l d e h d o u c d a t o r
f u n o d k s n o w l e o d u l e d p i t l g e a n p y r a c E t m i p c h e a s h i o z n i e m g l o m m u h a s y d
f u n o d k s n o w l i e d t e x p a n d o s i n t e h e o e s y c b y s c e a t l (2.0,15 e i t s v i d e n c e
b y o t h s e t u d C B S v i o h p e a r r t i c e p l a n h, B e r y n e a t 12.0,21 a c h, B e g y a s t
e a 12.0,21 a c h e a 12.0,23 S p e c i, f y o a n l g y l d e a n r o t u t h e m s (e a l n e s s
t h e y p l v a r r e i d o i u n s e n s C o t h s a t r e e l e t v d a m o w r i v G e i s v e l m a n p l u g g e
c o d a o g i v e t d e a w c h i l d a e l i y a s e h i l d o e (k l s e d u n 20,19 h e
p r e v a d f e u o d l s n o w l e l g e u t g h e R u r o g n m a k s e n t l e i s t u d r y i n g s
a t t e n d l i n e e n d e n s t u l t h e e x p e r f e d a e i l s i g r e d h c e h i l d o e k s e c t e
f o C r T a c t i a i o e i l e t s u r e d e a v y a c h e t s p o t n e l i a l e k t i a m x l n d i g e l m b u d r e
T h i s s p e c i m a p o l o g y i a t e h a n i y n t r o p u r o t g o r a y n o a l i g n h e r b e i r a t s l e y d
a g a n e o m i c a r l t a u n e d a h w a i y o s b e i a n g d n o w (i n g e t a t 12.0,21

Tw o w a y t s f u r t b e n t t e h e a s c a s a y u s i q a e p y o p o e r i a a r d l e y i l d h o o
i n c l (u l a) e m p h a s i o s l l a b v o i r p l e e t o o s u p s o o r c t s k a l a l n a s w a r e f n o e r s
r e f e o t a i n d g d e r s t a t h e d i r s i e g d e t n i (o a n t a i l) a s (d 2 s) u p p o y r o t u i n t g i l d r e
a s t e c h n o l s a r a g e h (t A s s h e r a l 2.0,17 y e m p h a s t i r z a i n n s g f o u s o f i o n
t e c h n (e l m o g) y n d o n s i d e i v a t o i r c e a s t o e r s q r a p t w h a e n (d e n 5) F o r
e x a m p l e c h r i l d a r u e s n e e c h n b d e a g n s i o e j i a s t i s s a e t s o r r i t t i h q u e
l i m i t a f e x o s t s e i o n g n b d a d y a j n u c e (e c A g s. h, c e a f 20,17 h e y a l s o
b e c o t n e e c h n l o e l a d e y i d s n o v i a n t n o i r t s w a t h v y e s u (t e h S g h. e r e i d 12.0,13
o c r e v a t r e i a d u s o r a i n t t h r m a n s t h l a i s h e b y s d i e c s a i t g h a s t m v a e r g i n c a o l m i - z e d
m u n i t e e g g. l, a s h l 2.0,20 u f n d i s h g o s w h a d u o l g i l d a r a e l n s e C e T a n d
t e c h n a s t o f y o e r x p r e a s t i o n l s v e e l d e n p i r b o d b e u n t s e l y s o t h r o u g h
i m a g o p e d a s c e o d n t l e a e r t x s a. m p P l e a 2 s c e h i l b d u r i a n d t p o r t o t d e y p a e
p r o b t l h e a n t e g l e n a t n i d f P y h; a 4 s t e h e y n n a e l o g t o r t i o t h m t u e r a a v t i m a g d t o i o n
c r e t a h t e e w p h y s d i e c s a i t g h n e s s e e n a r i m o a s g (i n e d l a y n e o a t c t u s a o l l t y h r e g
p r o b w l e t a l n o b a r t s i m p l (i i f. t e d a v, i e a v a h g o r a i r t o r n e s a t s e i u n g p l u g g e
p r o g r a m t h o a b g u s t) h e x p e r i n e o m c e e t s h p e l s e i s t b i j o l n a s d e g e t a a t n o d r
i n n o v c a a t p o a r b e l e e f n t i h u e s e s t e c h n. t h e p g l a a s a e n d i m a g o p p d r t u n i
f w e w l t h w e a y i s v h i c h i l l d e a r a n t u a r a s d e l t h y e o u n d f a c e m e n g d e g t i t i
a s t e c h n o c h a o a i g a e l n t s.

6.3 Futurietions

Theurisd midlyl umsi enaet eas etaorptihvud ud oln t r t i a l n u t r e h o r o o g h
d e r s t a h d w a g p b d a l a k t, a n l n d i g p e m e s u c s h C o T a n s e r n e s b e e l o n g n
i o m p s c e o m h i c e l e f r n d i r n e g f s e o w h i l n d i r g e h n t g a g e t h r c u R g h a s e d
o r c u r r o p p b a t w a e a t h s p e d a i k r e t o t h l y l d c e a x a p e r n e o n u t e c s o A m e s
l o g i n e a t e p e s t u i d h y p l e m e i n t a a r t i d u a s s r e o t o t i p n e g c s i, n o a w t o l r y k s
n e e d e a n d e r l s d v i d b k t i a m x l n d i g e h o l e x p e n r p l e u n g i g n e e l r s u
u n p l u a g c t e i d d e s i g e e d u l t u e a s p b o n s p o e i e a c l a d u y s l e t r u e r l a e l a a n d c e
f u n o d l s n o w l a e l l e i e n k e o m p u b t y a d g (l e d s e v e l i o r p l e s i s u a d n y d d u i l r t s
o t h s e t r u d s i u e a s t, a c h, B e g y a s a h l 2.0,21 E x t e n d h i e n g o k b t H e C r i S T E M d -
u c a t r i e o s n e a f e l P g a r r s s 2, 3, 9 t u d a i r n e s e d e d a k e t h r a d i a t p i p o r n o a l o h e s



the key mechanisms that underpin the effectiveness of the CECP practice.

ACKNOWLEDGMENTS

Th w s r w k s u p p o r t f o r d u c t i o n f o r n e a t i n s o n a f f o c u e n d a s f i o a n t p r o g r a m
(w a # 2 0 3 1 8 9 4) i n f o d s a n c o n c l o s e r o n m e n e d x p r i e o s t h s e i d s
m a t e a r r i t h b o s t e h a u t h a n d s o n t e c e s s a f r i l o v j e o n s f

DATA AVAILABILITY STATEMENT

Data availability statement

ETHICS STATEMENT

Approved by the Board of Directors on 12/18/2018. The Board of Directors has approved the
02/18/2019. The Board of Directors has approved the
Dec 18, 2018. The Board of Directors has approved the

ORCID

Frankle, A. <https://orcid.org/0000-0003-3718-7676>

Magræo ui <https://orcid.org/0009-0001-9783-8330>

Lo C à u ID het <https://orcid.org/0000-0002-3735-5994>

REFERENCES

2 0 19t aotCemp tSteierEnduec aB q uant i ver.(2 0 19) d e a d v o c a c y i b m p n t e n c
t e a c h s e r o s c è a p a o c d o j m p u e t d i u n g a p a i t h n a y s i e n t r e i f e r v e n t p s : / . / c a o d d v e o . c o a r c g /

As h c C a E g e r K . & S c o t t , A . (2 0 1 7) c o m t i e n g h n o c h o a c r i g e l n t s e r s e a n d w h a t i a r y
r e s p o n s e d i a g a s y i e r s b o f o r r e s e g a i r p l a s t ' i c i i m p a c t p i w A n n i t o b o l & E d u c a t i o n
Q u a r t e r 3 2 8 3 - 2 5 1 p s : / / 1 1 1 0 / i a . e o g r . q 1 / 2 1 1 0 9 . 7 1

At Aktür A., Demirci Ç. (2021) popliteal lymph node metastasis of a melanoma of the head and neck region. *Journal of the Turkish Society of Otorhinolaryngology and Head and Neck Surgery*, 35(1), 1-5. doi:10.1501/JTOS_0000000000000000

Be Ms.U. (2019) diagrama programi i komputaci i knjižnica i digitalni
Routledge.

Car K_e(y1.9 000) taennat ly B E A s h & J M . Y . S i m p s o n t h e n c y c l o o p a e n d g i a g l e n g u i s i
(12.p p7.2 5 - 730r)g.a.m.o.n .

Chau A Myo, r r i t s W e y l, E n d Y p s h i H a (w 2 a 0, C 7) a d h e i n g d a e r r A n e p l a n o m b i a n e q u a l i t y
(2 n d R u s s a b l e .

Chen, H., Hsiao, C., & Baldus (2008). Development of a high school mathematics teacher's professional learning needs scale. *Journal of Curriculum and Instruction*, 9(1), 1-15. doi:10.1080/00220270701400715

ChorR.(2020) Singrat d h i d rompust a h i d rompust Aecrase:uiday h-i r d
gr adcompuctle asu.ron f aduc a tCiompaulR e s e h 5 8 3 9 7 0 - 5 9 5 p s :g//1d07.71/ o
073569812908

Clemens, S. A. (2022). A comprehensive review of the development of the early life of the child. *Journal of Child Development*, 23(3), 15-26. <https://doi.org/10.90102020230305>

Corr ttiJn(a2,0 R5) a c b i n g a p d e r u l o a s t i u d t e h r t o s w g n h p l u a g c t e i d c o m m e s i o d i a c o v n s
5 8 3 2 5 - 2 7 t i p s : / 0 / 1 d 4 5 i / . 2 6 7 2 3 6 1 7 1

De o l m o u ñ o J z C ó z a r t i e r . & z o n z - e a e z u A o . (2 0 2 0) m p u t a t i i n k a i n g u n p h u g g e d
a c t i v e a i e y o r P s r i n E a d r u y c a C o i n p u & E d r u c a t i 5 i , 0 0 3 8 3 2 . p s : / / d o i . o r g / 1 0
2 0 2 0 . 1 0 3 8 3 2

ASEAN Cohere & Expo Site 2024. 1-24.1968.1/3. doi:10.182

Two approaches to education at 50029-656 ps: //id7071.00r4g2/0185.911349921

Eglar, S. H., Bach, M., Babb, B. M., Bennet, A. R., Elin, H. A., & Davis, J. (2020). *Coloconduzi and Adnishi*
na adre Genera Sa Te Mwa p at t indig fentou Eniutcy a Tei omna Rleogya Develo p (n3) it
 1569-1593 s : /0/.doi10.4e03n91728

- [illegible]

- [illegible]

SUPPORTING INFORMATION

Add it si upon a list of non-integer values to the list of integers.

How little at least in Halden, Kr. L. ar. J. An. Qui. M. G. a. L. E. ar. Ber.,
Sado An. (i. 20, 24) n. p. l. urge. m. d. x. u. l. t. u. r. e. s. p. b. y. o. s. m. i. p. u. t. o. e. r. a. g. l. y.
chil. d. h. u. o. c. o. f. t. u. i. t. u. n. E. d. u. c. a. R. e. s. e. a. r. - 20. <http://t.p.s.g//1001002/f/e/r>