ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ
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Faculty of Education

Department of Primary Education

The Effect of an Interactive e-book on the Development of Sustainable Citizenship Regarding Climate Change to Primary School Students

Η επίδραση ενός διαδραστικού ηλεκτρονικού βιβλίου στην ανάπτυξη της βιώσιμης πολιτειότητας για την κλιματική αλλαγή σε μαθητές δημοτικής εκπαίδευσης

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Keep Ithaka always in your mind.

Arriving there is what you're destined for.

But don't hurry the journey at all.

Better if it lasts for years,

so you're old by the time you reach the island,

wealthy with all you've gained on the way,

not expecting Ithaka to make you rich.

C.P. Cavafys

Abstract

This study investigated pre-service teachers' reactions to the use of a Web-Based Learning Environment designed for primary school students and structured as an e-book, according to their educational philosophies and how that environment's characteristics enhance sustainable citizenship. Although many researchers have studied the benefits of ICT use in education, there is little research examining the factors influencing educators' implementation of ICT tools according to their educational philosophies. Moreover, there has also been little work on the ways that combining ICT with educators' beliefs affect the qualities of active sustainable citizenship: Intercultural Communication, Justice, Self-awareness, Global Civic Engagement and Social Responsibility.

To obtain some insight into these larger questions and considerations, this study set out to demonstrate the necessity and benefits of a Web-Based Learning Environment for primary school students, implemented by pre-service teachers, in education on issues of sustainability and climate change. This study focused on the theoretical and methodological framework in developing a web-based learning environment (WBLE), and secondarily on the perceptions of pre-service teachers toward education. Finally, we draw some conclusions regarding future curriculum implementation by pre-service teachers for primary school students in learning about sustainability and climate change.

Keywords: sustainable citizenship, climate change, web-based learning environment, perceptions of pre-service teachers, education for sustainable development, ICT

Περίληψη

Η παρούσα διδακτορική διατριβή πραγματεύεται ένα σημαντικό και επίκαιρο θέμα στην εποχή της διαρκούς τεχνολογικής ανάπτυξης, της παγκοσμιοποίησης, αλλά και της κρίσης για τη βιωσιμότητα του πλανήτη μας, όχι μόνο σε θέματα περιβάλλοντος, αλλά και σε θέματα κοινωνίας, οικονομίας και πολιτισμού. Ο σύγχρονος άνθρωπος βρίσκεται αντιμέτωπος με την ανεργία, με την έξαρση της βίας και του ρατσισμού, με τον κοινωνικό αποκλεισμό, με την καταπάτηση των ανθρωπίνων δικαιωμάτων, με την πείνα, με την κλιματική αλλαγή, με την μόλυνση των υδάτινων πόρων και των θαλασσών, με την χημική δηλητηρίαση του ανθρωπίνου σώματος, τις πανδημίες, με την αποψίλωση των δασών και πληθώρα άλλων. Η έμφαση της διδακτορικής διατριβής στην εκπαίδευση για την κλιματική αλλαγή, που εν πολλοίς καθορίζει την ύπαρξη και το μέλλον του κόσμου μας, αποτυπώνει την ιδιαίτερη συνεισφορά της. Οι επιπτώσεις της κλιματικής αλλαγής επηρεάζουν όχι μόνο όλα τα φυσικά συστήματα αλλά και όλες τις ανθρώπινες κοινωνίες ανεξάρτητα της γεωγραφικής θέσης τους πάνω στον πλανήτη μας. Η ανάπτυξη της περιβαλλοντικής γνώσης και ευαισθητοποίησης των μαθητών βρίσκεται σε σημαντική υστέρηση όσον αφορά στη μετουσίωση της περιβαλλοντικής στάσης και της γνώσης τους σε δράση. Είναι γεγονός, όπως φανερώνεται στη διεθνή βιβλιογραφία, ότι ένας από τους παράγοντες μπορεί να είναι το ίδιο το εκπαιδευτικό σύστημα. Η εκπαίδευση για ένα βιώσιμο μέλλον απαιτεί διδακτικές μεθόδους και στρατηγικές που στηρίζονται σε μη γραμμικά μοντέλα διδασκαλίας και μια μετασχηματιστική θεώρηση της εκπαιδευτικής διαδικασίας και πράξης.

Η συγκεκριμένη διδακτορική διατριβή βασίστηκε στην ανάπτυξη ενός διαδικτυακού περιβάλλοντος διδασκαλίας και μάθησης για την πραγμάτευση της κλιματικής αλλαγής. Σε ερευνητικό επίπεδο, ο σκοπός ήταν να διερευνηθούν πιθανοί παράγοντες που καθορίζουν εάν ένα άτομο θα ενεργήσει περιβαλλοντικά ή όχι σε σχέση με την βιώσιμη πολιτειότητα που είναι ζωτικής σημασίας για την επίτευξη μιας περιβαλλοντικά βιώσιμης κοινωνίας. Αυτό επιχειρήθηκε με την ενσωμάτωση ενός διαδραστικού μαθησιακού περιβάλλοντος (Δ.Μ.Π.) με δομή ηλεκτρονικού βιβλίου σε μαθήματα του Παιδαγωγικού Τμήματος Δημοτικής Εκπαίδευσης του Πανεπιστημίου Κρήτης, ώστε να δοκιμαστεί πώς η μάθηση για την

κλιματική αλλαγή θα μπορούσε να συμπεριληφθεί στο πρόγραμμα σπουδών. Είναι σημαντικό να σημειωθεί ότι η παρούσα διατριβή ακολουθεί τα συμπεράσματα και τα ευρήματα δύο προηγούμενων ερευνών, αυτών της κας Γ. Καλλιατζή (2016) και κ. Δ. Γκότζου (2017) και έχει σαν βάση το περιβάλλον μάθησης που από κοινού αναπτύχθηκε. Έχει ως αφετηρία τη διερεύνηση των απόψεων, γνώσεων και ενεργειών των φοιτητών του Παιδαγωγικού Τμήματος Δημοτικής Εκπαίδευσης του Πανεπιστημίου Κρήτης, για την ενεργό πολιτειότητα στο πλαίσιο του φαινομένου της κλιματικής αλλαγής, μέσα από τη χρήση του διαδραστικού μαθησιακού περιβάλλοντος «Δράσε για το Κλίμα», το οποίο χρησιμοποίησαν και συμμετείχαν συλλογικά στην περαιτέρω βελτίωση του.

Η έρευνα βασίστηκε στο εμπειρικό αναλυτικό παράδειγμα (ποσοτική προσέγγιση) μέσα από ένα ημι-δομημένο ερωτηματολόγιο το οποίο συμπεριελάμβανε και ανοιχτές ερωτήσεις. Το υλικό ουσιαστικά δημιουργήθηκε για μαθητές, δεν παύει όμως να αποτελεί ένα νέο εκπαιδευτικό υλικό το οποίο οι εκπαιδευτικοί καλούνται να χρησιμοποιήσουν στην πράξη. Οι εκπαιδευτικοί για να το χρησιμοποιήσουν πρέπει πέρα από το να έχουν θετική στάση απέναντι σε αυτό θα πρέπει να αναπτύξουν και ικανότητες δράσης. Χωρίς την δράση δεν μπορεί να υπάρξει ουσιαστική αλλαγή. Η διαπολιτιστική επικοινωνία στην ευρύτερη έννοιά της είναι σημαντική στη διαμεσολάβηση ανάμεσα στη στάση και τη δράση. Παράγοντες για την θετική στάση και υιοθέτηση του εργαλείου είναι η χρηστικότητα, η ικανοποίηση και η σχετικότητα περιεχομένου (usability, satisfaction and content relevance). Η χρηστικότητα (usability) αναδεικνύεται από προηγούμενες μελέτες (Davis, 1989; Chow et al. 2012). Όταν οι μελλοντικοί εκπαιδευτικοί αντιλαμβάνονται την ευκολία χρήσης ενός τεχνολογικού εργαλείου, μπορούν να αντιληφθούν τη χρησιμότητα του και είναι πιθανότερο να το υιοθετήσουν. Προηγούμενες δε έρευνες έχουν επιβεβαιώσει μια σημαντική θετική συσχέτιση ανάμεσα στην ικανοποίηση και την πρόθεση συμπεριφοράς (Chen, Yen and Hwang, 2012; Alraimi, Zo and Ciganek, 2015; Wang et al., 2019). Επίσης το επίπεδο και η σχετικότητα του περιεχομένου όπως αναδεικνύουν πρόσφατες έρευνες (Mohammadi, 2015) είναι σημαντικό στην γενικότερη αποδοχή και αυτό γιατί η ποιότητα του τεχνικού συστήματος, του περιεχομένου και των πληροφοριών επηρεάζουν θετικά την πρόθεση χρήσης. Οι προσωπικές δε εκπαιδευτικές φιλοσοφίες έχουν άμεση σχέση με τις διδακτικές πρακτικές για την ενεργή πολιτειότητα όπως υποστηρίζουν ο Buehl και Beck (2015). Οι εκπαιδευτικές φιλοσοφίες μπορεί να μην είναι πάντα εμφανείς στην πράξη παρόλο που

υπάρχει απόλυτη ευθυγράμμιση μεταξύ των εκπαιδευτικών φιλοσοφιών και των αντιλήψεων που έχουν οι εκπαιδευτικοί σχετικά με τη διδασκαλία και τη μάθηση.

Η έρευνα σχεδιάστηκε και υλοποιήθηκε στις ακόλουθες τέσσερις φάσεις:

- Φάση 1: Βιβλιογραφική Ανασκόπηση του φαινομένου της κλιματικής αλλαγής και των συνεπειών του φαινομένου στο περιβάλλον, στην οικονομία και στην κοινωνία, της ενεργής πολιτειότητας και σχετικών ερευνών και ερωτηματολογίων που επιχειρούν να την προσδιορίσουν, των εκπαιδευτικών φιλοσοφιών, των θεωριών μάθησης στις οποίες βασιστήκαμε για το σχεδιασμό του Αναλυτικού Προγράμματος για την κλιματική αλλαγή, των μοντέλων εκπαιδευτικού σχεδιασμού στα οποία βασιστήκαμε για το σχεδιασμό του διαδραστικού περιβάλλοντος βασιζόμενοι στη μετασχηματιστική μάθηση, στο μαθησιακό μοντέλο ExConTra και στο εκπαιδευτικό ή ερευνητικά εξελισσόμενο μοντέλο

- Φάση 2: Χρήση του Δ.Μ.Π. από τους φοιτητές του Παιδαγωγικού Τμήματος του Πανεπιστημίου Κρήτης κατά το χειμερινό εξάμηνο του ακαδημαϊκού έτους 2017-2018. Το διαδραστικό μαθησιακό περιβάλλον αποτέλεσε το εργαλείο των φοιτητών για τη σε βάθος μελέτη όλων των διαστάσεων της κλιματικής αλλαγής. Οι φοιτητές διάλεξαν, ελεύθερα, ενότητα της αρεσκείας τους από τους θεματικούς τομείς του διαδραστικού μαθησιακού περιβάλλοντος και εργάστηκαν ανεξάρτητα ο ένας από τον άλλο. Στο τέλος του εξαμήνου ζητήθηκε από τους φοιτητές να αναπτύξουν μια εναλλακτική διδακτική παρέμβαση και να αξιοποιήσουν δραστηριότητες και υλικό από το μαθησιακό περιβάλλον εφόσον το επιθυμούσαν.

- Φάση 3: Σκοπός αυτής της φάσης ήταν η αξιολόγηση του υλικού μετά την παρέμβαση. Το δείγμα αυτής της φάσης αποτέλεσαν 200 φοιτητές (82.5% Γυναίκες, 17.5% Άνδρες) του Παιδαγωγικού Τμήματος του Πανεπιστημίου Κρήτης από το Γ’ έως το Ζ’ εξάμηνο που παρακολούθησαν τα μαθήματα Αναλυτικό Πρόγραμμα: Θεωρία και πράξη, ΤΠΕ στην Εκπαίδευση για την

Βιώσιμη Ανάπτυξη. Ο ερευνητικός σχεδιασμός βασίστηκε στην ποσοτική ανάλυση κάνοντας χρήση μιας σειράς κλειστών ερωτήσεων. Η μέτρηση των θεωρητικών εννοιών είχε σαν εργαλείο το τυποποιημένο ερωτηματολόγιο η εγκυρότητα του οποίου επιτεύχθηκε με την χρήση ερωτημάτων και κλιμάκων δοκιμασμένων από άλλους ερευνητές, όπως αυτό διαπιστώθηκε κατά την ανασκόπηση της βιβλιογραφίας. Σαν εργαλείο συλλογής δεδομένων χρησιμοποιήθηκε online ερωτηματολόγιο με μορφή Google Forms, με 121 ερωτήσεις κλειστού τύπου σε 4/βαθμη κλίμακα Likert (1=Διαφωνώ απόλυτα έως 4=Συμφωνώ απόλυτα) και 2 ανοιχτές ερωτήσεις. Ο σύνδεσμος του ερωτηματολογίου δόθηκε στους φοιτητές κατά την διάρκεια του μαθήματος.

- Φάση 4: Για την ανάλυση των ποσοτικών δεδομένων έγινε χρήση σύνθετων μεταβλητών, ώστε να γίνει ευκολότερη η διερεύνηση των σχέσεων και των αλληλεπιδράσεων και επιπρόσθετα να διασφαλίσουμε την αξιοπιστία της έρευνας. Χρησιμοποιήθηκε το στατιστικό πρόγραμμα SPSS στην Έκδοση 25 ενώ οι Ποσοτικές μέθοδοι ανάλυσης που επιλέχθηκαν ήταν ο έλεγχος εσωτερικής αξιοπιστίας, η περιγραφική ανάλυση, οι συσχετίσεις Pearson, το T-test & Ανάλυση Διακύμανσης (one-way ANOVA) καθώς και η βηματική παλινδρομική ανάλυση (Stepwise Regression). Οι ερωτήσεις 1-10 εξετάζουν τα δημογραφικά στοιχεία των φοιτητών. Οι ερωτήσεις 10 έως 33 του ερωτηματολογίου εξετάζουν τη χρήση των ΤΠΕ εν γένει και τη χρήση του διαδραστικού μαθησιακού περιβάλλοντος. Οι ερωτήσεις 48 έως 97 επιλέχθηκαν από παρόμοιες έρευνες σχετικά με την ενεργή πολιτειότητα. Τέλος οι ερωτήσεις 98 έως 123 χρησιμοποιούνται συνήθως στον προσδιορισμό της εκπαιδευτικής φιλοσοφίας.

Τα δεδομένα της έρευνας που συλλέχθηκαν επέτρεψαν την κατανόηση του τρόπου με τον οποίο το Δ.Μ.Π. μπορεί να ενσωματωθεί στα προγράμματα σπουδών και να χρησιμοποιηθεί από τους φοιτητές στην μελλοντική τους καριέρα. Τα ποσοτικά και τα ποιοτικά δεδομένα που συλλέχθηκαν έδωσαν αρκετά στοιχεία για την ενδελεχή κατανόηση του θέματος. Για την ανάλυση των ποσοτικών δεδομένων χρησιμοποιήθηκαν σύνθετες

μεταβλητές, ώστε να μμπορέσουμε να διερευνήσουμε τις διάφορες σχέσεις και να διασφαλίσουμε την αξιοπιστία της έρευνας.

Πιο συγκεκριμένα για τις ανάγκες της ανάλυσης των δεδομένων δημιουργήθηκαν δυο ομάδες εξαρτημένων μεταβλητών και μια ομάδα ανεξάρτητων μεταβλητών. Οι λειτουργικοί ορισμοί που δόθηκαν σε κάθε σύνθετη μεταβλητή προήλθαν από τα ερωτήματα που τις απαρτίζουν. Στην πρώτη ομάδα εξαρτημένων μεταβλητών, που εξετάζει τις αντιλήψεις των φοιτητών ως προς τη χρήση των νέων τεχνολογιών, είχαμε την Χρηστικότητα, την Ικανοποίηση και την Σχετικότητα του περιεχομένου από την χρήση του διαδραστικού μαθησιακού περιβάλλοντος. Στην δεύτερη ομάδα εξαρτημένων μεταβλητών είχαμε τον Προοδευτισμό, τον Νεοσυντηρητισμό και τον Αναδομισμό. Στην ομάδα τέλος των ανεξάρτητων μεταβλητών είχαμε την Διαπολιτισμική επικοινωνία, την Δικαιοσύνη, την Αυτογνωσία, την Παγκόσμια συμμετοχή πολιτών και την Κοινωνική ευθύνη. Οι λειτουργικοί ορισμοί που δόθηκαν σε κάθε μεταβλητή προήλθαν από τα ερωτήματα που τις απαρτίζουν. Ειδικότερα ως προς τις ανεξάρτητες μεταβλητές η σύνθετη μεταβλητή "Διαπολιτισμική επικοινωνία" αποτυπώνει την αποδοχή και κατανόηση της διαφορετικότητας σε επίπεδο κουλτούρας και αντιλήψεων, η σύνθετη μεταβλητή "Δικαιοσύνη" ερευνά το αίσθημα δικαίου αναφορικά με τις κοινωνικές ανισότητες, η σύνθετη μεταβλητή "Αυτογνωσία" ερευνά την αντίληψη των φοιτητών σχετικά με το κατά πόσο αντιλαμβάνονται την θετική επίδραση και επιρροή που μπορούν να έχουν σε τοπικό ή παγκόσμιο επίπεδο, η σύνθετη μεταβλητή "Παγκόσμια συμμετοχή πολιτών" αποτυπώνει την ευαισθητοποίηση των φοιτητών σχετικά με τα κοινωνικά προβλήματα, την προθυμία τους να παρέχουν βοήθεια σε κοινωφελείς οργανισμούς και την ενεργή συμμετοχή τους στην κοινωνία (ενεργοί πολίτες) και τέλος η σύνθετη μεταβλητή "Κοινωνική ευθύνη" ερευνά το αίσθημα αλληλεγγύης των φοιτητών και το κατά πόσο μπορούν να συνδράμουν και να συμπαρασταθούν σε δοκιμαζόμενους συνανθρώπους, σε τοπικό ή παγκόσμιο επίπεδο.

Δημιουργήθηκαν επίσης έξι μοντέλα που περιείχαν τις συγκεκριμένες σύνθετες μεταβλητές. Κάθε ένα από τα έξι μοντέλα ονομάστηκε σύμφωνα με την εξαρτημένη μεταβλητή την οποία μελετά. Τα μοντέλα 1 – 3 αφορούν τις εξαρτώμενες μεταβλητές του διαδραστικού μαθησιακού περιβάλλοντος. Οι φοιτητές που συμφώνησαν ή συμφώνησαν έντονα στις ερωτήσεις σχετικά με την διαπολιτισμική επικοινωνία είναι πιθανότερο να βρουν το διαδραστικό μαθησιακό περιβάλλον χρήσιμο στη διδασκαλία τους, είναι ικανοποιημένοι

με την χρήση του στην τάξη, και είναι πιθανότερο να δουν το περιεχόμενο του ως σχετικό με τη διδασκαλία με τα ζητήματα που αφορούν την αλλαγή του κλίματος. Οι ερωτηθέντες που συμφωνούν ή συμφωνούν έντονα στις ερωτήσεις της παγκόσμιας συμμετοχής πολιτών είναι πιθανότερο να αντιληφθούν τη χρηστικότητα του μαθησιακού περιβάλλοντος, να ικανοποιηθούν από την χρήση του στην εκπαίδευση, και είναι πιθανότερο να δουν το περιεχόμενο του ως σχετικό με τη διδασκαλία τους σε ζητήματα που αφορούν την αλλαγή του κλίματος. Τώρα τα μοντέλα 4, 5 και 6 επικεντρώθηκαν στη αποτύπωση της εκπαιδευτικής φιλοσοφίας του Προοδευτισμού, του Νεοσυντηρητισμού και του Αναδομισμού. Οι ερωτηθέντες που συμφωνούν ή συμφωνούν έντονα σε δηλώσεις σχετικά με τη διαπολιτισμική επικοινωνία, την παγκόσμια συμμετοχή πολιτών, την κοινωνική ευθύνη και την δικαιοσύνη είναι άτομα που διαθέτουν προοδευτική εκπαιδευτική φιλοσοφία. Είναι δηλαδή υπέρμαχοι της φιλοσοφίας της βιωματικής και επικοινωνιακής μάθησης και του εποικοδομισμού,

Είναι ενδιαφέρον να σημειωθεί ότι η Αυτογνωσία, ένας από τους ακρογωνιαίους λίθους του προοδευτισμού δεν αποτέλεσε σημαντική μεταβλητή πρόβλεψης του συγκεκριμένου μοντέλου. Οι ερωτηθέντες που συμφωνούν ή συμφωνούν έντονα σε δηλώσεις σχετικά με τη διαπολιτισμική επικοινωνία, την κοινωνική ευθύνη, την δικαιοσύνη και την αυτογνωσία είναι άτομα που διαθέτουν αναδομιστική εκπαιδευτική φιλοσοφία. Υποστηρίζουν την κριτική παιδαγωγική και βλέπουν την εκπαίδευση και τον εκπαιδευτικό ως φορέα κοινωνικής αλλαγής. Περισσότερη έρευνα σε μελλοντική έρευνα μπορεί να αποκαλύψει γιατί αυτό συνέβη στη συγκεκριμένη μελέτη.

Σημαντικό συστατικό αυτής της έρευνας αποτέλεσε και το Δ.Μ.Π. που αναπτύχθηκε και βασίστηκε στο μοντέλο ExConTra και εφαρμόστηκε τόσο στην Σχολική Τάξη όσο και στο Πανεπιστήμιο. Το μοντέλο ExConTra στηρίζεται στην ενεργό μάθηση που θεωρείται η γέφυρα μεταξύ της εκπαίδευσης και των πραγματικών καταστάσεων.

Το Δ.Μ.Π. χρησιμοποιήθηκε σαν πηγή γνώσεων σε θέματα που σχετίζονται με την κλιματική αλλαγή και το περιβάλλον, την διδασκαλία τους στην σχολική τάξη, τη χαρτογράφηση σχετικών εννοιών, για συνεργατικές δραστηριότητες μάθησης καθώς και αξιολογήσεις του επιπέδου κατανόησης. Ο σχεδιασμός του Δ.Μ.Π. ήταν σκόπιμο να γίνει μαθητοκεντρικό. Κείμενο, εικόνες, βίντεο, σύνδεσμοι σε ιστοσελίδες και άλλα online

εργαλεία ενεργοποίησαν τους μαθητές και φοιτητές σχετικά με τη σημασία της βιώσιμης ανάπτυξης και της δράσης που αποτελεί βασικό κομμάτι της ενεργής πολιτειότητας.

Οι ερωτηθέντες φοιτητές παρείχαν πολύτιμα σχόλια και παρατηρήσεις σχετικά με τη χρήση του Δ.Μ.Π. Στο σύνολο τους αφορούσαν τη χρησιμότητα του Δ.Μ.Π. και το πώς αυτό θα καταστεί καλύτερο εργαλείο διδασκαλίας και μάθησης. Τα αποτελέσματα αυτής της μελέτης φέρνουν νέες γνώσεις στην έρευνα και την πρακτική της εκπαίδευσης. Αν και το Δ.Μ.Π. σχεδιάστηκε για μαθητές δημοτικού σχολείου ουσιαστικά οι εκπαιδευτικοί είναι αυτοί που πρόκειται να το εφαρμόσουν στην τάξη. Υπό αυτό το πρίσμα η εφαρμογή αυτή δυνητικά μπορεί να έχει αντίκτυπο στην ανάπτυξη δεξιοτήτων από την επόμενη γενιά πέρα από την ενημέρωση σχετικά με τα ζητήματα της κλιματικής αλλαγής. Τέτοιες δεξιότητες είναι η κριτική αξιολόγηση των πληροφοριών που ανακτώνται και στη συνέχεια, μέσω της δημιουργικότητας και της επίλυσης προβλημάτων, να αναπτύξουν και να εφαρμόσουν λύσεις σε θέματα κλιματικής αλλαγής στον κόσμο που ζούμε όλοι.

Γενικά, η εννοιολογική και η μεθοδολογική προσέγγιση βασίστηκε σε ένα σαφή και δομημένο σχεδιασμό ακολουθώντας όλα τα ακαδημαϊκά και ερευνητικά κριτήρια. Τα αποτελέσματα αυτής της έρευνας προβάλλουν νέες πτυχές στην θεωρία και πράξη σε θέματα εκπαίδευσης για την κλιματική αλλαγή με την υποστήριξη των νέων τεχνολογιών. Το διαδικτυακό περιβάλλον «Δράσε για το Κλίμα» δημιουργεί προϋποθέσεις τόσο για την εκπαίδευση των εκπαιδευτικών, όσο και για τη διδακτική μεθοδολογία και το αναλυτικό πρόγραμμα.

Summary

In the era of continuous technological development, globalization, and sustainability crisis -- not only in terms of environment, but also in terms of society, economy and culture -- education of young people is an important and topical issue. Modern societies are facing unemployment, violence, racism, social exclusion, human rights abuses, hunger, pollution of the water resources, pollution of the seas, chemical poisoning of the human body, pandemics, deforestation and many other challenges. Our emphasis on education about climate change, the defining crisis of our time, which largely determines the existence and future of our world, reflects its special contribution. The effects of climate change affect not only all-natural systems but also all human societies regardless of their geographical location on our planet.

The development of students' environmental knowledge and awareness is lacking in terms of transforming their environmental attitude and knowledge into action. In fact, as literature shows, one of the causes may be the education system itself. Education for a sustainable future requires teaching methods and strategies based on non-linear teaching models and a transformative view of the educational process and practice.

This thesis was based on the development of a web-based learning environment regarding climate change. At research level, our aim was to investigate possible factors that determine whether or not an individual will act in accordance with environmental values in relation to sustainable citizenship, vital to achieving an environmentally sustainable society. This was attempted by integrating a web-based learning environment (WBLE) with e-book structure into the courses of the Primary Education Department of Samos University. The aim was to examine how climate change could be included in the curriculum. It is important to note that this thesis follows the conclusions and findings of two previous studies, those of Kaliantzi (2016) and Gkotzos (2017) and is based on the learning environment that they co-developed. Its starting point is the investigation of the views, knowledge, and actions of the students of the Pedagogical Department of Primary Education of the University of Crete for active citizenship in the context of climate change. It used the interactive web-based learning environment, "Act for Climate".

The research used the empirical analytical example (quantitative approach) through a semi-structured questionnaire which included open-ended questions. The material was

designed mainly for students; nevertheless it remains a new educational instrument forteachers to use in their teaching. For teachers to use it, they must have both a positive attitude toward it and the skill set to implement it effecrtively. Without action there can be no real change. Intercultural communication in its broadest sense is important in mediating between attitude and action. Factors determining the positive attitude and adoption of the education tool are: usability, satisfaction and content relevance. Usability is highlighted by previous studies (Davis, 1989; Chow et al. 2012). When educators realize the ease of use of a technology, they can perceive its usefulness and are more likely to adopt it. Previous research has confirmed a significant positive correlation between satisfaction and behavioral intention (Chen, Yen and Hwang, 2012; Alraimi, Zo and Ciganek, 2015; Wang et al., 2019). Also, as recent research reveals (Mohammadi, 2015) the relevance of content is important in acceptance, mainly because the quality of the technical system, content and information positively affect the intention to use. Personal educational philosophies are directly related to teaching practices, as argued by Buehl and Beck (2015). Educational philosophies may not always be apparent in practice, although there is a perfect alignment between educational philosophies and teachers' perceptions of teaching and learning.

The study was designed and implemented in four phases:

- Phase 1: Literature review of climate change and its effects on the environment, the economy and society; active citizenship and related surveys and questionnaires that attempt to identify it; educational philosophies; learning theories on which we relied for the design of the Curriculum for climate change; the educational planning models on which we relied for the design of the WBLE based on transformational learning; ExConTra learning model; and educational or research evolving model.

- Phase 2: Implementation of the WBLE at the Pedagogical Department of the University of Crete during the winter semester of the academic year 2017-2018. Pre-service teachers used the interactive learning environment for an in-depth study of climate change dimensions. Pre-service teachers selected a unit of their choice from the thematic areas of the WBLE and worked independently of each

other. At the end of the semester, pre-service teachers were asked to develop an alternative teaching intervention based on activities and material from the learning environment.

- Phase 3: Evaluation of the use of WBLE after the intervention. The sample consisted of 200 students (82.5% Women, 17.5% Men) of the Pedagogical Department of Samos University from the 3rd to the 6th semester who attended the courses “Curriculum: Theory and practice”, and “ICT in Education for Sustainable Development”. The research design was based on quantitative analysis using a series of closed-ended questions. The questionnaire measured theoretical concepts, the validity of which was achieved by using questions and scales tested by other researchers. An online questionnaire on Google Forms was used as a data collection tool, with 121 closed-ended questions on a 4 / degree Likert scale (1 = Strongly disagree to 4 = Strongly agree) and 2 open-ended questions. Questions were centered on beliefs about the use of the WBLE. There were also statements about active citizen engagement and perceptions, and finally, statements meant to determine education philosophy. The link to the questionnaire was given to the students during the course.

- Phase 4: Coding and analysis of quantitative and qualitative results. The quantitative analysis of the closed-ended questions was conducted with IBM’s SPSS 25 statistical software. The statistical tests performed were internal reliability test, descriptive analysis, Pearson correlations, T-test & Analysis of variance (one-way ANOVA) as well as stepwise regression analysis. Questions 1-10 of the questionnaire investigate pre-service teachers’ demographics. Questions 10-33 examine the use of ICT in general and the use of the WBLE. Questions 48-97 were selected from similar research on active citizenship. Finally, questions 98-123 are commonly used in defining educational philosophy.

The data allowed understanding of the way in which the WBLE can be integrated into the curriculum and used by pre-service teachers in their careers. The quantitative and

qualitative data collected provided adequate information for a thorough understanding of the subject. Synthetic variables were used to analyze the quantitative data, so that we could investigate the various correlations and ensure the reliability of the research.

More specifically, we used two groups of dependent variables and a group of independent variables. The questions that created each synthetic variable also gave their functional name. The first group of dependent variables, examining pre-service students' perceptions about the use of new technologies, were “Usability”, “Satisfaction” and “Relevance” of content. The second group of dependent variables included “Progressivism”, “Neoconservatism” and “Restructuring”. The group of independent variables included “Intercultural Communication”, “Justice”, “Self-Awareness”, “Global Civic Engagement” and “Social Responsibility”.

The functional definitions given to each variable came from the questions that form them. In particular the variable “Intercultural communication” reflects the acceptance and understanding of diversity in terms of culture and perceptions; the variable “Justice” investigates the sense of justice in the context of social inequalities; the variable “Self-awareness” examines students' perception of whether they can have a positive impact and influence locally or globally; “Global Civic Engagement” reflects students' awareness of social problems, their willingness to help, and their active participation in society (active citizenship); and "Social Responsibility" investigates the students' sense of solidarity and ability to help and support fellow human beings, locally or globally.

Six statistical models were created. Each model was named after the dependent variable that it examined. Models 1 - 3 examined the dependent variables of the interactive learning environment. Pre-service teachers who agreed or strongly agreed on questions about intercultural communication are more likely to find the WBLE useful in their teaching. They are satisfied with its use in the classroom and are more likely to perceive its content as relevant to teaching climate change issues to elementary school students. Respondents agreeing or strongly agreeing with statements regarding global civic engagement were more likely to recognize the usability of the WBLE, were (more) satisfied with the WBLE in instruction, and were (more) likely to perceive the content of the WBLE as being relevant to teaching climate change issues to elementary school students.

Models 4, 5, and 6 focused on capturing the viewpoints towards three different educational perspectives: Progressivism, Neo-conservatism, and Reconstructionism. Individuals with a progressivist ideology view education as being completely student-centric, i.e. the purpose of teaching is to engage the whole child through active learning, as opposed to the «all-knowing teacher-centric» philosophy where the teacher is the center of all knowledge. Those with a Neo-conservative outlook perceive global issues in terms of a person's individual freedom based on values of democracy, incorporating free market and capitalistic perspectives. Reconstructionists view education as a means to promote social reforms, such as actively addressing issues of climate change. Participants agreeing or strongly agreeing to statements regarding intercultural communication, global civic engagement, social responsibility, and social justice were shown to possess a progressive outlook toward education, that is, these individuals believed in learning for its own sake, not necessarily to educate workers of the future. As a result, progressive teachers typically serve as a guide to students' individually designed curricula. Students are involved in curriculum development, and education is a mechanism for students to seek their own path in society, especially in terms of their beliefs.

It is interesting to note that self-awareness – one of the cornerstones of Progressivism – did not emerge as a strong predictor in this model, given that progressive educational constructs involve student self-reflection. More investigation may uncover why this occurred. Participants who responded agree or strongly agree to intercultural communication and self-awareness statements were shown to have neo-conservative educational outlooks. These individuals perceived education/teaching as a common body of knowledge including instruction about the great thinkers of the past. Within this outlook, education is perceived as a means to teach future workers to be productive in the marketplace. In this model, students are expected to successfully complete all aspects of one grade level before going on to the next grade level. Moral values are taught as being important to transfer from generation-to-generation. Participants that indicated an agreement or strong agreement with intercultural communication statements, statements about social responsibility, social justice, and self-awareness were shown to have the Reconstructionist view of education in society. This view sees education as a means to teach understanding and acceptance of diverse individuals and cultures. Within the reconstructionist framework, students are taught to analyze and address

social problems. Active learning is seen as a bridge between education and real-world situations to improve the lives of everyone.

It is important to place the responses to the questionnaire in the context of the climate change artefact that was developed using the ExConTra design. The WBLE was developed and implemented as a major component of this study. The WBLE was used to provide knowledge on various topics related to climate change and the environment, peer-tutoring, concept mapping, and other collaborative learning activities, and included assessments to gauge levels of understanding. The design of the WBLE was intentionally made student-centered rather than teacher centered. Text, links to websites, videos, images, and other online tools engaged students with learning about the importance of healthy living environments.

The WBLE used in this study was created by the researcher specifically with climate change education in mind. Respondents provided insightful experiences, comments, and observations regarding the use of the WBLE in instruction. Comments regarding the usefulness of the WBLE were mostly in regard to how to make it a better teaching and learning tool. The results of this study bring forth new knowledge to education research and practice. This study tried to uncover the probability of using a robust web-based environment developed to teach and engage primary school students about issues of climate change and sustainability, by pre-service teachers. Though the WBLE was designed with primary school students in mind, teachers are the ones who will implement it in the classroom. This can potentially impact the development of the next generation's qualities, not only by informing them of such issues, but also developing and practicing skills to critically assess information retrieved and then, , develop and implement solutions to climate change issues within the world in which we all live.

Dedication

In memory of my father

Acknowledgments

As C.P. Cavafy states at his poem Ithaka this journey is better if it lasts for years, so you can be wealthy with all you've gained on the way. The wealth for me was all the amazing individuals that believed in me and help me accomplish the journey. I am grateful to my mother and my brother for always been there for me. Also, to my friends and my significant other for their continuous support during all these years. Their love and understanding kept me going at times that it seemed pointless.

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Table of Contents

Abbreviations, Acronyms, and Initialisms

AAAS:	American Academy of Arts and Sciences
ACCAC:	Qualifications, Curriculum, and Assessment Authority for Wales
CCE:	Climate Change Education
EE:	Environmental Education
ESD:	Education for Sustainable Development
ESDGC:	Education for Sustainable Development and Global Citizenship
ESSIE:	European Schoolnet and University of Leige
ExConTra:	Experiencing, conceptualising, transforming
EU:	European Union
IALEI:	International Alliance of Leading Education Institute
ICT:	Information and communications technologies
IJSHE:	International Journal of Sustainability in Higher Education
IPCC:	Intergovernmental Panel on Climate Change
NEF:	New Education Fellowship
NOAA:	National Oceanic and Atmospheric Administration
NSF:	National Science Foundation
PBL:	Project-based learning
ppb:	parts per billion
ppm:	parts per million
SMR:	Stepwise multiple regression
SD:	Sustainable development
UN:	United Nations
UNESCO:	United Nations Educational, Scientific and Cultural Organization
UNICEF:	United Nations Children's Fund
WBLE:	Web-based Learning Environment

List of Tables

List of Figures

Chapter I.

Introduction

With the contemporary pace of technological development, globalization and unbridled consumerism, major social and environmental problems are emerging in every aspect of our lives. Human beings are faced with financial crises, unemployment, large incidents of violence and racism, social exclusion, violation of human rights, hunger and climate change, contamination of water resources, chemical poisoning of the human body, deforestation and many more phenomena. According to UNESCO (2002), climate change is the most threatening environmental issue of our time. It is a global problem that threatens the survival of the planet (Ojala, 2012). This is a complex problem with many implications and impacts on the environment, the economy and society (UNESCO, 2002).

I.1. Climate Change and Its Effect on Human Society

There is incontrovertible evidence that our planet is warming up and that there are significant changes to the climate (Stocker et al., 2014). However, not everyone accepts that climate change exists, with many querying the identified causes of climate change, the extent to which the human race is responsible, and/or whether climate change is something that should be a cause for concern. Climate change is and will continue to be one of the biggest global challenges for the 21st century and constitutes a significant existential threat to humanity. In its 2030 Agenda for Sustainable Development, the United Nations called out the need to address climate change within the Sustainable Development Goal 13 (Federica Doni, Gasperini and Joa̋o Torres Soares, 2020). Recent estimates from the World Health Organization have shown that climate change is expected to cause approximately 250.000 additional deaths per year between 2030 and 2050; 38.000 due to heat exposure in elderly people, 48.000 due to diarrhoea, 60.000 due to malaria, and 95.000 due to childhood undernutrition (World Health Organization, 2018).

However, there are some dissenting voices even within the scientific community, on the relationship between human activity and climate change. R. A. Bryson for example believed that human activities do not cause the changes in climate, but that climate change is a part of the natural cycles of climate. Bryson also states that "it has been assumed that variations of the gross energy flow controls extrinsic to the atmosphere are adequate to explain climatic variations without seeking some "trigger" mechanism of small size, such as a burst of solar particles which modifies the high atmosphere and, in turn, the low-level climate. This does not imply that there is no short-term atmospheric effect, but that there is simply no climatic effect of significance compared to those which relate to the all-important solar energy which drives the atmosphere" (Bryson, 1974, p. 759).

Others claim that the recent changes in climate can mostly be attributed to the minor alteration of the Earth's planetary orbits, which changes the quantity of solar energy received by the Earth (Zeebe and Lourens, 2019). The urgency surrounding climate change stems from the fact that, whatever the cause, it has been accelerating alarmingly for the last 60-70 years since the 1950s/1960s (Bates et al., 2008). The findings from the Fourth Assessment Report by the Intergovernmental Panel on Climate Change (L Bernstein et al., 2008) outlined many concerning signs regarding climate change showing that climate change exists and if not tackled as a matter of urgency, not only the planet but the very existence of human beings are at risk. Some of the regional climate change effects predicted by the IPCC (2007) include:

- North America: A reduction of frost and snow on the mountains of western North America. A 5-10% increase in agricultural production due to rain in some areas (Walther et al., 2002; Stewart, Cayan and Dettinger, 2004). More frequent, stronger and longer heat waves in cities where such phenomena already occur.

- Latin America: The progressive encroachment of the forest due to the savanna in the eastern region of Amazonia. The eradication of many plant and animal species in the tropical areas increasing the possibility for substantial biodiversity loss (Jones and Thornton, 2003; Crane, Roncoli and Hoogenboom, 2011). Significant changes in drinking water resources (Bates et al., 2008).

- Europe: The increased risk of floods in central Europe. Frequent flooding in coastal areas and erosion due to storms and rising sea levels (Kundzewicz et al., 2005). Dramatic reduction in frost and snow in mountainous areas. The extinction of many species of flora and fauna. Decrease in agricultural production in southern Europe (Lindner et al., 2010).

- Africa: By 2020, 75 to 250 million people will be faced with a shortage of drinking water. Agricultural production will be reduced by up to 50% in some areas due to lack of adequate rainfall and irrigation (Ziervogel and Ericksen, 2010). The adequacy of food will decrease severely (Toulmin, 2008).

- Asia: By 2050, the availability of drinking water will decrease in central, southern, eastern and southeastern Asia (Park et al., 2010). Coastal areas will face an increased risk of flooding (Xu et al., 2009). There is an expected increase in deaths as a result of diseases linked with famine and floods in certain areas.

I.2. Education for Sustainable Citizenship

Climate change requires a new active form of citizenship. This kind of citizenship change puts forward the need to improve people's ability to handle environmental, development and cultural diversity issues (Vare and Scott, 2007). Sustainable citizenship has an ethical awareness at its core, emphasising the active participation of citizens in social changes and inclusive decision-making processes (United Nations, 1993; Vargas, 2000). UNESCO is highly concerned with the promotion of this goal and urges member states to activate their mechanisms and elaborate an array of programs for promoting sustainable citizenship through education.

Moreover the 21st century is considered a digital age since most of the activities of everyday life use digital media and services in work, studies and personal life. Knowing reading, writing and math is no longer enough to cope with the new requirements that society nowadays considers as a standard. A new set of skills and ways of thinking are needed so that one can live and work in the new digital world. It is no longer adequate to be literate. It

is a necessity to be digitally literate. The European Council identified digital competence as one of the eight key competences for citizen survival in a knowledge-based society (European Union Council, 2018). The European Commission suggested that digital literacy is "increasingly becoming an essential life competence and the inability to access or use ICT has effectively become a barrier to social integration and personal development" (European Commission / Digital Literacy High-Level Expert Group, 2008. p. 4). In 2010 the Digital Agenda for Europe 2020 (European Commission, 2015), included seven pillars and 101 actions, from which the sixth pillar concerns "strengthening digital literacy, skills and social inclusion". Moreover UNESCO (2011) in one of its policy summaries defines digital literacy as a life skill and characterizes it as an umbrella concept that includes many dimensions.

Especially now that the economic and social crisis is sweeping not only Greece but most of the countries worldwide there is a need to enhance digital literacies of learners of all ages. Children should be able to think critically, collaborate, investigate, challenge, reflect, act as a group and use ICT to address complex problems like climate change both inside and outside of school and moreover inside and outside the country's borders. In terms of education for sustainability, digital technologies represent a means of reaching and motivating learners in terms of raising awareness of how they can promote ways of being more active citizens and living more sustainably.

Such an orientation in education requires the development of the concept of the sustainable active citizen, which must be incorporated into a transformative process of learning as outlined by Diduck (1999). In this regard, the transformative learning process includes, among other things:

a. Students participating actively in their learning.
b. Recognizing and accepting the diversity of various cultures.
c. Affirming the course material as a component of language and thought of students' participation.
d. Starting discussions on re-thinking and inspiring self-thinking among students.
e. Focusing on the process of learning and research schema "action - reflection – action" (Diduck, 1999).

The purpose of Education for Sustainable Citizenship is to integrate sustainability into the theory of teaching, teaching methodology and syllabi at every educational level, including the education of teachers, with the final aim to prepare current learners and tomorrow citizens as agents of change. It is also expected that, through this process, the quest for transformative change that is necessary for building a more sustainable society can be realized. This goal is not without its challenges. For example, the criticism of education today, not only in Greece (Glewwe and Kremer, 2006), but also in many countries worldwide, is that education mainly focuses on:

1. Its reproductive role and the fact that it is stuck in the tradition of "legitimizing" human-orientated domination of man in nature.
2. Its approach to interculturalism through monoculturalism (Coulby, 2006).

Learning and changing behavior in association with a transformative perception are essential ingredients to achieve a sustainable way of thinking and living (Makrakis, 2012). There were four pillars of learning identified within the Delors Report in 1996, in order to focus education on sustainable development (Delors, 1996):

1. Learning to know: is the skill to learn through life itself, develop critical thinking and acquire tools to understand the world and sustainability.
2. Learning to do: is the skill to understand and act on local and global sustainability issues and to apply the gained knowledge in everyday life and environment.
3. Learning to live together: is the ability to participate and collaborate in multicultural societies. To understand and respect diversity and to respond to situations of tension, violence, exclusion and terrorism.
4. Learning to be: is the ability to see ourselves as the main factor in shaping the future and to acquire self-awareness, autonomy and personal responsibility.

A fifth pillar was added by UNESCO "learning to transform oneself and society" which is the skill to shape a better, racially neutral world without discrimination, to minimize the ecological footprint and promote peace and democracy (Combes, 2005).

Makrakis & Kostoulas-Makrakis (2016) added another 6th pillar: Learning to give and share: it is the ability to volunteer and social work and learn to give, share, feel and feel the needs of others. This pillar promotes the importance of social responsibility.

Such an approach reflects the collaboration of the individual and society through acquiring practical and cognitive skills that will potentially contribute to the promotion of a sustainable future (Combes, 2005; Massialas, 2005). Other studies show that there is great inconsistency between the way in which people interact with their environment and the way in which they would like to interact with it (Redondo and Puelles, 2016). In other words, while most people have a positive attitude towards the environment, a very small percentage of them convert their interest into action. Exploring possible factors that determine whether a person will act environmentally or not is crucial to achieving a society that is environmentally sustainable (Kollmuss and Agyeman, 2002; Poortinga, Steg and Vlek, 2004). The need to change learners' attitudes toward valuing the environment and motivating them to take actions to protect the environment, such as reducing consumption patterns, is critical. To enable thus, learners must engage with transformative learning experiences in the processes of education for sustainable development. In this context, the issue of educating learners for sustainable citizenship, which is also the focus of this study, is of great importance (Taniguchi and Nakano, 2017). Information and Communication Technologies (ICTs) can assist students, through the utilization of modern technology, to explore safely from the class, authentic problems, to enhance their metacognitive skills and their current knowledge. In addition, ICT enhances education for sustainable citizenship as it is closely associated with advanced learning strategies (Fien and Tilbury, 1996; Summers and Kruger, 2003; UNESCO, 2016). Moreover, the fact that climate change, active citizenship and teaching for sustainable development do not fit in traditional modes of teaching, learning and curricula syllabi is increasingly being recognized. These aspects were considered during the development of the web-based interactive material based on the transfer of climate change and sustainable development concepts.

I.3. The purpose and rationale of this study

The overall purpose of this study was primary the development and the implementation of an interactive web-based learning environment, titled “Act for Climate” specifically designed for primary school students. The WBLE though it was designed for primary school students was also enriched with special sections and extra features for teachers in order to simplify its use in the classroom and make it easier for them to organize their lessons. In addition, all the material was developed with structure similar to an e-book. That made the WBLE more familiar to the students that used it. Issues of sustainable development and climate change education were covered, focusing on the following topics: a) energy and climate change, b) climate change and water, c) solid waste and climate change. Since it was a new educational material it needed to be tested first with the primary school students to study its effectiveness. Kaliantzi (2016) used participatory emancipatory action research that took place over three cycles and it was implemented on students of 2nd, 4th and 6th grade of a primary school in Attica. Before the intervention primary school students knew nothing or had false ideas about climate change, weather and climate. Moreover, they did not have any interdisciplinary learning material in their curriculum, and they weren't used to get information through ICT. They weren't trying to solve environmental and social problems and they did not act in order to prevent and address climate change through ICT. They had a small degree of awareness, sensitivity and responsibility for modern problems, but they had not developed any kind of environmental ethics, behavior, conscience and citizenship. After the use of the WBLE students understood the concepts of climate change, weather and climate and they linked cross-thematic knowledge and skills. They acquired skills in searching, composing, generalizing, analysing, evaluating and processing information using ICT and also developed skills to solve environmental and social problems. Most importantly they acted in order to prevent and tackle climate change through ICT by gaining more awareness, sensitivity and responsibility for modern problems. Finally, they strengthened and acquired a new environmental ethics, behavior, conscience and citizenship.

Gkotzos (2017) used phenomenographic and empirical-analytical research approach with active participation of the subjects that where both teachers and students. Moreover, in his research he achieved equal participation of the class teachers as co-researchers and

actively involved learners in the design and development of the WBLE. The WBLE was implemented in one hundred sixty-five (165) learners of nine (9) classes (5th - 6th grade), in five (5) primary schools, all members of the UNESCO Associated Schools Project Network (ASPnet). The class teachers were all treated as partners and co-researchers. In his survey human intervention was initially mentioned as the most popular cause of climate change referred to by teachers but after the teaching interventions, the use of fossil fuels became an equally popular cause of climate change. Floods were the most popular effect of climate change mentioned by teachers. The majority of learners associated climate change with disasters and the corresponding percentage has been more than doubled, after the teaching interventions. Most learners agreed that there is collective responsibility for climate change. Before the teaching interventions, one-third of learners believed that climate change had no personal effects on them. This percentage decreased to about one quarter after the teaching interventions. After the teaching interventions, more learners referred to the global and local effects of climate change with devastation and destruction of plants, forests or cultivated areas being the most popular responses.

In both studies teachers were asked to use the developed WBLE in their school classes and practice. In order to successfully use the WBLE, teachers needed to develop certain action skills in order to have a positive attitude towards it. That was mainly because without action there could be no real change. Intercultural communication in its broadest sense is important in the mediation between attitude and action. Important factors for the positive attitude and adoption of the WBLE are usability, satisfaction and content relevance. Usability is highlighted by previous studies (Davis, 1989; Chow et al., 2012).

When teachers realize the ease of using a technological tool, they can understand its usefulness and are more likely to adopt it. Previous research has confirmed a significant positive correlation between satisfaction and behavioral intention (Chen, Yen and Hwang, 2012; Alraimi, Zo and Ciganek, 2015; Wang et al., 2019).

Also, the level and relevance of the content as highlighted by recent research (Mohammadi, 2015) is important in general acceptance and this is because the quality of the technical system, content and information positively affect the intention to use. Personal educational philosophies are directly related to teaching practices for active citizenship, as Buehl and Beck argue (2015). Educational philosophies may not always be evident in

practice even though there is an absolute alignment between educational philosophies and teachers' perceptions of teaching and learning. The focus of the study was to explore six different models as possible predictors of certain categories of perceptions regarding educating and engaging learners in sustainable development was the second major section and focus of this study.

Within this context, the specific research objectives mainly were to explore pre-service teachers' experiences of the WBLE, and relationships between the pre-service teachers' qualities, dispositions, awareness and educational philosophy and their impressions of the WBLE.

I.4. The structure of this study

Chapter I provides an introduction and rationale of the study. It focuses on the urgent need for education to provide solutions to sustainability issues, such as climate change. It supports that the issue of climate change is the most threatening problem of our time and that the new generation must be educated and strengthened with skills so that it can address it. The chapter also presents the aims and the objectives of the research as well as how the thesis is organised.

In Chapter II a literature review of the concept and essence of citizenship, active citizenship and global citizenship are presented. In addition, the importance of introducing education for sustainable development and global citizenship in school curriculum and promotion of education for sustainable development and global citizenship is discussed. Furthermore, in this chapter the contribution of Information and Communications Technology in school education and global citizenship is presented. Finally, key theorists and research studies relating to teacher education for ESD are presented and discussed.

Chapter III presents and discusses firstly the research questions and hypotheses. The research methodology as well as the validity and reliability in the research process are also examined. Finally, ethical considerations are presented.

The instructional design of the "Act for Climate" Web-based Learning Environment along with the curriculum structure, the thematic areas and the tools, is discussed in Chapter IV.

Chapter V presents the results of the conducted survey of 200 pre-service teachers that used WBLE in their courses. In this chapter the relationships and correlations between pre-service teachers' perspectives on intercultural communication, self-awareness, global civic engagement, social responsibility, justice matters, and their levels of agreement on aspects of usability, satisfaction and content relevance of the WBLE are also presented.

Chapter VI summarizes the main findings and conclusions of the thesis and discusses the significance and the limitations of the study. In addition, the implications for research as well as for successful implementation of the proposed curriculum and WBLE in primary schools are discussed. Finally, recommendations for future research are presented.

Chapter II.

Literature Review

This chapter introduces and portrays arguments concerning concepts and contexts of global citizenship. Firstly, and more specifically, this chapter focuses on the definition of citizenship and the clarification of the components, which form the concept of global citizenship. In addition, it presents the relationship between education for global citizenship and education for sustainable development and the significance of this integration at the school curriculum level. The ways of promoting global citizenship and sustainable development through education are also presented. This chapter further presents an overview of research on the effect that the web-enabled learning environment has on the promotion and implementation of active and sustainable citizenship at the local, national, and global levels. Finally, it examines pre-service teacher education, with integration of material from key theorists and research studies relating to teacher education for sustainable development and more particularly those relating to student teachers' dispositions vis-à-vis integration of ESD in their practice.

II.1. Education for Sustainable Development and Global Citizenship

II.1.1 Global Citizenship

In an era of change, the construction of a sustainable future requires not only changes in the lifestyles of societies but also changes in the values-bases that sustain them. In that sense, the path to a sustainable future inevitably effects not only production, consumption and the management of natural resources but also well-established power relations, issues of social equality, issues of human rights and proper management of diversities within societies. A sustainable future cannot be built on the basis of a society characterized by exclusion,

exploitation of migrants, violation of children's rights, social inequality, racism and violence towards the natural environment (Kostoulas-Makrakis, 2008).

The traditional political practices cannot adequately redress global issues, mainly because the typical political measures of regulatory politics and litigation cannot efficiently solve environmental problems and issues of social justice (Ruggie, 2008). Global challenges require intergovernmental intervention and change of behavior on the account of the citizens individually. Therefore, there is an increasing focus among researchers on examining the personal responsibility of citizenry within world politics.

It is essential at this point, and before clarifying the concepts and contexts of global citizenship, to determine the meaning of citizenship, on the grounds that there is no consensus for its content. Citizenship has a certain complexity both in theory and practice although it usually refers to a national or regional identity. For example, Greek citizenship according to article 4 of the constitution of Greece (Hellenic Parliament, 2008), gives the right to an individual to be equal before the law, to have equal rights and equal obligations as the rest. Greek men and women are eligible for public service and to contribute without distinction to public charges in proportion to his/her means. Greek citizenship does not provide these rights outside Greece's boundaries and even to non-citizens inside Greece's territory. In other words, an individual can be a citizen according to the criteria of a democratic country, as in the example of Greece, and have certain rights and duties, but that same individual is not considered as a citizen in other democratic countries or other forms of government like a monarchy or an oligarchy. The same thing can happen in societies where other considerations apply, like social class, ancestry, income or occupation. This leads to the conclusion that even if global citizenship exists, it is not analogous to the national citizenship. A brief survey of the concept of citizenship through history offers an illustrative example.

The term citizen or citizenship was developed based on the principle of solidarity and that of shared identity, rights and obligations among the members of a national community. The majority of scholars agree that the birthplace of citizenship is located in the city-states (polis) of ancient Greece (Heater, 2004).

The concept of the term at that time entailed the participation in public affairs of a narrow class of educated and wealthy people. Even in a democratic polis like Athens with inhabitants living in a constitutional system of liberty and equality, non-citizens like women,

slaves or barbarians were not members of that democracy. Citizenship in Athens was defined on the basis of the mandate of citizens to perform their duties rather than their rights. This was not peculiar, given the fact that the people had a deep sense of belonging with their city-state and linking their individual destiny to that of the entire community.

Many philosophers of ancient Greece, like Plato and Aristotle, envisioned citizenship and the role that it should serve. Plato's primary interest was to create a framework for the ideal state with stable and harmonious citizens (Plato, 2012). In Aristotle's view, being a citizen was natural as "a man was a political animal (zoon politikon)" (Politics 1.1253a) and in order to fulfill his role he had to be an active citizen to polis (Heater, 2004).

According to Aristotle (Politics 1.1253a) an individual without a city that he can be identified with as a result of a voluntary and not an accidental decision is either poor or supreme. Aristotle compares the man to Homer's writing in denunciation as a lawless, heartless and clan-less individual. Furthermore, he portrays the man as a passionate individual for war and an individual positioned at an advanced solitary position in the context of the game of draughts.

Still, Aristotle argued that citizenship had a commanding role as citizens could rule over non-citizens and that it was suitable only for the free, male members of the community. Only citizens could hold deliberations with their peers regarding the morality of the society, that is, the common good. It is interesting to note that even within the narrow boundaries of the term citizenship at that time, philosophers like Socrates perceived a broader view of citizenship. Socrates (Montaigne, 1993) described himself as a global citizen who did not want to limit his origin based on where he lived (e.g., Athens or Sparta). He describes his global citizenship by elaborating on the boundless sky where the boundaries of countries possess similar attributes that are experienced in the whole world, such as air, fire and water. This was a revolutionary concept, considering that the greatest social identity in Greece at that time was polis. This same concept was also adopted by Diogenes of Sinope, the ancient Cynic philosopher. When Diogenes was asked where he came from, he replied "I am a citizen of the world" (kosmopolites) (D.L. 6.63).

Some important refinements to the concept of citizenship were made during the years of the Roman Empire. Cicero (Keyes, 2006) viewed citizenship as a virtue in the same way as Robespierre did during the French revolution (Dunn, 2009). At first citizenship was only

available to residents of Rome, but later it became available to all people living in the Roman Empire. The Roman Empire, unlike the Greek city-states, was relatively generous to its captives by giving them a second class or semi-citizenship to many of them. As Pocock (1998) states, a citizen, at that time, was mainly a legal entity that could act freely by the law and could ask and expect the law's protection. In a sense that legal entity can be compared to modern nationality (McIntyre, 2009).

The Byzantine Empire was the direct continuation of the eastern part of the Roman Empire after the decline of Rome. During its reign, Christianity played a vital part in the development of the associational character of the occidental cities (Turner, 1974). In later European history and during the Middle Ages, feudalism overtook the concept of citizenship. Laws and constitutions were defined differently and according to the will of a federation of noble families (Weber, 2019). During the start of the Renaissance period, people transitioned from being servants of monarchs to having citizenship of a city and then to be citizens of a nation.

The foundations of the modern concept of citizenship rose with French and American declarations of rights. French and American revolutions were crucial in connecting common perceptions of basic human rights to the notion of sovereignty. With the ratification of the Constitution of the United States in 1788, the idea of citizenship began to form its modern sense and with the Fourteenth Amendment in 1868 the term got a broader definition. Nevertheless, the history of the term citizenship highlights the difficulty in defining its meaning and its elements or dimensions. According to the Encyclopedia Britannica, citizenship is an interdependent relation between a state and an individual where an individual has a strong sense of affinity for the state offering it allegiance and in turn the nation is responsible for protecting him/her. Also, citizenship refers to having freedom that is accompanied with specific obligations. The citizens have particular privileges, rights, tasks and obligations that are often refused or partially allowed to non-citizens living in the specific country. For instance, service in the military, allegiance, and participating in politics, such as holding public office and voting are examples of specific rights.

In the late modern (1800-1900) and early global (1900-1950) periods, philosophers and political scientists perceived and described the various perspectives and dimensions of citizenship. John Stuart Mill supported the concept that both genders should be treated

equally under the same law (John Stuart Mill, 2015), Thomas Humphrey Marshall perceived the growth of citizenship as the development of civil, then social, and political rights (Marshall, 1950).

Jürgen Habermas highlighted the importance of the public sphere and its influence in the political action (Habermas, 2010). The dominant theories of citizenship that were developed were the liberal, the civic republican and the post-cosmopolitan citizenship theory (Dobson, 2003). Still, revolutionary thinkers like Aristotle (in ancient times) always maintained a broader view of citizenship. According to Immanuel Kant, all the people of the world at some point will share a universal right for the earth and that will progressively assist in establishing a citizenship of the world (Kant, 2003). The universal right for the earth stresses the fact that the nature of human existence entails that people without a place on earth, can't act and hold others morally accountable for their actions. That global view of citizenship was also supported by scholars and scientists such as Albert Einstein, Bertrand Russell, Amartya Sen, Martha Nussbaum, Andrew Linklater, Michael Walzer, Richard Falk, and John Urry, among others (Schattle, 2008).

Upon further review of the literature on the idea of citizenship, three overarching dimensions and aspects are consistently noted (Kymlicka and Norman, 2010; Carens, 2000): the legal, action, and personal dimension, as illustrated in Figure 1. These interrelated dimensions reflect the theoretical and philosophical aspects of the term described in the literature. Within each dimension of citizenship, further sub dimensions exist and add complexity to the term. For example, the legal dimension is defined by civil, social, and political rights (Marshall, 1950).

Recently, as a result of global issues like the changes in climate and the importance of protecting the earth (Noddings, 2005), the concern regarding global citizenship is being reinforced, and the transition from citizenship to global citizenship, as status and practice, is becoming a necessity. The literature review analysis highlights the complexity involved in the term citizenship. This complexity grows even further when the whole world is considered.

In figure 1. there is a depictions of the main dimensions that formulate citizenship and global citizenship connected with the moral dimension that is the central idea of both kinds of citizenships.

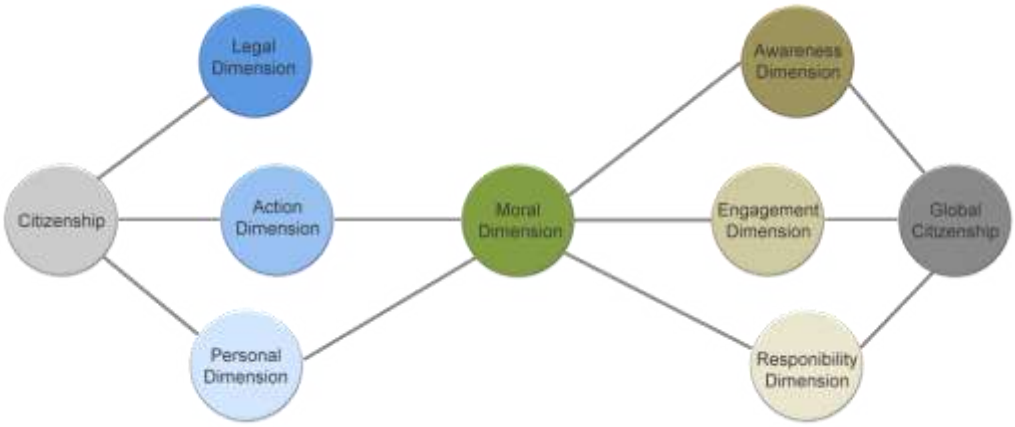

Figure 1. Citizenship and Global Citizenship Conceptual Model.

So, what could global citizenship mean and what relationship does it have with citizenship? Could it mean a citizenship at a planetary level that covers the entire world? Even scholars and scientists have different and competing perspectives on these issues and have used the term in multiple ways as discussed earlier.

Others, like Young, claim that global citizenship applies to a citizen who possesses a spherical perception of the world, a citizen that focuses more on self-reflection and meditation, and that easily understands, adapts, and fits into various positions, locations, even countries and cultures (Young, 2008). Others argue that global citizenship is an identity that someone has from the moment they walk on earth (Dower and Williams, 2002) and McCrudden (2008) adds that it's the fundamentals of human dignity and equality of all people on the Earth. Moreover, international organizations like Oxfam, the United Nations, and Amnesty International define global citizenship in a similar way. Oxfam Education, for example, defines the term as a way of thinking and behaving with the conviction that people can make a difference in society, thereby creating a safe and unique place for all generations that will come after us (Oxfam, 2015).

Among those who criticize the concept of global citizenship are Carter, Parekh, and Davies that make a skeptical approach about the meaning and real use of the term (Carter, 2006; Parekh, 2002; Davies, 2006). Others, like Roman, Zemach-Bersin and Woolf have

concerns about its broad usage and its misunderstood meaning in the educational context (Roman, 2003; Lewin, 2009; Woolf, 2010). However, other researchers support the benefits that can be aqcuired from the integration of the concept at the school curriculum level (Praetzel, Curcio and Dilorenzo, 1996).

Before analyzing how Global Citizenship relates to Sustainable Development through education, it would be useful to extend the three dimensions of citizenship to their analogous global level. The legal dimension seems difficult to transfer to a global level. There is no global legislation, though the Declaration of Human Rights can be considered as a global guideline for humanity, although it is not respected by all countries. Moreover, global organizations like the European Union (EU) and the United Nations (UN) enable citizens to rely on universal rights, which apply in most parts of the world. The personal and active dimension can be elevated to be seen as a moral dimension. The moral dimension, from its very nature, includes a variety of aspects. These aspects can be divided into three main categories (Schattle, 2008; Parekh and Biekart, 2009): awareness, responsibility, and engagement. Awareness can be understood as the ability of recognizing and caring about local and global issues and events. Responsibility is described as the concern for others, concern about society, and concern about the environment. Although awareness and responsibility are vital moral virtues for global citizens, a difference to any one of these cannot occur if citizens do not convert them into social action (Parekh and Biekart, 2009).

The most notable significant feature of a global citizen is the ability to act (Davies, 2006; Lim, 2008). This active role in addressing the global issues of the present will achieve social justice, equality, and ecological sustainability (Davies, 2006). Successful active engagement with the world requires citizens (especially younger generations) to possess some core competencies in order to make Earth a just and sustainable place in which to thrive and survive (Oxfam, 2015). This highlights the importance of Sustainable Development through education to prepare young people for a future that is sustainable.

II.1.2. Education for Sustainable Development and Sustainable Development Goals

According to Kostoulas-Makrakis (2011), ESD framework belongs within the cognitive educational subjects and it is not an evolution of Environmental Education (EE).

The ESD was started by Peace Education, Human Rights Education, Gender Equality Education, Poverty Eradication Education, etc. and at its beginning it had not an environmental dimension. Later, EE was integrated into World Studies and the ESD. Therefore, the ESDs origin is from World Studies and not from EE. Of course, EE is now an important part of the ESD. The first definition for EE was given in Nevada, USA in 1970 at the IUCN international working meeting: "EE is the process of values recognition and concepts clarification, with the aim of developing the necessary skills and attitudes to understand and assess the correlation of humans, culture and the biophysical environment. The EE also implies practical involvement in the decision-making process and the development of a code of conduct on quality environmental issues" (Blionis, 2009, p. 22). In 1972, the UN organized the first international conference on the environment, recognizing the need to establish EE programmes to tackle continued environmental degradation. In 1975 UNESCO the "Belgrade Charter" was established, which set out the main objectives of the EE (United Nations Environment Programme, 1975).

"The objectives of environmental education are:

1. Awareness: to help individuals and social groups acquire an awareness of and sensitivity to the total environment and its allied problems.
2. Knowledge: to help individuals and social groups acquire basic understanding of the total environment, its associated problems and humanity's critically responsible presence and role in it.
3. Attitude: to help individuals and social groups acquire social values, strong feelings of concern for the environment and the motivation for actively participating in its protection and improvement.
4. Skills: to help individuals and social groups acquire the skills for solving environmental problems.
5. Evaluation ability: to help individuals and social groups evaluate environmental measures and education programmes in terms of ecological, political, economic, social, esthetic and educational factors.
6. Participation: to help individuals and social groups develop a sense of responsibility and urgency regarding environmental problems to ensure

appropriate action to solve those problems." (United Nations Environment Programme, 1975, p. 3).

The "Belgrade Charter" also set out the guidelines for the EE programmes. The guiding principles of environmental education were the following (United Nations Environment Programme, 1975, p. 4).:

1. To view the environment holistically as a natural, man-made, ecological, political, economic, technological, social, legal, cultural, aesthetic environment.
2. To make the EE a continuous and lifelong educational process at all levels of formal and non-formal education.
3. Follow a cross-thematic approach.
4. Emphasis should be given on active participation to prevent and solve environmental problems.
5. Examine the main environmental problems from a global perspective, while considering local specificities.
6. Focus on the present, but also on the future state of the environment.
7. Consider growth and economic growth from an environmental perspective.
8. Highlight the value and necessity of cooperation at local and global level to solve environmental problems

According to Liarakou and Flogaiti (2007), the term ESD (Education for Sustainable Development) came into life through discussions and consultations of international organizations (UNESCO, OECD, IUCN, UNEP, WWF). In particular, the term "sustainable development" first appeared in 1980 by IUCN, UNEP and WWF in their text "Global Conservation Strategy" (IUCN, 1980). ESD was related to education in the Brundtland report of the World Commission on Environment and Development (WCED) in 1987 (WCED, 1987). This report states that: "Sustainable development seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future. Far from requiring the cessation of economic growth, it recognizes that the problems of poverty

and underdevelopment cannot be solved unless we have a new era of growth in which developing countries play a large role and reap large benefits. sustainable development is development which satisfies the needs of the present, without underestimating the ability of future generations to meet their own needs", (WCED, 1987, p. 39). In 1991, a definition of the ESD was given by "Caring for the Earth: a Strategy for the Sustainability of IUCN , UNEP and WWF", which adopts together with the principles of ecological sustainability and social justice: "ESD means improving the quality of human life within the carrying capacity of supportive ecosystems", (Liarakou and Flogaiti, 2007, p. 59). The combination of the two definitions describes the basic idea of sustainable development that promotes the interests of people and ecosystems. The management of production, consumption, natural resources and the development of the natural environment.

The United Nations has set 8 goals (United Nations Millennium Development Goals-MDG) to achieve by 2015 on sustainable development (UN Millennium Campaign, 2008):

1. "Eliminate hunger and poverty.
2. To spread primary education worldwide.
3. To promote gender equality and empower women.
4. To reduce child mortality.
5. To improve the health of every mother.
6. Fight AIDS, malaria and other diseases.
7. To ensure the sustainability of the environment.
8. To develop a global cooperation for development".

Having already reached 2015, there has already been a transition from these 8 goals (MDG) to 17 new global sustainable development goals (Sustainable Development Goals-SDG). The 17 Goals were adopted by all UN Member States in 2015, as part of the 2030 Agenda for Sustainable Development which set out a 15-year plan to achieve the Goals. These new goals (SDGs) are an extension of previous goals (MDGs) and are as follows (United Nations Economic and Social Council, 2020):

1. "Eliminate poverty in all its forms everywhere.

2. Eliminate hunger, ensure safe nutrition and promote sustainable agriculture.
3. To ensure the health and well-being in the lives of people of all ages.
4. Ensure quality education and promote lifelong equal learning opportunities for all.
5. To achieve gender equality and empower all women and young girls.
6. Ensure access to water, as well as sustainable water management and sanitation for all.
7. To ensure economical, reliable, sustainable and modern energy for all.
8. To promote sustainable economic development, complete, productive and decent work for all.
9. To build the appropriate industrial infrastructure, to promote sustainable industrialization and to cultivate innovation.
10. Reduce inequality within and between countries.
11. Make cities and people's homes safe, resilient and sustainable.
12. Ensure sustainable consumption and production.
13. Take urgent action to combat climate change and its consequences.
14. Use the oceans and seas in a sustainable way.
15. Protect and restore terrestrial ecosystems, sustainably manage forests, combat desertification and land degradation and stop biodiversity loss.
16. To develop peaceful and sustainable societies, to have access to justice for all and to build effective and credible institutions for all sectors.
17. Strengthen and revitalize the process of global cooperation for sustainable development" (United Nations Economic and Social Council, 2020).

The issue of quality education is the 4th goal while the climate change is the 13th goal of the United Nations agenda. More specifically Target 4.7 states that "By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development" while the Target 13.3 urges to "Improve education, awareness-

raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning" (United Nations, 2017)

II.1.3. How does Global Citizenship relate to Education for Sustainable Development?

The promotion of sustainable development through education applies different aspects from many educational theories and perspectives and it is strongly interwoven with the development of active global citizenship and civil society (Liarakou and Flogaiti, 2007). It has become a growing necessity to educate individuals about sustainable development due to the growing urgency of global issues, many associated with the rise of globalization (Dower and Williams, 2002), that have negative effects on everyone. One of the global issues is climate change, which highlights the global impact of each individual's actions on the environment, since these actions transform the conditions of human existence in a negative way. In order to change that impact, it is essential to transform human societies and make them more sustainable. The primary agent of transformation towards sustainable development is education. As Orr (2004) argues, there is no prospect of creating a sustainable society without active, informed and capable citizens with paideia. The Greek concept of paideia reminds us that the main reason for learning should be the proficiency of self and not the subject matter (Orr, 2004). In this way education can work towards the goal of creating responsible citizens who will sustain and improve the environment at the local and global levels, and will take into account the choices they make, the needs of present and future generations, and, by doing so, will change things for the better.

There is extensive realization among researchers and educators on the significance of educating children to enhance literacy on climate matters and to ensure action on environmental and social issues (Dupigny-Giroux, 2010; Shafer, 2008). Organizations like NOAA (National Oceanic and Atmospheric Administration) and the AAAS (American Academy of Arts and Sciences) Project 2061 in collaboration with the US. Global Change Research Program define a person who is climate literate as one that:

- Can comprehend the vital elements of the Earth's climatic system.

- Knows the ways of scientifically assessing credible information concerning climate.
- Can discuss meaningfully what climate change entails.
- And, who can make informed and responsible decisions, which will affect climate change by understanding the effects of unsustainable actions by an individual (U.S. Global Change Research Program, 2006).

To increase climate literacy, especially among young people, a different approach to education must be brought to the schools of today. This different approach is critical to implement in contemporary education and is perceived inside the sphere of Sustainable Development through Education. Education for Sustainable Development (ESD) relates similarly to terminology such as education for sustainability and sustainability in education. Here, ESD is used since it is frequently found at the international level and within UN documents. According to the Brundtland Report, sustainable development complies with the needs and aspirations of the present without putting future generations' needs in jeopardy (UN. General Assembly, 1987). According to Hartmann, there are three sets of relations that need to be maintained: social, environmental, and ecological relations (Hartmann, 1998).

The International Alliance of Leading Education Institutes (2009) defined Climate Change Education (CCE) and Education for Sustainable Development (ESD). In its work, the International Alliance of Leading Education Institutes identified two aspects concerning CCE. In the first aspect, climate change is viewed as a natural issue on a scientific basis. In the second aspect, CCE views climate change as an essential annex of sustainable development.

The significance of sustainable development through education is reflected in Agenda 21 developed at the Earth Conference held in Rio de Janeiro, 1992 (Conference on Environment and Development (1992, Rio De Janeiro, 1993). In 2002, the connection between education, citizenship, and sustainable development was also emphasized by the decision of the General Assembly at the United Nations in its 57th Session to declare the period 2005-2014 as the duration for Education for Sustainable Development (Buckler, Creech and UNESCO, 2014b).

UNESCO acknowledges that global citizenship should be among the objectives of this education (UNESCO, 2015) and that the development of skills, values, and attitudes necessary for global citizenship is the outcome of Education for Sustainable Development. The mission of ESD, according to UNESCO, includes four integrated units, the so-called "pillars", which are:

1. To learn how to learn, by combining general knowledge with work in depth on substantial subject matters to better understand the world.
2. To learn how to act (do), so that the person can be productive in collaborative environments.
3. To learn how to live with others, i.e. how to understand, respect and cooperate with people who have different values, culture, and skin.
4. To learn how to be, in order to develop main competencies of one's personality such as autonomy, judgment, and responsibility.

UNICEF added a fifth pillar to the above. To learn how to transform oneself and society by developing respect for one's surroundings, social solidarity, and the planet without social, racial, and gender discrimination (Combes, 2005). The successful development of active and responsible global citizens and the change of society's lifestyle are needed for the full implementation of the five pillars. Makrakis & Kostoulas-Makrakis (2016) added a sixth pillar entitled "Learning to give and share" arguing that such a pillar integrates a neglected dimension of the five-pillars model of the 21st learning goals.

In this context, education must play a transformative role that will allow a person to:¨

a) Revise his/her anti-ecological relationship with the environment.
b) Realize that the path to a sustainable future depends on the redistribution of global wealth and that the things that unite people are much more than the things that separate them.
c) Understand other people in order to better understand him/herself and his/her relationship with the environment (Kostoulas-Makrakis, & Makrakis, 2006).

Education's transforming role is supposed to meet the diverse learning requirements of learners. Furthermore, if it is personally emancipatory and enriching, it will lead to a sustainable world (Combes, 2005). The UN recognized education's transforming role by claiming that education is a motor for change. That is why in December 2002, the United Nations General Assembly, through its Resolution 57/254, declared a Decade of Education for Sustainable Development (2005-2014). The lead agency for the promotion of this Decade was UNESCO. Integrating the values, practices, and the fundamentals of sustainable development into every accompanying aspect of studying and education. The efforts in education will certainly encourage behavior changes that will ensure the creation of a sustainable future while regarding economic viability, integrity in the environment, justice in the society for future and current generations (UNESCO, 2014b).

According to UNESCO the founding value of ESD is respect. Respect for everyone else besides ourselves in the present and in the future as well as respect for our natural environment and the wellbeing that it provides to us. More specifically, ESD is about learning to:

1. respect, value and preserve the achievements of the past;
2. appreciate the wonders and the peoples of the Earth;
3. live in a world where all people have sufficient food for a healthy and productive life;
4. assess, care for and restore the state of our Planet;
5. create and enjoy a better, safer, more just world;
6. be caring citizens who exercise their rights and responsibilities locally, nationally and globally (UNESCO, n.d., p. 1)

Such a radical change in the incumbent perceptions needs to be accompanied by corresponding changes in the incumbent social and educational structures. Such a change would transform the education of society and move toward the emancipation and positive change for all.

In this context, according to Kostoulas-Makrakis, & Makrakis (2006) there is an imperative to create learning environments that enable today's learners and tomorrow's active citizens to:

- Develop criteria to determine the best practices to preserve their cultural and natural heritage;
- Follow values and strategies that develop the principles and ethics of sustainability in local communities;
- Have the ability to participate in the configuration of their own teaching and learning;
- Follow ways of learning, through which they learn to participate responsibly in taking personal and collective decisions;
- Have the ability to engage in activities that encourage equal participation, collaborative spirit, teamwork and the participation in decisions on matters of common interest;

And, be able to solve problematic and controversial issues while acquiring full consciousness that there are always alternative perceptions, interpretations and solutions to the problems with which they are dealing (Kostoulas-Makrakis and Makrakis, 2016).

These learning environments will contribute dramatically to the creation of active global citizens. Nevertheless, there are some elements that restrain the whole process. Social factors such as gender, race, poverty and age can put certain sections of the population at a disadvantage and prevent their active participation in modern societies. In other words, as Bourdieu and Passeron (2016) argue, inequalities between social groups prevent the existence of equal educational opportunities.

It has been argued that education for sustainable development is an idea that can and should be an integrated as a subject of learning, if societies want a sustainable future (UNESCO, 2018). That is an absolute necessity for students where most of their learning process takes place in school. Student alienation, due to inequalities, makes for a portion of students perceiving citizenship as something that is suitable "for other people". Students that live in the prosperous western nations can acquire knowledge about the burning issues of the world, but remain disengaged from them, choosing to stay in a safe position (Boulding,

1990). Therefore, education must adapt to the multicultural nature of societies and respond to the demand for equal treatment and equal rights according to the democratic principle of equality and freedom of all citizens regardless of their social status, gender, and race and include non-citizens in ESD, too. Moreover, the focus within education for sustainability should be on the experiential learning as this is essential for active global citizenship (Davies, 2006).

In conclusion, an attempt has been made to highlight the relationship between Global Citizenship and ESD. ESD is an important asset to address social, political, humanitarian and environmental problems, for example, climatic change, through the development of active global citizenship. The context of ESD should aim for developing active global citizens through empowerment and emancipation processes. In this sense, the people can individually or collaboratively feel that they control the socio-political environment instead of being controlled by it (Kostoulas-Makrakis, 2008). In response to this, it is not strange that many schools are currently looking forward to incorporate principles of ESD in curriculum planning (Shepardson et al., 2011; Henderson and Holman, 1993) in spite of the numerous practical and conceptual challenges surrounding its implementation, as demonstrated in the following section.

II.1.4 Importance of Introducing Education for Sustainable Development and Global Citizenship in School Curriculum

If it is acknowledged that schools and universities need to educate future generations of global citizens, then it is easy to understand the significance of Education for Sustainable Development and Global Citizenship (ESDGC) throughout curricula in learning institutions. This fact is widely understood by many scholars who argue that ESDGC must be embedded into the school curriculum (Shepardson et al., 2011; Henderson and Holman, 1993). In order to successfully embed this form of education, it is essential to understand the very essence of it. As UNESCO argues, the most important purpose of education is the reorientation of the societies towards sustainability. The pedagogical principles of ESDGC emphasize attitudes, skills, knowledge and values.

According to Oxfam, the insights that a global citizen should have includes knowledge of diversity, sustainable development, equity, globalization, interdependence and conflict and peace (Oxfam, 2015). The global citizen must also develop skills such as the ability to effectively argue, critical thinking skills, respecting people and their ideologies, cooperation, and the ability to challenge inequality and injustice, including resolving disputes (Oxfam, 2015). Finally, a global citizen must have empathy, a commitment to equity and justice in the society, self-esteem, and a sense of belonging. Moreover, an individual must respect and appreciate diversity, the ecosystem, and be committed to sustainable development. It is also essential for him/her to believe that people can make a difference if appropriate ethical foundations are provided, especially to the younger generations, to further the cause of human happiness and peace (UNESCO, 2014a). For UNESCO, the education for global citizenship is not a fast means to social change, but it seems to be the most effective one.

In order to develop these different aspects of global citizenship, many schools implement collaborative learning approaches in their curriculum, which include constructivist, reflective, participative, experiential and holistic methodologies. These approaches have the tendency to increase the likelihood of students to become global citizens. Many scholars argue that ESDGC strategies and values must not simply act as another subject to be included in the already overburdened school's curriculum, but should be interwoven within the school culture and particular ethos, and should be embedded throughout the whole curriculum if they want to be successful (Davies, 2006).

Although global organizations, like UNESCO, described the ESD framework, only lately have specific, practical directions for achieving them appeared. As Wals and Jickling (2002) point out in their evaluation of the International Journal of Sustainability in Higher Education (IJSHE) it is only recently that the pedagogy for teaching sustainable development has been published. Earlier volumes focused more on the meaning of sustainability and its integration into multiple disciplines. Consequently, it is not unusual to have a plethora of pedagogical theories that seek to reorient curriculum to address sustainability. All of these theories have different approaches of how and what learners should learn, yet they do have some similarities, such as engaging students in meaningful social interactions, actual problem-solving, personal reflection, and an understanding of a wide range of knowledge

(Bates, 2019). Most of these pedagogical theories focus on the development of values and attitudes necessary towards supporting sustainable development (SD) with the purpose of promoting a positive attitude toward 'sustainability'. In order to make decisions regarding sustainability, a fundamental comprehension of ones' surroundings as well as the social science structure is necessary (Bell, 2004).

Attempts have been made to address the same issue using ideas such as deep learning (Warburton, 2003), problem-based learning (Dale and Newman, 2005), transformative learning (Mezirow and Taylor, 2010), experiential learning (Jucker, 2002), active learning (Cranton, 2012), action learning (Sipos, Battisti and Grimm, 2008), participatory learning (Seel, 2012), applied learning and inquiry-based learning (Jiří Dostál et al., 2015), critical pedagogy (Gottesman, 2016), service learning, and critical emancipatory pedagogy (Levesque-Bristol, Knapp and Fisher, 2010). In addition, many authors have associated ESD with multidisciplinary (Dale and Newman, 2005; Jucker, 2002), interdisciplinary (Barlett, 2004; Sherren, 2008; Wright, 2004) intra-disciplinary and trans-disciplinary (Sipos, Battisti and Grimm, 2008; Jucker, 2002) approaches to education.

Different pedagogical models are also proposed for particular learning contexts such as online learning. Holland, Mulcahy, Besong & Judge (2012) taking inspiration from the Community of Inquiry framework presented by Garrison, Anderson and Archer (1999) propose an ethical-values pedagogical model, which promotes the exploration of and reflection on the ethical values of educators and learners within ESD, recognizing the influences of values-bases on the cognitive and social presences and in ensuring meaningful and appropriate cognitive experiences (teaching presence). Makrakis and Kostoulas-Makrakis (2012) propose the ExConTra learning paradigm, as illustrated in Figure 2, which promotes the use of experiential, constructivist and transformative learning approaches in ESD.

Makrakis and Kostoulas Makrakis (2012) explain the ExConTra learning paradigm as follows: "Experiential learning concerns learners identifying aspects of the issue. Beginning with experiencing, learners' original and realistic duties that are concerned with the issue of sustainable development engage in information collection for analysis using different inquiry-based methods. Learners examine and organize the data collected to gather new experiences from different perspectives through self-reflecting as well as observations

and reading to establish meaning. Learners can make meaning, either sharing or personally, through reflecting on their personal experiences.

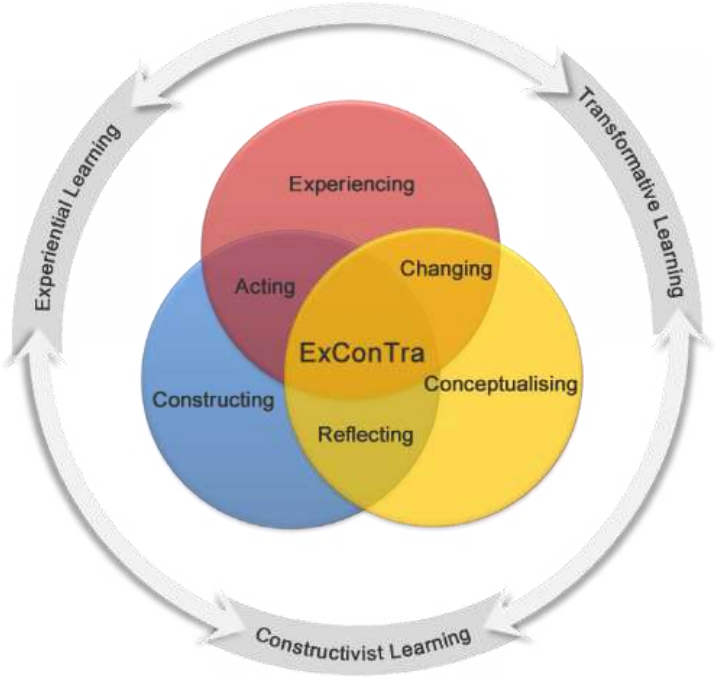

Figure 2. The ExConTra Learning Paradigm (Makrakis and Kostoulas-Makrakis, 2012).

This often leads to developing more comprehensive abstracts through the conceptualization of personal experiences. Learners should be involved in an inquiry shared through a consistent pattern of active experimentation, reconceptualization and reflection. Constructing meaning and knowledge is of vital essence when it showcases opportunities for actions. Acting refers to the merging of meaning and knowledge with action that suggests an agency change and active citizenship. Empowering learners in the transformation experience through active experimentation and continuous critical reflection should occur. The transformation of critical reflection into action creates a custom that makes learners function as agents of change (transforming). The learners are empowered through experiential, constructivist and transformative-critical reflective orientation for active citizenship" (Makrakis and Kostoulas-Makrakis, 2012, pp. 18-19).

This model aims to promote the emancipatory knowledge interest advanced by Habermas (1972). Habermas specifies three classifications of knowledge: technical, emancipatory, and practical. Technical knowledge focuses on explaining phenomena, which in turn demands practical knowledge that involves values clarification and focusing on exploring the experiences of people. Emancipatory knowledge allows for the development of the learner's self-realization and insight on the basis of knowledge generated, both practically and technically, especially through reflection and reflexivity (Kostoulas-Makrakis and Makrakis, 2016). The emancipatory interest encompasses fundamental concerns regarding ethical and moral dimensions of human actions for building a sustainable world by enquiring the type of activities and experiences that will assist people to realizing more sustainable lives, lives that are attributed to equity and justice and that should result in better standards of living for everyone today and into the future (Makrakis, 2000).

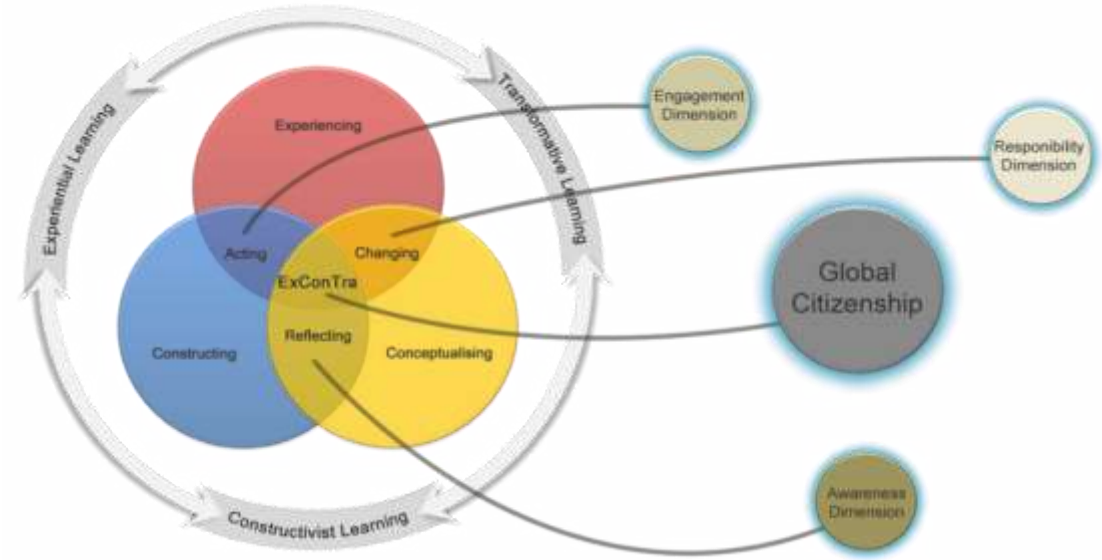

Figure 3. The ExConTra Learning Paradigm Possible Effects on Global Citizenship Dimension.

As the Figure 3 illustrates each of the dimensions of Global Citizenship in a way correspond to a certain area of the ExConTra Learning Paradigm. More specifically

responsibility dimension requires a change in order for someone to perceive duties and ethical concerns, awareness dimension is connected to the constant reflection that is necessary for understanding our surrounding and engagement dimension is based on the merging of meaning and knowledge with action that suggests an agency change and active citizenship.

Learning about the realities of climate change and the environment guides teachers and learners toward realizing the role that society and schools play in perpetuating unsustainable ways of thinking and actions as well as to uncover the social, economic, political and cultural factors that have affected the planet's sustainability (Makrakis, 2011). In this context, curriculum is perceived as praxis, where empowerment and action are highly valued (Grundy, 2001). This contrasts with product and process approaches. It is also founded on critical constructivism, where children understand and become knowledgeable through interaction, conversation and critical reflection that lead to conceptual change (Makrakis and Kostoulas-Makrakis, 2012). The historical and social context of acquiring knowledge is crucial. Critical constructivism empowers people to take action for constructing a more sustainable community (Kostoulas-Makrakis, 2008).

Beyond the pedagogical theories, another important factor is the need for school curriculum to be locally relevant and to address local as well as global issues. Engagement is one of the critical dimensions of global citizenship and local issues are an excellent field for practice, beyond the limited boundaries of schools and educational institutions. It is therefore important to give opportunities to students to participate in decisions within their environment and to actively become involved at the community level (Hart, 1996), thereby developing the engagement dimension (Dobson and Bell, 2006).

As Huckle and Wals (2015) elaborate, what is the context in which people have the opportunity to learn a way to sustain themselves in conjunction with governments and enterprises? Such contexts may include: management of the environment, rural development, social responsibility and urban greening.

In this section, an attempt has been made to show that while the need for ESDGC is clear, the methods of approaching it in the school curriculum might be different and will certainly continue to develop. Many scholars agree that the benefits from implementation are worth the efforts, yet there is not, until now, a universal agreement in which way this can be

achieved. The different pedagogical theories and models make clear the difficulties of choosing the right path towards sustainability.

II.1.5 Promotion of Education for Sustainable Development and Global Citizenship

In the previous section, the importance of introducing education for sustainable development and global citizenship at the school's curriculum level was highlighted. The aim of this section is the examination of practices that can promote education for sustainable development and global citizenship. As it was pointed out earlier, ESDGC must have certain characteristics if it is to be successful. First, it should be integrated as a whole into the curriculum and not taught as a single subject. Second, since the very nature of ESDGC is value-driven, it should be based on a set of values that include respect, both to other humans and to the environment. Third, and final, it should be locally relevant. That means it should address both international as well as local issues.

In addition to these characteristics, in the UN (2011) report 'Learning for the Future: Competences in Education for Sustainable Development' (ECE/CEP/AC.13/2011/6) experts from around the globe set the framework of educator competences for ESD. They argue that the adaptation of a comprehensive approach to envisage change to attain transformation is needed. These three elements are the following:

a) holistic approach, which seeks integrative thinking and practice
b) envisioning change, which explores alternative futures, learns from the past and inspires engagement in the present; and
c) achieving transformation, which serves to change in the way people learn and in the systems that support learning.

and they will remain impossible without educators who have particular knowledge and pedagogical skills in ESD (United Nations, 2012). The literature review clearly indicates that educators need particular abilities, which will help them facilitate, collaborate, and build moral values among their students.

There are various learning methods in the hands of these educators that can be used in ESDGC. All these methods ensure a development of values, skills, knowledge and attitudes amongst the people that are required to address the burning issues affecting the world.

According to Oxfam (2015) it is important for individuals to have knowledge and a basic understanding of subjects like social justice, sustainable development, economics, democracy, gender, good governance, human rights, citizenship, diversity, equality, conflict and peace resolutions, health, interfaith and intercultural dialogue, equal access to technological and scientific achievements in order to better understand and respect diversity.

Since ESDGC focuses on behavior, it includes certain skills or competencies. Along with knowledge, educators also need specific skills in areas that include critical thinking and analysis, recognition of negative stereotypes and prejudices, teamwork and cooperation, the ability of arguing effectively, the ability of dealing with conflicts, and decision making. The development of these skills plays an important role in global citizenship education (Frits Prior et al., 2009). With the knowledge of global issues and the relevant skills, teachers can fulfill the ultimate purpose of ESDGC, that is, to develop values and build attitudes that promote global citizenship at an individual and social level. These values and attitudes encourage self-esteem, self-confidence, self-respect and respect for others, social and environmental responsibility, open-mildness, visionary attitudes, proactive and participatory community membership, solidarity and commitment to social justice and equity.

Fowler, & Blohm (2012) going a step further from the guidelines that Oxfam and the Global Education Week Network suggest introducing training methods and activities oriented to promote attitudes, skills and knowledge in order to advance competency globally as a result global citizenship. In the following table of Desired, Training Outcomes, Suggested Methods, and Evaluation Activities, there are multiple methods of learning, including word, art, drama, debate, computer, role-playing, field trips, problem solving, simulations, etc.

Table 1. Desired Training Outcomes, Suggested Methods, and Evaluation Activities.

Desired Outcomes	**Training Methods and Activities**	**Evaluation Activities**
Knowledge (facts and information) Learner will Understand	Readings, songs, lectures, brainstorming, TV, radio, audiotapes, videos, computer, programmed instruction, debates, panels, interviews, galleries and workstations, field trips	Written exams, oral exams, application in other training activities
Skills (manual, thinking, planning, etc.) Learner will be able to do something	Demonstration of instructions followed by practice with feedback in order to correct mistakes; role playing, in-basket exercises, drills, games, coaching, case studies, worksheets, simulations	Observations on the job or in practicum or role play; observation checklist might be useful; case studies with decision making; development of product; training design, newsletter, media materials, drama
Skills (manual, thinking, planning, etc.) Learner will be	Discussion, role plays, role modeling, values-clarification exercises, films and videos, case studies, critical incidents, debates, games, self-analysis, feedback, simulations, field trips	Indirectly, by observing behaviors: interpersonal relations, approaches to issues and problems, choices of activities

In Table 1. the Desired Training Outcomes, Suggested Methods, and Evaluation Activities (Fowler & Blohm, 2012) are adapted from work by Knowles (1970). In their analysis, these researchers also propose a taxonomy based on the methodology of the activities by classifying the activities into cognitive, active and intercultural methods. Computer-based training is found in the cognitive methods category and is described as a method where the most typical outcome is knowledge acquisition, although skills development and attitudinal changes are possible. This is not strange, considering that the

rapid advancement in technology can bring a tremendous impact to the training methods. Information and Communications Technology (ICT) is among the assets recommended by organization such as UNESCO to promote ESDGC.

II.1.6 Information and Communications Technology in School Education and Global Citizenship

The integration of ICTs bring opportunities and challenges to the reorientation of education towards learning to live sustainably (Makrakis, 2017ab; Makrakis, 2006). Gigler (2004) states that "Similarly to literacy, newly acquired 'informational capabilities' can act as an agent for change of individuals and communities enhancing their abilities to engage with the formal institutions in the economic, political, social and cultural spheres of their life" (Gigler, 2004, p. 31). Jonassen (2010), on the other hand, examines the benefits that ICTs have in mediating meaningful learning activities. Table 2 outlines some of the strengths and weaknesses of computer-based training and, as Fowler and Blohm (2012) state, it currently bests address knowledge acquisition.

Table 2. Strengths and Weaknesses of Computer-based Training.

Strengths	Weaknesses
• Connects people globally to work harmonious in real time. • Include pictures, words and sounds that are captivating to the different preferences of learning. • Training is available according to the schedule of the participant. • Offers learning experience from both the moderator and peers.	• Some participants are uncomfortable with using technology or applying this pedagogy. • Employees have to be self-driven and might be required to train during their leisure time. • Necessity for access to required hardware and software may limit participation.

• Can be motivating if questions addressed are timely on target. • Currently best addresses knowledge acquisition: Get it, repeat it, practice it, and apply it (Kimball, 2002).	• Absence of interactions with the participants and facilitators. • Not everyone is accustomed to using cyber speech conventions effectively, which is a requirement in using current technologies. • The requirement of online training programs might cost the moderator to respond to the people; the development of skills requires a lot of feedback. • Absence of privacy: The available paper, comments to an instructor might be overwhelming. For instance, considering officials of the government.

ICTs may assist children in comprehending better climatic change options and may motivate them to interact and engage in actions to prevent climate change. As Jonassen (2010) points out, actions are a central learning mechanism. He suggests various technologies that may help students to construct understanding (effectiveness), such as computer supported collaborative work, electronic performance support systems, virtual reality simulations, and intentional information searching, videography, multimedia/hypermedia construction, knowledge-building communities – computer supported collaborative learning, mid-tools, cognitive tools and constructivist (problem-/project based) learning.

Schools and universities will be in position to educate their students for sustainable development and global citizenship by implementing a curriculum that has distinguishable levels of environmentally friendly skills, knowledge and attitudes. Civics and citizenship are very important for the learners' socialization (Calogiannakis, 2004) as well as the individuals' role to be a successful teacher (Karakatsani, 2008). An array of methods can be used to promote this purpose. As the intention of this thesis is to analyze the impact of the web environment, the study focuses more on the ways that online ICTs can be integrated into

meaningful learning environments to promote education for sustainable development and global citizenship.

According to several surveys published by the European Commission (European Commission, European Schoolnet and University of Liège, 2013; European Commission, 2019) indicators such as student computer ratios and Internet connectivity place some countries slightly above average in terms of ICT performance (e.g., Ireland). In fact, the 2013 ICT Census identified lack of enough technical support as the second most severe barrier to the use of ICT in teaching and learning. The outcomes of the study revealed that 60% of teachers working in different schools (primary, post-primary and special schools) consider high-speed broadband a very important aspect for learning and progress (Butler et al., 2013). In Ireland for example, the National Education and Research Network HEAnet completed the rollout of 'high speed' (100Mbs) broadband to every post-primary school in the country beginning in 2014. That infrastructure upgrade was co-financed by the Department of Communications, Energy and Natural Resources (DCENR) and the Department of Education and Skills, the programme supported government's Next Generation Broadband Policy of June 2009 to improve teaching and learning and increase collaboration and new opportunities for both online and offline technology-enabled learning. However, issues have arisen as follows:

- Need for policies to ensure support for schools in terms of ICT equipment purchases and installation.
- Need for clarification on supply of hardware - responsibilities and control
- Need for Technical support.
- And, more guidance needed on pedagogical methods to obtain the full benefit of digital tools in the educational process.

As described by the Survey of schools: ICT in Education (European Commission, European Schoolnet and University of Liège, 2013), most EU teachers have been using ICT in teaching and learning activities for many years, both in the preparation phase and during classes to provide information in a practical and attractive manner. According to the same report, 35% of all students in Europe do not benefit from ICT in schools. Additionally,

between 50% and 80% of students do not use digital textbooks, data-logging tools, podcasts, simulations and video games as learning tools in their schools. In addition, one of the results showed no evidence between complex infrastructure resources and students and teacher attitudes, action and confidence in ICTs. A different perspective on the education processes is offered by Johnson et al. (2011) who predicted an increase of game-based learning in educational tertiary institutions as well as a focus on problem solving and communication skills improvement through digital games - considered also as a viable strategy to anticipate the professional preparation for future jobs. Ash (2011) supported the idea of game-based learning to transfer and improve students' skills, combining classical learning with the game practical features, arguing that game-based learning develops problem solving and creates connections between theory and reality. Dolan, Goodman and Strain -Seymour (2012) enriched the previous findings with a digital game-based performance task to measure the skills of students in problem solving areas.

Therefore, ICT has multiple roles, in both formal and complementary learning, as it provides opportunities to practice learning without turning the negative consequences associated with gaming experience, like resourcing game-based learning approaches that can be difficult, into failure (Groff, Howells and Cranmer, 2010, p. 5). The importance of ICT to the intellectual development, in every type of the process of learning and teaching, is obvious. A positive aspect of ICT use in non-formal education is related to the level of motivation across time. Challenging tasks maintain students' interest and can sustain their engagement in the long run (Rupp et al., 2010). The advantage of technology in the 21st century has been widely recognized and consists mostly of its flexibility in supporting a variety of learning styles and a complex decision-making environment. Shute and Ventura (2013) argued that ICT facilitates the information collection on the players – students – with positive effects on the assessment process, part of the learning environments.

According to the U.S. Department of Education (2010), ICT activates thinking, planning, and learning, while simulations and virtual games engage learners in dynamic activities and offers them the possibility to gather new knowledge and to improve their skills. Spires et al. (2011) highlighted the success of ICT in the global economy, where interaction and procedural thinking are the most common processes. Under the empire of globalization, present at all levels and areas, the notion of global citizenship is often linked to the ICT

power. However, in recent years, developed economies have introduced the citizenship concept into their education systems.

Selwyn et al. (2007) revealed that in the UK, citizenship as a subject domain became a statutory element of the National Curriculum in 2002 at secondary school level (grades 3 and 4) and a non-statutory element of teaching and learning in primary education (grades 1 and 2). According to the National Curriculum, citizenship education is compound of three elements, as follows:

- Information, knowledge and understanding of the responsibility of being informed;
- Communication skills;
- And, the need for being active.

Therefore, ICT supports and facilitates citizenship education, and allows for the introduction of multiple teaching and learning methods through both technologies and software development. ICT applications have become vital for citizenship education. From a different perspective, teachers have a moral and ethical obligation to prepare students to become responsible global citizens. Digital media is a useful instrument to engage citizens in learning (Nebel, Jamison and Bennett, 2009).

Based on the existing literature, defining global citizenship in a broader sense includes three general elements, mainly related to learning and humanity, as follows: recognition of fundamental human equality; the capacity to achieve multiple and legitimate knowledge in the world, but in a critical thinking process designed to deliver valuable judgments consistent with the fundamental equality right of all people; and options for students engaged on personal, political, and consumer levels, dictated by their wide recognition of basic human equality. In this context, educators have the responsibility to use ICT in order to evidence the components of global citizenship, embrace multiple learning methods and offer challenges for developing problem solving skills. Deepening the thinking process becomes a clear objective in the fight for human equality, particularly in terms of re-orienting worldviews, and the development of new perspectives (Hartmann, 1998).

Global consciousness is a key aspect of citizenship education. This includes the interest and concern for global issues such as environmental degradation, violence, illiteracy, poverty, intolerance and xenophobia. These problems are not specific to a country or community and their resolution involves the combined responsibility of several factors. In terms of global awareness, global citizenship means:

- To learn about global issues;
- To share the world;
- And, to act in a global perspective.

Livingston (2012) argued that ICT sustains the concept of independent learning and is critical for the development of the global citizenship spirit. Personalization, choice and determination, as characteristics of student-centered learning activity, open new perspectives on the global scale and create freedom regarding the ownership of learning. Therefore, ICT assists the transformation of the teaching environment into a learner-centered one, where the control of learning is transferred from teachers to students and the latter receive authorization to compare options, to make decisions, plans and to find the best solutions (Lu, Hou and Huang, 2010; Castro Sánchez and Chirino Alemán, 2011)

Existing academic studies describe three main applications of ICT, as follows:

- Student-centered facilitation and self-directed learning – students have access to new knowledge through broad selection options, complex organizing tools and interpretation frameworks. By comparing information from different sources, they learn how to critically assess the materials and experience multiple new situations (Castro Sánchez and Chirino Alemán, 2011).
- Development of a creative learning environment – according to Chai, Koh and Tsai, 2013), students reach new levels of understanding in terms of learning styles. Adaptation to different requests leads to a higher scale of creativity. Learner's benefit from advanced techniques through computers and specific applications designed to improve concepts and offer flexibility for various activities (both formal and

informal). The ICT can support multiple learner needs and innovative paths to personalize learning pathways. Educational computer games, augmented reality educational applications and interactive e-books represent channels that support their creativity, autonomy and capability. In this context, ICT has a significant role in teaching and learning quality improvement (Gee and Hayes, 2011).

- Problems solving – for students, the main prerequisite of problem-based learning through ICT is being able to handle technology, apart from memorization of facts, making connections with real world situations. Reflection on personal experiences becomes a viable option for integration with ICT (Jimoyiannis, 2010). There is a bilateral relationship between problem-based learning and ICT starting with a basic example-real problem-solving tasks related to the implementation of ICT is an efficient way of learning with regards ICT and its integration processes (Makrakis and Kostoulas-Makrakis, 2016; Makrakis, 2017b).

Given that ICT implementation differs from country-to-country, researchers have identified obstacles to technological integration in conjunction with solutions for dealing with changes and challenges. From a teacher's perspective Ertmer and Ottenbreit-Leftwich (2010) highlighted the lack of collaboration, pedagogical support and experience; Almekhlafi and Almeqdadi (2010) mentioned the reduced time for using ICT during a class period; Hutchison and Reinking (2011) emphasized the lack of knowledge related to proper usage of technology in delivering pedagogical content and low support in the learning process and Tezci (2011) evidenced both ineffective use of ICT and the inability to manage large size classes. However, in order to counter the problems, among the strategies used by the schools, the most important include long-term partnerships with external policy makers and nonprofit organizations to ensure support for teachers, sharing the experiences and practices of ICT (Ertmer and Otternbreit-Leftwich, 2010); the opportunity to participate at workshops that offer practical information about technology integration (Almekhlafi and Almeqdadi, 2010) and continuous improvement of ICT skills through training and technology resources (Hutchison and Reinking, 2011).

The factors that influence ICT functionality can be categorized into external and internal factors. Their combined effects influence the level of effectiveness and the quality of ICT

usage and integration in learning institutions. An extensive range of external determinants has been identified as potential threats to ICT performances. These are: availability of technology, accessibility of ICT equipment, duration used for preparation, administrative and technical support, school curriculum and environment, the load of faculty teaching, management and culture, and time and pressure of preparing students for their national entrance exams (Tezci, 2011; Lin, Wang and Lin, 2010).

Limited access to software and computers, bad management of time for planning of courses and inappropriate administrative and technical support are the most common external factors that influence ICT (Chen, 2008). Cuhadar, (2018) showed positive relationships between several external factors and technology integration; inter alia, availability of technology and the support of specialized staff, teachers and principals. The availability of technology and its overall coordination are two essential features of technology integration. The better the support structure and availability of technology, the higher the technology integration efforts are made by teachers.

Tutor-related internal factors include the understanding of ICT use; personal opinions, which may be different from the ICT principles; position toward technology integration; perceptions of the ICT impact; self-confidence and motivation; the level of knowledge and skills associated with technology; and efficacy predictions in classes, beliefs and actions (Chen, 2008; Sang et al., 2010; Tezci, 2011).

Chen (2008) documented two main problems linked to the internal factors: inconsistent interpretation of ICT use because of limited information, knowledge and perception, and too much pressure generated by the fact that teachers have to deliver specific content to students and do not have time to cover all subjects areas and explore the topic using technology. It may create a gap between their beliefs and practical activity. In education institutions where competition is very intensive and the assessments are extremely rigorous, tutors are not willing to invest a lot of time in practical tasks involving technology.

One of the priorities is to improve the ICT infrastructures in all countries. According to Bakia et al.(2011), Australia, Canada, Estonia, Israel, Japan, Korea and New Zealand have made huge investments in this area. An initiative called ConnectED will connect 99% of the U.S. students through advanced ICT performances in terms of speed and access within schools and libraries. Apart from the infrastructure segment, an important aspect of success

is the instructors' profile (attitude and skills in managing ICT resources) and their knowledge and creativity in delivering most efficient learning and teaching experiences. The results of a study published by Wu, Hwang and Kuo (2014) showed that the integration of ICT and problem-based learning increases the level of understanding of problem-based learning and promotes collaboration and cooperation. Karami M., Karami Z. and Attaran (2013) argued the need of implementing a course for teachers called Methods of Using ICT in teaching various courses, in conjunction with the integration of ICT and problem-based learning as a teaching method useful in their current activity. The outcomes consist of more active and integrated classrooms, increased efficiency and confidence. Use of ICT in education has great potential for the teaching process, increasing the level of awareness towards integrity, ethics and respect while acting in a critical manner (Bennett, Maton and Kervin, 2008). Along with the new skills, ICT facilitates the development of the civic spirit, with positive effects on the existing social relations. Therefore, social communication technologies prove to be efficient through new channels for educational debates, social purposes, labour markets, political movements and other issues concerning the global arena. The positive externalities of ICT use include the aggregated beneficial outcomes for the participants. In this regard, Ebner et al. (2010), suggests that apart from learning, ICT drives progress of innovative social networking promotes participation and information sharing as well as friendship development on a global scale. In this context, the changes in the education systems have encouraged new trends that focus more on collective responsibility, synthesizing capacities and creativity, as features of justice-orientated citizens.

In traditional education systems, especially in typical decontextualized approaches, tutors often did not focus on external influences such as social trends, political movements and government strategies concerning societal development. In recent years, positive changes have resulted from teachers and students working together, aiming to gain new knowledge, embracing problem-based learning, and making responsible decisions in the integration of ICTs within both individual and collaborative learning. The global citizenship mentality requires new skills to adapt to a digital global economy. As the applications have continuously developed, students need to learn the craft of using and controlling the ICT to connect information in their own reality and to create new paths for learning. In these contexts, learning is more than a personal activity, but a collective and social process, which

combines a formal agenda of educational institutions with the personal goals and interests of students, transforming classroom spaces into global communities that are well-positioned to promote more sustainable ways of living.

II.2. Education for Sustainable Development and pre-service teachers

Education for sustainable development as was presented earlier is critical for our future yet it still relies on traditional education for adopting it and strengthen it. As UNESCO emphasizes "education has the potential to play a major role in the future realization of a vision of sustainability that links economic well-being with respect for cultural diversity, the Earth and its resources" (UNESCO, 2007, p. 6). Educational institutions will have a key role in this education transformation since they are key players in individual and social learning systems thus, contribute significantly in sustainable development processes. Among educational institutions, universities have the greatest burden and responsibility for fostering sustainable development, mainly due to the influence they have on society and to the freedom to develop their own curriculum. Developing a curriculum related to sustainable development enhances students' awareness and helps develop skills and creative solutions that will later disseminate to society. Among the university students, those who have perhaps a greater special weight on their shoulders are the students of the Pedagogical Schools. Pre-service teachers will become the future teachers. And as teachers they will be called to pass on their values and beliefs to the next generations. Many surveys (Andersson, 2016; Andersson et al., 2013; Appleyard and McLean, 2011; Brody and Ryu, 2006; Chatzifotiou, 2006; Hunt, 2017; Kieu, Singer and Gannon, 2016; Olsson and Gericke, 2015; Schuler et al., 2017; Schutte et al., 2017; Shephard et al., 2015; Spahiu and Lindemann-Matthies, 2015; Zachariou and Valanides, 2006) have been conducted on pre-service teachers' dispositions regarding education for sustainable development and global citizenship. In most of the surveys the aim is the transformation of pre-service teachers' perception of sustainable development and global citizenship along with the development of certain skills and attitudes that align to the values and goals of sustainability.

The major skills or competencies that are described in these surveys are:

- systems thinking which assists students in understanding the complexity of natural, social and economic systems,
- values and ethics that are essential for moral decisions,
- future visioning which puts pre-service teachers in the process of thinking about the future and along with critical reflection give to them an action orientation,
- communication and collaboration that is vital in order to obtain a balanced dialogue between pre-service teachers and students and
- finally, the problem-solving skills will assist pre-service teachers in tackling the obstacles that prevent society from having a sustainable future.

The participatory approach is used in a significant number of the surveys which were mentioned earlier with pre-service student discussion and group exercises that embrace problem-solving methodologies and analyze real-world problems. The constructivist approach is also preferred by many researchers. Most of those approaches engage pre-service teachers in sustainable development issues and encourage them to solve them by applying the knowledge and specialization that was previously acquired within the project or course. Additionally, there projects that rely on active engagement in the real world for acquiring their positive effects (Kubal et al., 2003).

In order to evaluate the efficiency of these interventions many studies expose pre-service teachers to core values and lifestyles of sustainable development while others don't examine an intervention explicitly but rather investigate the degree that the universities' curriculum introduces competencies of ESD to the students. The interventions that were examined varied from one day to one academic semester and most of them were implemented by teachers either in the universities or in the school classes. In our case the method that was chosen was the one semester intervention in order to provide sufficient time to pre-service teachers for exploration and reflection on the provided material. The majority of the surveys that were examined, had a transformative intension and had as main goal the change in pre-service teachers' knowledge, perceptions, awareness, morality and ethics regarding sustainable development and global citizenship.

II.3. Education Philosophies

Philosophies of teaching range along three parallel spectra: modern to postmodern; traditional/conservative to contemporary/liberal; and authoritarian (convergent) to non-authoritarian (divergent). These spectra express four major world philosophies: Idealism, Realism, Pragmatism, and Existentialism.

The Idealist philosophy, furthest toward the modern, traditional, authoritarian ends of the spectra, manifests as the Perennialist approach to education, teaching unchanging truths (Cohen, 1999). Lecture and discussion are primary means of teaching in this mode. It is the oldest mode of instruction in Western culture (Hughes, 1997, p. 25), originating as far back as Plato and Socrates. Lecture consist of the teacher transmitting a set body of subject knowledge to listening students; conversely, the technique of Socratic questioning, in which the teacher asks questions such as "Why do you think so?" or "Is this true in all cases?" encourages learners to examine ideas in depth. Socrates envisioned learning as an encounter between the learner and the subject being learned (Morrison-Saunders and Hobson, 2013). The very term education is derived from the idea that knowledge is educed, that is, discovered within the learner.

Because of its emphasis on universal truths, Idealism does not necessarily account for cultural differences among students (Kozikoğlu and Uygun, 2018). Although this seems a noble approach, it has its pitfalls. In the first place, high ideals and ideas are not the reality of life; the attempt to transform students and society through teaching what are thought to be unchanging truths can instead lead to a failure to question the current state of society and passive acceptance of it (Kertz-Welzel, 2011).

Each teaching philosophy has its associated learning style, and for Idealism, it is Information Processing (Cohen, 1999), in which the mind processes a fixed body of knowledge and constructs meaning from it. A difficulty with this is that if the fixed body of knowledge is presented as a lecture, in which the students are simply supposed to listen to the teacher, their attention is likely to be elsewhere, and little real learning will then take place (Morrison-Saunders and Hobson, 2013).

Realism is less modern, traditional, and authoritarian, than Idealism, and is represented in education by Essentialism, teaching the "essential" skills needed for

citizenship in the world (Cohen, 1999). This approach uses such techniques as demonstration and recitation. However, because Realism advocates problem solving by the scientific method, it also emphasizes the importance of observation alongside reason (Hughes, 1997, p. 28). Perennialism and Essentialism are considered subject-based approaches (Kozikoğlu and Uygun, 2018), because the main focus is on the course subject matter and its transmission. Subject knowledge forms the basis of learning in this mode, and the teacher is thus seen as a subject-matter expert (Hedges and Cullen, 2005); although this can potentially be detrimental, if it leads to a "teacher-centered" approach in the sense of being more about the teacher than the subject (Morrison-Saunders and Hobson, 2013). Realism has two associated learning styles: Behaviorism and Social Learning (Cohen, 1999). In Behaviorism, the premise is that absolute answers exist, and the goal is a change in the learner's behavior (Singhal, 2017). This approach makes use of reinforcement as a training tool through facts, drills, and practice, an approach referred to as instruction, as opposed to construction (Dexter, Anderson, and Becker, 1999). Social Learning makes use of the human need to belong to a social group and involves learning to observe and imitate the behavior of others.

These non-constructivist modes are characterized by the idea that learning a skill set is the primary objective, that recall of facts and concepts is achieved through note-taking and practice, and that grades and recognition motivate students (Dexter, Anderson, and Becker, 1999). Currently, standardized tests are based on measuring factual learning in the Essentialist mode. To the extent that the need to prepare for them dominates the curriculum, they prevent teachers from teaching in other modes.

Pragmatism tends toward a postmodern, contemporary, non-authoritarian approach, and engenders the Progressivist view of education, in which ideas are tested through experimentation (Cohen, 1999). It arose largely as a refutation of Idealism (Hughes, 1997, p. 25), and sought to address its shortcomings (Kertz-Welzel, 2011). Pragmatism is concerned with human problems and solutions (Hughes, 1997, p. 28), and acknowledges that effective learning must not be oversimplified to the point of becoming merely the transfer of skills (Morrison-Saunders and Hobson, 2013).

This is considered a problem-based approach (Kozikoğlu and Uygun, 2018), emphasizing solving problems more so than absorbing subject matter. John Dewey was a prime proponent of this approach (Hughes, 1997, p. 29), seeing in it the contrast between

older modes of Idealism and Realism, with docile, passive students absorbing information, and the Pragmatist mode, in which students actively take responsibility for their learning. Dewey believed that even young children can, and indeed need to, establish aims for themselves (Glassman and Whaley, 2000). His ideas set off a shift in America throughout the twentieth century, away from the teacher-as-transmitter and toward experiential learning (Hughes, 1997, p. 29). Pragmatism addresses the Constructivist mode of learning (Cohen, 1999), in which the learner interacts with the environment, reflects on his or her actions, and constructs meaning from this – a mode called, appropriately, construction, in contrast to instruction (Dexter, Anderson, and Becker, 1999) It depends on self-discovery and value judgments, and their application to problem-solving (Singhal, 2017). Also, within Pragmatism is the Cognitivist mode, which is the process of making generalizations from specific experiences. This sets Pragmatism apart from Idealism and Realism in that teacher and student share responsibility (Singhal, 2017). In the Constructivist mode, knowledge is seen as temporary due to changes and advances, and socially defined (Franklin, 2005) – hence in direct contrast to Idealism – and students are thought to retain learning best when the subject matter is personally meaningful to them (Dexter, Anderson, and Becker, 1999). With children, a successful Pragmatist approach requires understanding the difference between experience and mere activity (Glassman and Whaley, 2000); in experience, the mind and body interact, so that the activity of the body results in a transformation of the mind. Play, if the teacher understands it, can thus be integral to learning.

The final philosophy, Existentialism, is the most postmodern, contemporary, and non-authoritarian. It represents the Reconstructionist, Radical, or Critical Theory philosophy of education, and focuses on analyzing current events in order to formulate ideas for a better world (Cohen, 1999). In its Reconstructionist aspect, this is also a problem-centered approach; however, because it also partakes of Humanism, it is to be considered student-centered as well (Kozikoğlu and Uygun, 2018), with its primary goal the development of the individual. Existentialism is about each individual forming their own meaning in life, and advocates largely self-directed education. And since in real life, every endpoint is a beginning for something, new, this should be the case in education as well (Glassman and Whaley, 2000). Although popular today, this mode, too, can be criticized, if its student-centered

approach degenerates into too much focus on the wants and needs of the students, to the detriment of learning content (Morrison-Saunders and Hobson, 2013).

In this philosophy, a Humanist mode of learning is used, i.e. an emphasis on personal responsibility for choices, for the greatest good, and determining one's own destiny (Cohen, 1999), that is, it is concerned with developing the whole person, and emphasizes different needs of different learners (Hughes, 1997, p. 26). Humanism includes developing the skills of critical thinking, problem solving, and good communication, which together make up metacognition or "learning to learn" (Singhal, 2017). Since adult life requires constant learning to keep up with the continual changes in the world, "learning to learn" can, in a sense, be considered an essential skill.

One reason Idealism has historically predominated is that the lecture is the easiest part of a curriculum to develop (Singhal, 2017). As class discussion cases and labs have gained traction, there has in turn been a shift toward other modes of teaching. Likewise, the shift towards more online learning has coincided with, and helped to promote, a shift toward more student-centered approaches to education (Stacey and Wiesenberg, 2007; Kimaiyo, Kitainge and Too, 2016). To look at it in reverse, teachers with a Pragmatist teaching philosophy also tended to feel at ease with using computers in the classroom for facilitating student discovery (Franklin, 2005). Kozikoğlu and Uygun (2018) found that Existentialism was the most popular philosophy among the teachers they surveyed, Essentialism the least popular. Similarly, in the teachers surveyed by Hughes (1997, p 83) Progressivism, associated with the Pragmatist philosophy, was the most favored, although this group differed in that Radicalism, part of the Existentialist philosophy, was least preferred. Stacey and Weisenberg (2007) also found the greatest preference for Constructivism, i.e. the Pragmatist philosophy, as did Franklin (2005), and Dexter, Anderson, and Becker (1999) found that more than three-quarters of teachers could be considered Constructivist. Conversely, Kimaiyo, Kitainge and Too (2016) found that slightly more than half of teachers favored student-centered education; they considered this a hindrance to the goal of improving competency in informtion and communication technology.

Computers in the classroom, in themselves, would not necessarily lead to postmodern teaching modes. Teachers who had shifted to a more student-centered approach said that computer technology had not changed them, but rather, had assisted them with changes they

had already planned to make (Dexter, Anderson, and Becker, 1999). All the four modes can involve computers (Singhal, 2017): Idealism can involve the delivery of information, in a lecture format, through videos or podcasts. Realism is supported by Computer-Assisted Instruction (CAI), in which lectures and class exercises are posted online, facilitating repetition, sequencing, and reinforcement. This has been used with the youngest elementary students (Franklin, 2005). Pragmatism is supported in two ways: Cognitivism is supported by Computer-Directed Instruction (CDI), in which computers are a means of accessing numerous sources based on student needs; Web Quests are one example. The other facet of Pragmatism is Constructivism, in which problem-solving is a key element; computer applications, certain games, and even the creation of applications by students, can bring problem-solving to the forefront. Social Constructivism also adds that people learn when socially engaged, and the growth of collaborative platforms such as Slack and Google Docs enables students to collaborate socially through computer mediation. Finally, Humanism, in its aspects of metacognition (learning to learn – critical thinking, problem solving, communication) and socialization, is facilitated by interactive online conferencing.

In discussion of shifting norms in teaching philosophy, it is important to consider the actual needs of students. Is the shift towards more student-centered modes of instruction a sign of progress, or an indication that teachers lack sufficient subject-matter knowledge (Hedges and Cullen, 2005)? Could it be that because Pragmatism and Existentialism are seen as socially desirable, teachers might answer questionnaires, not according to their actual beliefs, but according to what they feel they "should" say (Hughes, 1997, p. 76)? Morrison-Saunders and Hobson (2013) advocate for an approach in which the teacher is genuinely captivated by the subject and contend that only in this way will the students be fully engaged with it. Children are different from adult learners in that they lack years of life experience (Hughes, 1997, p. 13). Are Reconstructivist approaches, analyzing current events, most suitable for young children? In some cases, perhaps. But children of differing abilities – and disabilities – have different educational needs. In recent times, the children's experiences and learning environment has been emphasized to the detriment of subject knowledge (Hedges and Cullen, 2005). Even with adult learners, it has been noted (e.g. Hughes, 1997, p. 56) that the lecture still has its place for disseminating information. For how can Progressive or Reconstructivist activities take place without some basis in information? The Essentialist

approach, although falling out of favor (Kozikoğlu and Uygun, 2018), still has a role to play, especially with the youngest children who need to learn essential life skills. Conversely, the growth of information and communication technology (ICT) requires students to learn how to formulate and implement their own ideas, and hence, is best approached from a student-centered paradigm (Kimaiyo, Kitainge and Too, 2016); in systems where the advancement of ICT is seen as a desirable goal, those teachers who still adhere to older approaches such as lectures and drills are perceived as backward.

No one teaching philosophy is a catch-all solution. Indeed, it could be argued that different subject matter areas are best approached in different ways. Hughes (1997, p. 89-91) found that teachers of what are today called STEM subjects tended to favor a more subject-centered mode, teachers of humanities, a more student-centered mode. Nevertheless, the Humanist emphasis on critical thinking and metacognition equips learners for all aspects of real life.

Finally, it must be noted that although tools for assisting teachers in discovering their teaching philosophy are useful (Hughes, 1997, p. 128), there are limitations. The most obvious one is teachers' teaching style – made up of actual classroom behavior – does not always match their philosophy (Hughes, 1997, p. 138); in particular, teachers with a student-centered philosophy often still employ a teacher-centered teaching style in practice.

This survey focused on the two student-centered philosophies, Progressivism and Reconstructionism, and one teacher-centered philosophy, Neo-conservatism, since these are the ones most commonly encountered in the Greek Education system. Neo-conservatism is a movement found in many countries and based on conservatism (Elliott and MacLennan, 1994). The Neo-conservative school of thought offers a curriculum that fortifies conservative values along with cultural, religious, national, and ethnic identities (Tabrizi, 2014). Since language, religion, and history have a significant effect on personality development, the state places more emphasis on these educational subjects. All the items that were picked for the questionnaire reflect these philosophies.

Chapter III.

Theoretical and Methodological Framework of the Study

III.1 Introduction

This chapter presents an overview of the design and the methodology used in this study. At the beginning there is a description of the purpose and the objectives of this study. Secondly, the rationale for using survey as the most appropriate method in this study is discussed and the rationale for using questionnaires for data collection. The four phases of the research are also presented.

Phase 1, was the literature review of the climate change and the effects of the phenomenon on the environment, the economy and society, active citizenship and the qualities that form it as well as search for related surveys and questionnaires that attempt to identify it. In addition research for the educational philosophies, the learning theories on which we relied for the design of the Climate Change Curricula, the educational design models on which we relied for the design of the WBLE environment with the transformative learning in mind, the ExConTra learning model and the educational or research evolving model design of the questionnaire based on previous questionnaires identified by the bibliographical review. (Morais and Ogden, 2010; Conti, 2007). Phase 2 consisted of the implementation of the WBLE at the University of Crete within two different courses. Phase 3 was the main study, which was conducted after the end of the academic semester with two hundred pre-service teachers. In this chapter the instruments that were used in the main study, the sample, as well as the process of data collection are described. Phase 4 describes the coding of data and the methods of data analysis.

III.2 Philosophical Underpinnings of the Research

The study was mainly based on the empirical–analytical methodology and its 'positivist' ideologies, in environmental education research. (quantitative approach) through a semi-structured questionnaire which also included open questions to investigate further the views of the participants.

III.3 Research Questions and Hypotheses

This research study mainly explored pre-service teachers' experiences of the WBLE, and patterns of association between the pre-service teachers' dispositions - education philosophy and their impressions of the WBLE. More specifically the aim of this study was a) to design, develop and implement a WBLE that would be used from primary school students and teachers in order to expose them to the concepts of climate change and possible solutions like active citizenship b) to investigate the factors that influence pre-service teachers acceptance of the WBLE along with the qualities that believe they are important in order to use ICT in their teaching and c) to investigate the factors that influence pre-service teachers active citizenship according to their education philosophy.

In order to successfully use the WBLE, teachers needed to develop certain action skills in order to have a positive attitude towards it. That was mainly because without action there could be no real change. Intercultural communication in its broadest sense is important in the mediation between attitude and action. Important factors for the positive attitude and adoption of the WBLE are usability, satisfaction and content relevance. Usability is highlighted by previous studies (Davis, 1989; Chow et al., 2012).

When teachers realize the ease of using a technological tool, they can understand its usefulness and are more likely to adopt it. Previous research has confirmed a significant positive correlation between satisfaction and behavioral intention (Chen, Yen and Hwang, 2012; Alraimi, Zo and Ciganek, 2015; Wang et al., 2019).

Also, the level and relevance of the content as highlighted by recent research (Mohammadi, 2015) is important in general acceptance and this is because the quality of the technical system, content and information positively affect the intention to use. Personal

educational philosophies are directly related to teaching practices for active citizenship, as Buehl and Beck argue (2015). Educational philosophies may not always be evident in practice even though there is an absolute alignment between educational philosophies and teachers' perceptions of teaching and learning. The focus of the study was to explore six different models as possible predictors of certain categories of perceptions regarding educating and engaging learners in sustainable development was the second major section and focus of this study.

Within this context, the specific research objectives mainly were to explore pre-service teachers' experiences of the WBLE, and relationships between the pre-service teachers' qualities, dispositions, awareness and educational philosophy and their impressions of the WBLE.

To explore these questions, the following hypothesis were formulated:

- Hypothesis 1: Inter-cultural communication, justice, self-awareness, global civic engagement and social responsibility are expected to contribute significantly to the prediction of usability.
- Hypothesis 2: Inter-cultural communication, justice, self-awareness, global civic engagement and social responsibility are expected to contribute significantly to the prediction of pre-service teachers' satisfaction towards the 'Act for Climate' web-based learning environment.
- Hypothesis 3: Inter-cultural communication, justice, self-awareness, global civic engagement and social responsibility are expected to contribute significantly to the prediction of 'Act for Climate' content relevance.
- Hypothesis 4: Inter-cultural communication, justice, self-awareness, global civic engagement and social responsibility factors are expected to contribute significantly to the prediction of neo-conservative pre-service teachers' education philosophy.
- Hypothesis 5: Inter-cultural communication, justice, self-awareness, global civic engagement and social responsibility factors are expected to contribute significantly to the prediction of the progressivist pre-service teachers' education philosophy.

- Hypothesis 6: Inter-cultural communication, justice, self-awareness, global civic engagement and social responsibility factors are expected to contribute significantly to the prediction of reconstructionist pre-service teachers' education philosophy.

The dependent variables were: 1) usability; 2) satisfaction; 3) content relevance and the three dimensions of the subjects' educational philosophy, that is, 4) neo-conservatism, 5) progressivism, and 6) re-constructionism. While, the independent variables or predictors were a) inter-cultural communication, b) justice, c) self-awareness d) global civic engagement and e) social responsibility.

III.4 Research Methodology

The choice of the research design and methodology and data gathering techniques was based on the need to investigate the pre-service teachers' experiences of the WBLE, and patterns of association between the pre-service teachers' dispositions - education philosophy and their impressions of the WBLE. The method chosen, as the most appropriate, was the survey methodology; the instruments used for data collection were semi-structured questionnaires, which are used in large scale surveys to find more details about the sample.

The current research design is primarily based on a quantitative methodology with a few open questions which were treated qualitatively in order to shed light on some quantitative results. As explained earlier, the research objectives were to detect patterns of association regarding participants' perceptions, knowledge, and action on climate change and global citizenship matters. Thus, this study used a large-scale survey research instrument. According to Bryman (2012) survey methodology can be "construed as a research strategy that emphasizes quantification in collection and analysis of data and that entails a deductive approach to the relationship between theory and research, in which the accent is placed on the testing of theories; has incorporated the practices and norms of the natural scientific model and of positivism in particular; and embodies a view of social reality as an external, objective reality" (Bryman, 2012, pp. 35-36). Surveys can be conducted on a large scale by large research teams in order to investigate large populations or on a smaller scale carried out by the lone researcher (Cohen, Manion and Morrison, 2018). Cohen, Manion and Morrison

(ibid) claim that a survey is used to "scan a wide field of issues, populations, programmes, etc. in order to measure or describe any generalized features". The main reasons Cohen, Manion and Morrison (ibid) argue for using a survey are as follows:

- "gather data on a one-shot basis and hence is economical and efficient;
- represent a wide target population;
- generate numerical data;
- provide descriptive, inferential and explanatory information;
- manipulate key factors and variables to derive frequencies;
- gather standardized information (i.e. using the same instruments and questions for all participants);
- ascertain correlations;
- present material which id uncluttered by specific contextual factors;
- capture data from multiple choice, closed questions, test scores or observation schedules;
- support or refute hypotheses about the target population;
- generate accurate instruments through their piloting and revision;
- generalize and observe patterns of response in, the targets of focus;
- gather data which can be processed statistically;
- and rely on large scale data gathering from a wide population in order to enable generalizations to be made about given factors or variables" (ibid, p. 334-335).

Surveys can be experimental, cross-sectional, longitudinal, case studies and comparative (Bryman, 2012, p. 76). This study can be categorized as a cross-sectional study as the data drawn was from a specific point of time. This was done intentionally in order to avoid the complications of analyzing variable data from more than one point in time. According to Bryman a cross-sectional survey "entails the collection of data on more than one case (usually quite a lot more than one) and at a single point of time in order to collect a body of quantitative or quantifiable data in connection with two or more variables (usually many more than two), which are then examined to detect patterns of association" (Bryman, 2012, p. 58). In addition, this study used a mixed methods approach. Quantitative research

design was combined with qualitative research methology. Bridging quantitative and qualitative research methods needs clarification of each one's contribution and the level of the merge (Makrakis and Kostoulas-Makrakis, 2016). In our case, the primary research method was built on a quantitative research design and was supplemented by a qualitative one, that was integrated into the survey instrument of the first.

The collection of data in surveys involves one or more of the following data-gathering techniques: structured interviews, self-completion questionnaires and structured observation (Bryman, 2012). The instrument used in the current study was the self-completion questionnaire that was completed online at the computer lab of University of Crete. The desks were spaced out and the questionnaires were completed in exam-like conditions, with talking and overlooking of others' questionnaires strongly discouraged. The questionnaire included both Linkert scale and open questions. By using both Linkert scale and open questions it was possible to compare the data for inconsistencies. According to Yin (2014) this helps control for both construct validity and external validity. The rationale for using these instruments is discussed in the following sections.

The target group of this study were pre-service student teachers of the University of Crete. In this research, two hundred (n=200) pre-service teachers were studied over a period of one academic semester. The actual survey was conducted once after the use of WBLE for fourteen weeks The pre-service teachers that were selected to participate in the study had little or not at all previous knowledge of climate change issues but they were chosen mainly because of their interest in the topic. Participants were asked to voluntarily use the WBLE as an alternative tool in their teaching method. They used it throughout their courses as a reference for ideas, activities and general information. At the end of the semester most of them used parts of it that they were integrated in their own assignments.

III.5 Previous studies investigating the value of the developed WBLE

It is important to note that the WBLE material had been substantially revised during the implementation phase of Kaliantzi's research in 2014. As Kaliantzi (2016) points out, at the end of the first round of improvements in 2013 the material was ready to be tested as curriculum material in classes. The tracking of the material during the action research cycle

and the observations of the participants that included both teachers and students revealed that corrections and adaptations of the material were needed. Further the action research showed that it was urgent to simplify the material in terms of vocabulary and learning content in the Primary School classes of the first, second and third grade. Greater adjustments were made for the A and B grade. The web material was completed after many corrections at the end of October 2014. Kaliantzi used participatory emancipatory action research that took place over three cycles and it was implemented on students of 2nd, 4th and 6th grade of a primary school in Attica. Before the intervention primary school students knew nothing or had false ideas about climate change, weather and climate. Moreover, they did not have any interdisciplinary learning material in their curriculum, and they weren't used to get information through ICT. They weren't trying to solve environmental and social problems and they did not act in order to prevent and address climate change through ICT. They had a small degree of awareness, sensitivity and responsibility for modern problems, but they had not developed any kind of environmental ethics, behavior, conscience and citizenship. After the use of the WBLE students understood the concepts of climate change, weather and climate and they linked cross-thematic knowledge and skills. They acquired skills in searching, composing, generalizing, analysing, evaluating and processing information using ICT and also developed skills to solve environmental and social problems. Most importantly they acted in order to prevent and tackle climate change through ICT by gaining more awareness, sensitivity and responsibility for modern problems. Finally, they strengthened and acquired a new environmental ethics, behavior, conscience and citizenship.

The same procedure was followed with the second part of the topic of the web environment that focused on children’s rights and the way that the rights impact climate change. This was examined by Gkotzos who focused his research specifically on groups of in-service teachers that were given a selection from a teaching unit. In his research, teachers had to design an alternative teaching intervention. In his approach, learners were asked to choose and explore among the already developed units of the learning environment (climate change and right to a.) water, b.) food or c.) education) and use it as an example of good practice and as a source of reference for their own intervention (the redesign of an existing teaching unit). The redesign of the teaching unit included: a.) the theoretical background of the unit and guidelines for the teacher (teacher book), b.) the learning environment: b1.) a

student book and b2.) a workbook. The development of alternative teaching interventions aimed to make in-service teachers integrate each intervention into their practice of ESD as well as from a child rights perspective. The teachers were also instructed to reflect upon their previous teaching knowledge acquired in their School Practicum by asking themselves the question of planning and delivering their previous teaching in an alternative way. In-service teachers selected and redesigned units from several disciplines of the primary school curriculum including Geography, Language, Religion, Mathematics, Physics, Civic Education, and Aesthetic Education. Therefore, the material that was given to the pre-service teachers in this research study included all the corrections and improvements from these two previous studies.

Gkotzos used phenomenographic and empirical-analytical research approach with active participation of the subjects that where both teachers and students. Moreover, in his research he achieved equal participation of the class teachers as co-researchers and actively involved learners in the design and development of the WBLE. The WBLE was implemented in one hundred sixty-five (165) learners of nine (9) classes (5th - 6th grade), in five (5) primary schools, all members of the UNESCO Associated Schools Project Network (ASPnet). The class teachers were all treated as partners and co-researchers. In his survey human intervention was initially mentioned as the most popular cause of climate change referred to by teachers but after the teaching interventions, the use of fossil fuels became an equally popular cause of climate change. Floods were the most popular effect of climate change mentioned by teachers. The majority of learners associated climate change with disasters and the corresponding percentage has been more than doubled, after the teaching interventions. Most learners agreed that there is collective responsibility for climate change. Before the teaching interventions, one-third of learners believed that climate change had no personal effects on them. This percentage decreased to about one quarter after the teaching interventions. After the teaching interventions, more learners referred to the global and local effects of climate change with devastation and destruction of plants, forests or cultivated areas being the most popular responses.

III.6 The steps of the research process

This study consisted of four phases that they will be described in detail in the following section.

Figure 4. The four phases of current study

- The first (1st) phase included the literature review as well as the design of the WBLE.
- The second (2nd) phase included the use of the WBLE during a semester as a support tool, source of information and activities. The majority of the students used it for the completion of the final delivered assignment, mainly with the integration of its material, reports and online tools.
- In the third (3rd) phase, the overall evaluation of the WBLE and the teaching intervention at the University of Crete was carried out through a questionnaire given to the students after the completion of the courses and their final assigmnet.
- Finally, the fourth phase concentrated on the coding and analysis of the data as well as the completion of the writing of the dissertation.

The phases of this research are shown in Figure 4.

III.6.1 Phase 1: Literature Review and WBLE construction and development

During this initial period of literature review different sources of information were investigated in order to acquire a broader view of the subject. That included academic books, journals, web sites, online databases, reports and government documents. The development

of the interactive e-book that later became the web-based learning environment was also started in collaboration with Kaliantzi as the material created was used in her research as well.

The aims of the first phase were to:

1) Conduct a literature review of the global citizenship concept and the dimensions that it possibly has. Education for Sustainable Development as well as Sustainable Development Goals were also examined. The relation of Global Citizenship and Education for Sustainable Development was also investigated in addition to the importance of introducing Education for Sustainable Development and Global Citizenship in School Curriculum. In addition, the promotion of Education for Sustainable Development and Global Citizenship was also explored. Finally, the role of Information and Communications Technology in School Education and Global Citizenship.
2) Conduct a literature review of education theories along with educational philosophies in order to determine which of these are the most appropriate to investigate intention of using the WBLE from pre-service teachers' perspective, as a tool to educate primary school students.
3) Examine Instructional Design Models such as the Situated Cognition Theory, the Sociocultural Learning Theory, the Bloom's Taxonomy of Learning Objectives, the Problem-Solving Model, the SAM Model and the ExConTra Model. The ExConTra Model was determined to be the most relevant to the present research.
4) Design the questionnaire based on previous questionnaires identified from the literature review. The questionnaire was designed using many items from existing instruments. For example, the questions from V48 to V97 (see Appendices) refer to the items used for creating the initial global citizenship scale (Morais, & Ogden, 2011). The questions from V98 to V123 are from similar studies that focus on identifying educational philosophy by instructors of lifelong learners (Conti, 2007).

III.6.2 Phase 2: Class implementation

The implementation of the WBLE to the students of the Pedagogical Department of the University of Crete was conducted during the winter semester of the academic year 2017-2018. The pre-service teachers that took part in the survey were the ones who attended the courses 1) Curriculum: Theory and practice 2) ICT in Education for Sustainable Development. The interactive learning environment was the tool that pre-service teachers used for the in-depth study of all the dimensions of climate change. The WBLE became the pre-service teachers' instrument to study, in-depth, climate change issues and to develop alternative teaching interventions engaging ESD with the use of ICT tools. Pre-service teachers worked freely by using all the thematic areas of the WBLE ("Climate change and me", "Climate change in my area", "Climate change and ecosystems", "Climate change and atmosphere", "Climate change through time", and "Energy, fossil fuels and waste"). Pre-service teachers were asked to develop an assignment with an alternative teaching intervention engaging ESD with the use of ICTs. Pre-service teachers worked independently. Each participant had to select a teaching unit from the ones provided as the proposed primary school curriculum.

III.6.3 Phase 3: Questionnaire and the reliability of the questionnaire's measure

One of the objectives of the analysis of data was to provide evidence for the validity and reliability of the developed scales and subscales used in the pre-service teachers questionnaire, including their beliefs towards the WBLE and the way that their philosophical theories, in conjunction with the WBLE, affect their engagement in active citizenship. This objective was examined with content validity of the questionnaire and Cronbach's coefficient alpha. Table 4 shows the intercorrelations of the dependent and independent variables as well as the Cronbach a reliability of all these composite variables. The reliabilities ranged from a= .65 to .84, indicating a good measure for running the multivariate regression statistical analysis. Similarly, the intercorrelations among the independent variables do not show any multicollinearity effect, necessary for a multiple regression analysis.

For a normal distribution, the value of the kurtosis statistic is zero, something that is very unusual to happen in such types of research. If the value is greater than + 1.0, the distribution is leptokurtic. If the value is less than -1.0, the distribution is platykurtic. A skewness value more than twice its standard error is taken to indicate a departure from symmetry. For skewness, if the value is greater than + 1.0, the distribution is right skewed. If the value is less than -1.0, the distribution is left skewed.

Table 3. Bivariate Spearman-rho correlations and descriptive statistics of the variables.

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Usability	--										
2. Satisfaction	0.53***										
3. Content relevance	0.55***	0.48***									
4.Intercultural communication	0.48***	0.26***	0.35***								
5. Justice	0.13	0.08	0.17*	0.25***							
6. Self-awareness	0.40***	0.28***	0.28***	0.56***	0.06						
7. Global civic engagement	0.44***	0.29***	0.30***	0.54***	0.08	0.63***					
8. Social responsibility	0.24**	0.16*	0.27***	0.29***	0.42***	0.29***	0.38***				
9. Progressivism	0.35***	0.40***	0.44***	0.43***	0.34***	0.42***	0.50***				
10. Neo-conservatism	0.16*	0.14	0.34***	0.36***	0.04	0.29***	0.25***	0.07	0.23**		
11. Reconstructionism	0,41***	0.29***	0..43***	0.43***	0.42***	0.38***	0.37***	0.51***	0.79***	0.25***	
Items	15	4	4	6	8	8	19	5	8	6	8
Mean	3.02	3.06	3.18	3.14	3.37	2.96	2.86	3.28	3.41	2.88	3.43
Median	3.00	3.00	3.00	3.17	3.50	3.00	2.82	3.20	3.50	2.83	3.50
Standard deviation	0.31	0.40	0.37	0.36	0.40	0.41	0.35	0.45	0.36	0.45	0.37
Skewness	0.01	0.07	0.03	-0.14	-1.43**	0.06	0.34	-0.37*	-0.19	-0.01	-0.27
Kurtosis	-0.09	0.66	0.78*	1.45**	2.56***	-0.10	0.75*	0.66	-0.72*	0.57	-0.90*

Cronbach's α	0.78	0.69	0.67	0.68	0.75	0.75	0.84	0.65	0.76	0.69	0.79

Note. * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$. Significant skewness and kurtosis indicate a significant deviation from normality.

The questions used to develop the scales for the factors/ models being examined were chosen from a pool of questions. The exact questions used for data generation for all the variables are as follows:

The variable "usability" took the following questions into account:

The web environment "Act for Climate"

- V10 Helped me develop my personal teaching plan
- V11 Helped me organize my thoughts
- V12 Helped me structure my own assignment
- V14 With its use I gained time to write my own assignment
- V15 I found the web environment easy to use and navigate.
- V16 It is flexible and does not require much effort to find what you are looking for.
- V17 You can use all its functions without any instructions of use.
- V18 I believe that the primary school students can use it with ease.
- V20 It works exactly the way I want it to work.
- V22 I needed to learn a lot of things before I started using the content of the web environment.
- V24 The organization of the material in each thematic unit helped me to study it with ease.
- V28 Digital media and tools that are available in the web environment such as concept mapping, simulations, audio, video, etc. contribute significantly to the pedagogical use of the material.
- V29 The hyperlinks used in the web environment are active.
- V31 The texts are easy to read.
- V32 The climate change units can be used without a predetermined order.

The variable “satisfaction” took the following questions into account:

- V19 I am satisfied with the educational content of the web environment.
- V21 I found the climate change units very interesting and well structured.
- V23 The web environment has kept my interest constantly
- V26 The tools that are used within the web environment are enough to support the content of the climate change units.

The variable “content relevance” took the following questions into account:

- V25 The content of the climate change units is suitable for the age of the students that are addressed.
- V27 The visual and graphic environment is consistent with the educational content.
- V30 The hyperlinks are consistent with the content they refer to.
- V33 The content of the hyperlinks is directly related to the unit section in which they are mentioned.

The variable “intercultural communication” took the following questions into account:

- V72 I respect and am concerned with the rights of all people, globally.
- V78 I unconsciously adapt my behavior and mannerisms when I am interacting with people of other cultures.
- V79 I often adapt my communication style to other people’s cultural background.
- V80 I am able to communicate in different ways with people from different cultures.
- V81 I am fluent in more than one language.
- V82 I welcome working with people who have different cultural values from me.

The variable “justice” took the following questions into account:

- V64 I think that most people around the world get what they are entitled to have.

- V65 It is OK if some people in the world have more opportunities than others.
- V66 I think that people around the world get the rewards and punishments they deserve.
- V67 In times of scarcity, it is sometimes necessary to use force against others to get what you need.
- V68 The world is generally a fair place.
- V69 No one country or group of people should dominate and exploit others in the world.
- V71 I think that many people around the world are poor because they do not work hard enough.
- V75 I do not feel responsible for the world's inequities and problems.

The variable "self-awareness" took the following questions into account:

- V50 I like to choose courses that challenge my beliefs and values.
- V53 Knowing how to use the modern technology makes me feel better integrated into society.
- V56 I feel that I can make a difference in the world.
- V57 I believe that I have enough power to influence social development decisions.
- V76 I know several ways in which I can make a difference on some of this world's most worrisome problems.
- V77 I am able to get other people to care about global problems that concern me.
- V83 I feel comfortable expressing my views regarding a pressing global problem in front of a group of people.
- V84 I am able to write an opinion letter to a local media source expressing my concerns over global inequalities and issues.

The variable "global civic engagement" took the following questions into account:

- V51 I feel that I can have a positive impact on the community that I live in.
- V52 It is easy for me to neglect my personal interest for the common good.

- V54 It is very important for me to give 3% or more of my income to help people in need.
- V55 It is very important for me to develop a philosophy of life that aims at personal and social twists.
- V58 When I work in a group project, I can easily accept the criticism for my work from the others.
- V59 I would be interested in seeking practices in charitable organizations or different places from the school practice.
- V60 I feel that I can play an important role in improving the well-being of my community.
- V61 The course content is more interesting when there are links to real life situations.
- V74 Greeks should emulate the more sustainable and equitable behaviors of other developed countries.
- V85 Over the next 6 months, I plan to do volunteer work to help individuals and communities abroad.
- V86 Over the next 6 months, I will participate in a walk, dance, run, or bike ride in support of a global cause.
- V87 Over the next 6 months, I plan to get involved with a global humanitarian organization or project.
- V88 Over the next 6 months, I plan to help international people who are in difficulty.
- V89 Over the next 6 months, I will work informally with a group toward solving a global humanitarian problem.
- V90 Over the next 6 months, I will pay a membership or make a cash donation to a global charity.
- V91 Over the next 6 months, I will contact a newspaper or radio to express my concerns about global environmental, social, or political problems.
- V92 Over the next 6 months, I will express my views about international politics on a website, blog, or chat room.
- V93 Over the next 6 months, I will sign an e-mail or written petition seeking to help individuals or communities abroad.

- V94 Over the next 6 months, I will participate in a campus forum, live music, or theater performance or other event where young people express their views about global problems.

The variable “social responsibility” took the following questions into account:

- V62 I have the feeling that social problems are not my concern.
- V63 The provision of social services is something I prefer to let others do.
- V95 If at all possible, I will always buy fair-trade or locally grown products and brands.
- V96 I will deliberately buy brands and products that are known to be good stewards of marginalized people and places.
- V97 I will boycott brands or ?? known to harm marginalized global people.

The variable “progressivism” took the following questions into account:

- V101 Each student should determine his or her individual curriculum, and teachers should guide and help them.
- V104 Schools should develop students’ ability to think deeply and analytically instead of focusing on superficial learning
- V106 Since students learn effectively through social interaction, schools should seek to promote social interaction in the curriculum and the educational process
- V109 Education is not primarily concerned with producing future workers but should emphasise learning for its own sake and students should enjoy, learning and discussing interesting ideas.
- V110 Education should enable students to recognize injustices in society, and schools should promote projects to redress social inequalities.
- V111 Students should be active participants in the learning process, involved in democratic class decision making and reflective thinking.
- V116 The purpose of the school is to help students understand themselves, appreciate their own particular abilities and ideas, and seek their own unique path into the society

- V122 Teachers should help students review their beliefs constantly. Especially help them look for the gaps, silences, distortions and exclusions of persons, ideas and things from the school curriculum.

The variable “neo-conservatism” took the following questions into account:

- V98 A school curriculum should include a common body of knowledge that all students should know
- V99 The curriculum should focus on the great ideas that have survived through time and related to present day challenges.
- V105 In order for a country to compete successfully on the global market, schools’ aim should be to produce citizens who can respond effectively to market requirements
- V113 Students should not be promoted from one class to another unless they have conquered learning the material of the previous class
- V118 Schools should emphasize into the transfer of knowledge and moral values that prevail from generation to generation
- V120 The main objective of the teacher is to help students unlock the great ideas they have learned over time so they can gain wisdom from the great thinkers of the past

The variable “reconstructionism” took the following questions into account:

- V100 Schools should prepare students for analyzing and solving the social problems that they will face as adults.
- V102 Students should be taught about the changes that take place in their society and how they can contribute to the social being.
- V108 The gap between the real-world situations and school education should be bridged through extracurricular activities and practical exercises in workplaces
- V112 Students should be taught to be more sensitive to race, gender, ethnicity, and differences in general.
- V114 The school curriculum should be designed by teachers to better respond to students' experiences and needs.

- V115 Teachers should be able to deconstruct and reconstruct the school curriculum.
- V117 Students should learn political literacy and learn how to improve the quality of life for all people.
- V119 Teachers should help students to critically assess their values and redefine them, even when they come to conflict with traditional and dominant values

III.6.4 Phase 4: Coding and Analysis of the Data

In this survey the initial data capture was accomplished with the aid of Google forms. The respondents filled the questionnaire individually via manual keying at a personal computer or mobile phone. Data transfer and data capture processing were done simultaneously since all the answers were gathered automatically at a special excel sheet that google form created once the form was submitted. All the questions had validation code to ensure minimum data capture errors. The initial coding was performed inside Microsoft Excel. All the phrases were replaced with numeric equivalents. Strongly disagree became "1", disagree became "2", agree became "3" and strongly agree became "4". All the phrases that had reverse meaning were reverse coded. The Excel sheet was checked for missing values and duplicate answers. All personal data and google form's timestamp were deleted. The analysis of the data was made with the software IBM SPSS software version 23. The Excel sheet was imported to SPSS and variables were named accordingly. Content validity of the questionnaire was established through the adoption of validated and tested instruments by other researchers as found in the literature. For example, questions from V10 to V33 of the questionnaire consist of questions about the use of ICT in general and the use of WBLE. The V48 to V97 items were chosen from similar studies about active citizenship and the questions from V98 to V123 are items commonly used in philosophical theory determination.

The questionnaire included open-ended questions that pre-service teachers from the two courses filled in order to provide data relative to their experience both positive and negative with the WBLE. In addition, the open-ended question was a valuable way to collect feedback for further improvements at the existing WBLE. The analysis of the open questions had as reference the procedure that Kostoulas-Makrakis (2005) suggests in her survey about

emirati pre-service teachers' perceptions and had a similar approach. The procedure consisted of six steps which were the following:

- Coding: This step involved the reading of all open-ended questions and the selection of words or key phrases denoting the subjects' perceptions of the WBLE.
- Categorising: Four categories were formed for the coded notions which were 1) positive general feedback 2) Website comments 3) Comments regarding the instructional materials and 4) Language
- Classifying: In this step the words and key phrases were assigned to the four categories, according to the frequency of their appearance.
- Checking: A second rater was asked to classify the units into the same categories in order to prove consistency. There were sixteen units that had different classification but after discussion consensus was reached.
- Comparing: A comparison of the four categories in terms of frequency of ascribed concepts defining WBLE in each category.
- Inferring: Data analysis provided valuable conclusions about pre-service-teachers perception about the WBLE and it is discussed thoroughly in the qualitative results section of this thesis.

III.7 Reliability and Validity in the Research Process

A crucial objective of the research process was the reliability and validity. Reliability indicates the consistency in which we measure a concept and usually contains three prominent factors: stability, internal reliability and inter-observer consistency. In the current study we were not able to use the test-retest method which is the most obvious way of checking the stability of a measure mainly because it was not possible to have the same group of pre-service teachers after courses end. Moreover, to check stability would require a complex research design and would turn the investigation of reliability into a major project of its own. Internal reliability was tested with the commonly used test of Cronbach's alpha which calculates the average of all possible spilt-half reliability coefficients. The developed scales ranged from a= 0.65 to 0.84 which indicates an acceptable level of internal reliability

according to Berthoud (2000, pp. 169) who states that a minimum level of 0.60 is acceptable. Inter-observer consistency though it was not directly examined it can be assumed since all chosen items were part of studies that gave similar results. Content validity of the questionnaire was established through the adoption of validated instruments by other researchers in the literature (Morais and Ogden, 2011; Conti, 2007). Furthermore, professors of Crete University including the supervisor professor of this thesis studied the questionnaire and evaluated the level of relevance, clearness and conciseness. Several suggestions were made concerning the wording of some items and the overall structure of the questionnaire, and these suggestions were incorporated into the revised version.

III.8 Research Methodology and Ethical Considerations

The present study was carried out according to the articles of the code of ethics and conduct of the scientific research of the University of Crete with emphasis on the article 3: Principles of scientific integrity, 4: Principles of Research Ethics, 7: Respect for the rights of third parties and 8: Respect for intellectual property. More specifically it took into account that it should promote scientific knowledge and support the educational process. It is also linked to the utilization of scientific findings for the benefit of society as a whole. In particular, it was conducted with focus on scientific truth, respect for human dignity, personal autonomy and intellectual integrity of persons, intellectual property and personal data, and care for life, nature and the environment. Also, it protected the privacy of those involved in the survey, as well as it protected the processing of their personal data. The personal data was processed exclusively for the purposes of the research and with the means of processing determined by the University of Crete. Any other processing of the data for other purposes, even similar ones, was excluded. Throughout the processing, a comply with the requirements of the legal framework on personal data was followed, in particular the General Data Protection Regulation (GDPR) and the relevant legislation of both Greece and the European Union, as well as the decisions and instructions of the Personal Data Protection Authority.

During the survey there was respect for the dignity, and individual rights of third parties involved in the research activity. No discrimination on the basis of ethnicity, race, national origin, language, sex, religion, privacy, physical ability, socioeconomic status, or

any other factor unrelated to scientific ability and integrity was made. The participants of the survey they were informed, with a brief but comprehensible and as complete as possible, with honesty and adequacy for the purposes of the research. The information was provided in a transparent, understandable and easily accessible form, in a way that could be understood by the participants in the research. The information was provided electronically at the beginning of the google form that was distributed. In addition, it took into account the intellectual property rights of third parties.

Chapter IV.

Instructional Design of the “Act for Climate” Web-based Learning Environment

IV.1 The “Act for Climate” Web-based Learning Environment

This section describes the approaches and curriculum structure chosen to promote climate change education and, ultimately, actions to mitigate climate change. Each approach is justified by findings from existing literature and curriculum design. Thematic areas chosen are covered in detail.

IV.1.1. The Curriculum Structure: A Theme-based Approach.

The creation of a closed and target-centric curriculum that its learning content simply mentions the causes and consequences of climate change, makes it difficult to achieve the climate change education for sustainable development objectives. Also, a curriculum as a practice which aims to the understanding and interpretation of climate change-related issues is also not enough to fulfil the climate change education for sustainable development objectives. On the contrary, a curriculum that highlights and concentrates into critical reflection and action to prevent and address issues related to climate change through individual as well as social change in order to improve everyday social life can fulfil the climate change education for sustainable development objectives. The design of such curriculum should be horizontal and not vertical i.e. it should be initially defined and described not as specific learning objectives, but as thematic areas of climate change and divided into units and sub-units (Makrakis, 2012; Makrakis, Larios and Kaliantzi, 2012; Makrakis, 2014). The reasons why a horizontal curriculum design can fulfil the climate change education for sustainable development objectives are as follows:

1. “In the thematic units, knowledge is presented in a cross-thematic, holistic and multi-method approach and not based on a specific science or course.
2. The units present authentic modern problems taken from real life, through which students rebuild meanings and knowledge and understand complicated concepts more deeply.
3. The presentation of knowledge based on thematic modules in a cross-thematic way develops higher-level mental abilities and competences.
4. By presenting problem-centric climate change thematic sections the critical exploration, reasoning, dialogue, critical reflection, student collaboration in groups, decision-making, problem solving, action and change is promoted. When students face an authentic problem, that they encounter in everyday life, they have a better chance of collaborating in order to solve it.” (Makrakis, Larios and Kaliantzi, 2012, pp. 58-59).

In addition, Makrakis, Larios and Kaliantzi (2012) adopt the following conditions of a horizontal curriculum design proposed by Cunningham & Billingsley (2006) in order to fulfil the climate change education for sustainable development objectives:

1. “The design of thematic areas on climate change should promote self-learning, i.e. learning of the students should be achieved through their own initiatives, such as the search and organization of knowledge in subcategories, and also the presentation and exploitation of knowledge by their own means and criteria.
2. In the thematic areas the activities must be of a higher learning level, diverse and interesting for students, e.g. a treasure hunt, a mystery to be explored, a problem that seeks a solution, a confrontation of arguments, a critical decision, etc.
3. The thematic areas may contain material and ideas freely found and distributed from educational sources that can be easily integrated and used, e.g. material from the internet, educational websites, presentations, videos, programs, etc.
4. The simple presentation and interconnection of the thematic areas of the curriculum helps both teacher, pre-service teachers and students to use the material more effectively.

5. The thematic areas contain activities that cultivate students' imagination, creativity and self-expression.
6. Each activity in each thematic unit is designed to have a specific learning objective.
7. In the thematic areas there are arguments and ideas from many and opposite points of view. Contradiction helps students think critically, argue, and support the point of view they adopt.
8. Thematic areas are all supported by ICTs as cognitive tools.
9. Activities in the thematic areas extend beyond ICT i.e. in the classroom, at school, at home, in the neighborhood and in the local community.
10. The structure and nature of the activities in the thematic areas support the freedom of teachers, pre-service teachers and students to choose the thematics based on their own needs.
11. The activities in the thematic areas give teachers, pre-service teachers and students the opportunity to make their own choices and to plan their own activities inside and outside the school" (Makrakis, Larios and Kaliantzi, 2012, pp. 59-60).

The following figure (Makrakis, Larios and Kaliantzi, 2012) describes the stages of designing a horizontal curriculum for climate change education for sustainable development (Figure 7).

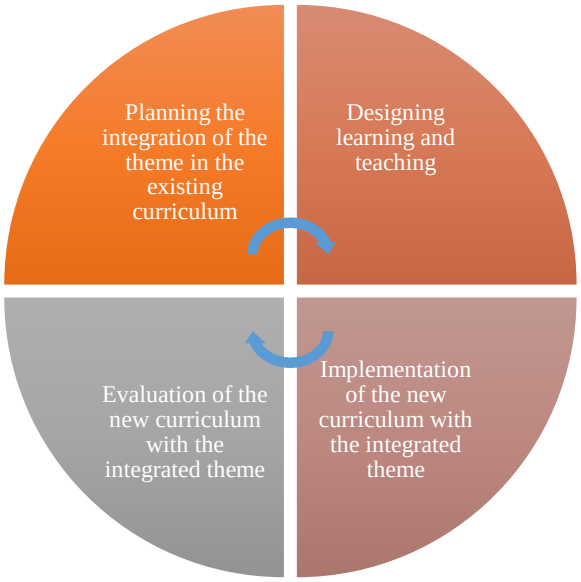

Figure 5. The stages of designing a horizontal curriculum for climate change education for sustainable development (adapted from Makrakis, Larios and Kaliantzi, 2012, p. 60).

In this regard, the steps in designing theme-based instruction articulated by Makrakis and Kostoulas-Makrakis, 2012 for Web-based Learning Environments (WBLE) provides a useful overview of the process for each stage of thematic learning, as follows:

- The first stage is about 'Theme selection'. This stage includes decisions on whether to opt for a significant theme associated with a compelling real-life issue, such as climate change which has many implications of environmental, social and economic nature. It is essential that this theme meaningfully connects various facets of human experience related to family, school and community, thereby providing a broadened framework. Thematic learning with a web based learning environment has been shown to: 1) make positive impacts on students' concepts of learning; 2) provide students with a structure from which they can develop related concepts into a more stable mode of learning, and 3) is appropriate for learners with different learning styles (Liu and Wang, 2010).

- The second step involves: ‘Planning the integrated curriculum’. The next phase focuses on integrating sub themes, which are components of thematic areas, skills, strategies, and concepts that offer direction and meaning to the process of learning. The instructors involved organized the core curriculum on climate change (including process, content knowledge and skills) and the sub-themes in a flexible and authentic manner. Adopting interdisciplinary approaches in designing an inclusive program provided for more emphasis on the process involved compared to focusing on results obtained. An Internet-based approach has been shown to increase focus on specific participant driven interactive choices such as facilitator-to-student, peer to peer, or a learner to the studying material. A properly thought out curriculum can help balance individual levels, as well as small and large group levels of activities. It is important for an environment to be richly textured to accommodate the majority of the learners’ requirements and the styles of learning by ensuring multiple communication channels, as well as collaborative and engaging design of the curriculum (Boettcher, 2007). At the design stage of integrating the theme into the existing curriculum, the central theme is divided into some key areas on climate change. The topic of climate change was separated into six (6) main units that emerged through the investigation of the topic of climate change: 1. Me and climate change, 2. Climate change in my area, 3. Climate change and ecosystems, 4. Atmosphere and climate change, 5. Energy, fossil fuels and waste and 6. Climate change over time. These units are divided into 61 smaller subunits. Initially there were 68 subunits, but the “Climate Change and Ecosystems” unit, which was the first to be designed, was reduced from 27 to 20 subunits because it was considered too large from the teachers that first used the material in class. The units and subunits were designed to cover three different age levels. The first age level was for the 1st and 2nd primary school classes, the second age level was for the 3rd and 4th primary school classes and the third age level was for the 5th and 6th primary school classes. Within each age level, units and subunits have no linear sequence. Teacher and students can choose to start and deal with any unit and subunit they

wish. The units and subunits are structured interdisciplinary and holistic, and the topic of climate change is integrated into various courses of the existing curriculum. The design of the curriculum for climate change continues with the formulation of key questions that describe the general learning contents in a per unit basis. Then, the main concepts of each subunit are defined, and a connection is made to the existing curriculum.

- The third step involves: 'Designing instruction and learning'. In the environment of Internet-based learning, learners constantly interact with instructors, technology and content. The stage involves Information Communication Technologies (ICTs) enabling the design of learning activities. The stage was driven by ExConTra (experiencing, conceptualising, transforming) so studying the content becomes the direction to an end and not the means to an end (Makrakis and Kostoulas-Makrakis, 2012). An example of a learning process that is consistent with ExConTra is brainstorming by teachers of learning activities through employing available curriculum materials. The end user's experiences, ideas and interests can be used to provide valuable insights into the process. The experts' and other community members' involvement might increase the value in the essential design and participation in learning activities. There is also planning of strategies that will ensure the reusability, adaptability and generalizability of teaching and learning materials. D In the planning stage of the activities of each subunit, emphasis is placed on the use of ICT as cognitive objects. Many of the designed activities are open-ended suggestions that can be defined, planned or decided by the teacher together with the students. These activities can be individual or teamwork and are intended for small or large groups. They are activities on the computer, such as conceptual mapping, information retrieval, critique of a text, presentation of a work, work on a copywriter or spreadsheet, painting, observation of phenomena and experiments, communication with other schools, etc. It also includes activities that need to be done in the classroom or outside the classroom and at school, at home, in the neighborhood or in the community with the aim of transforming action into personal changes. All

activities are based on the ExConTra learning model and aim to fulfil the climate change education for sustainable development objectives.

- The fourth step involves: ‘Executing the integrated curriculum’. Teaching about climate change along with subjects taken in schools, such as social studies, science, mathematics, arts and so on, can be an effective strategy for an integrated curriculum based on themes. Students can create links between different places as they look into topics in detail and from an array of different approaches. The inter-curriculum projects ensure that learners can see the links between skills and knowledge in an array of school subjects and discover a way of applying them to real life situations and contexts. This step involved the implementation of thematic learning activities through the project-based learning model. It is a change from traditional practices in many classrooms where the teacher (not the student) is the center of learning. Hence, it relies on great emphasis on long term, student centered, interdisciplinary learning activities. These are aligned with practical life issues. Students plan in implementing and evaluating projects with practical applications both inside and outside the classroom. It is suggested that using ICTs in curriculum design should be implemented in the following ways. Firstly, supporting the instructional process through technology. Secondly, the curriculums content is the essential element of the teaching and learning process, and not focused on the technology itself. The context for learning using ICTs should be depicted by the theme and vice versa. The tools of ICT assist in showing the relationship between concepts and helps learners to make insightful connections. The implementation of the integrated curriculum in a learning setting that is web-based, with various tools including online tools and resources for retrieving content, facilitates interactions between instructors, between instructors and students, and between students. Implementing ICTs effectively into instruction requires purposeful training of instruction with much time to practice the ICTs and use of ICTs in collaborative learning and peer tutoring.

- The fifth step involves: ‘Assessing the impact of the integrated curriculum’. This stage focuses on determining the extent of achieving the envisioned goals after the planned curriculum is implemented. The successfulness of the program depends on the collection of information, analysis of the evaluation carried out in attempting to achieve expected outcomes, and the value of the project. The entire process can be integrated into the following interlinked levels of assessment. First, diagnostic assessment referring to the initial phase process. Secondly, formative assessment referring to a specific process while establishing a curriculum to ensure success in case of revision. And, finally, summative assessment which elaborates on the process after implementation of the curriculum. Authentic assessment is the vital strategy incorporated into these processes. Moreover, authentic assessment used to determine the effects (if any occur) of the integrated curriculum involve the merging of strategies and tools which emanate from ExConTra learning and from other learning objectivist theories that might contribute to the principles of ExConTra learning. The most used tools include tests that contain multiple choice answers which extend different responses that build student’s self-awareness on their thinking processes.

The tools to support critical thinking process can include: portfolios, observations, checklists, scenario building, reflectivity and reflection, concept mapping, simulation, journaling and the analysis of a case-study. The different assessment levels are linked in a manner that offer opportunities to stakeholders and learners for actively participating in the planning of the integrated curriculum. The process employs effective tools such as structural knowledge representation techniques and concept maps. Formative assessment processes will ensure that learners have a peer learning support assessment and a self-assessment design practice (Wanner and Palmer, 2018; Hartmeyer, Stevenson and Bentsen, 2017). The visualization tools, like concept maps, assist in processing mental images and abstract concepts which are depicted more frequently while designing work materials, so that students can construct meaningful realities on the basis of new knowledge (Jonassen and Reeves, 1996; Cellucci, 2017).

IV.1.2. The Thematic Areas of the Web-based Learning Environment.

This study adopted a task-oriented climate education approach to empower students to distinguish between the web environment that provides tools and links with tasks that focus on the human approach to climate change, and to enabling deeper learning experiences. The web-enabled learning environment offered support to learners in comprehending the causes of climate change-related issues and outlined ways to intervene to help mitigate or eliminate the challenges of climate change. The framework of the "Act for Climate" curriculum is comprised of an integration of six thematic areas across the curricula of the primary level of education as illustrated in Figure 7, including: Climate change and me, Climate change in my area, Climate change and ecosystems, Climate change and atmosphere, Climate change through time, and, Energy, fossil fuels and waste.

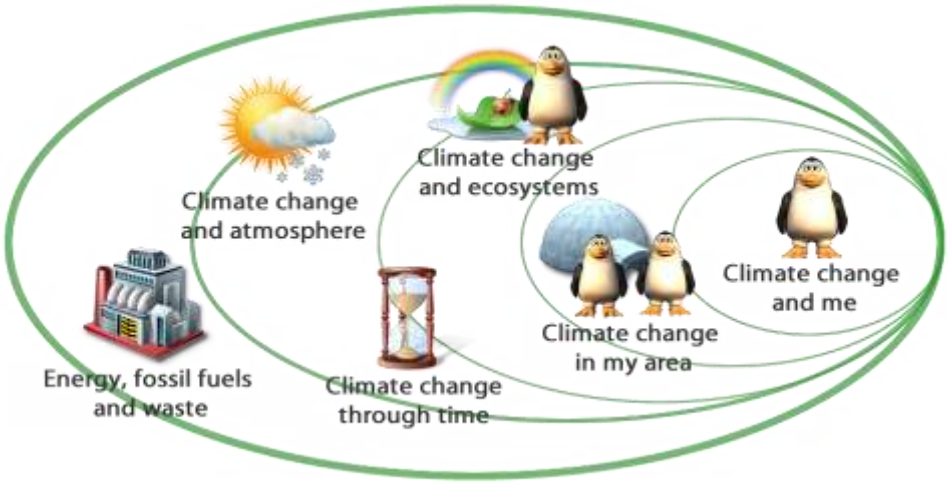

Figure 6. The curriculum areas of the ICT-enabled Climate Change Education.

The concept of "Climate change and me" is to create awareness amongst children to conduct investigations concerning climate change and how it affects them (their health, nutrition, clothing, and environment) and their responsibility in life to combat climate change (in school, at home, in the neighborhood, and in the local area). Children will then

progressively move to “Climate change in my area” where they will investigate the impact of climate change on the economy, employment, transportation systems and the local society The next unit “Climate change and ecosystems” offers opportunities for children to figure out their entire ecosystem and the consequences due to climate change. “Climate change and the atmosphere” will ensure that children study and comprehend the science involved in the atmosphere because of climate change. The next unit, “Climate change through time” offers the opportunity for children to acquire knowledge on climate change from the past to its present state. Lastly, in the subunit “Energy, fossil fuels and waste”, children learn about climate change and how it affects the world’s resources. Moreover, children are encouraged to find ways to make the future sustainable through utilizing renewable energy sources and better ways to manage waste.

Learners can choose any of their preferred units and participate in activities associated with it. In the units, children will deal with what climate change entails, their surroundings and their actions towards the environment. Practical and applicable activities outside the classroom are recommended to supplement classroom activities progressively from the local, to the national, and then the international stage. All units correspond to related Greek curriculum units, as illustrated in Figure 8.

Figure 7. The cross-disciplinary structure of the ICT-enabled climate change education curriculum.

Achieving climate change literacy requires a connected web of disciplinary, interdisciplinary, multidisciplinary and trans-disciplinary approaches. Interdisciplinary is sometimes used interchangeably with multidisciplinary and trans-disciplinary. Here, disciplinarity means to focus on one discipline, in contrast to interdisciplinary curriculum where there is involvement of two or more disciplines in order develop new ways of understanding complex sustainability problems. Multidisciplinary refers to curriculum involving two or more disciplines and the trans-disciplinary curriculum refers to a fusion of disciplinary knowledge to create a new hybrid. The curriculum is meant to be flexible with an allowance for the instructor to choose either a particular activity or all activities to develop alongside with his/her students from their learning activities. Furthermore, the learning can be taken as stand-alone units that are independent of each other. Therefore, the implementation of activities and units can be either sequential or dependent on the available organization of the curriculum needs and contents.

The thematic areas (topics) of each grade level are not prescribed by the Greek Ministry of Education as the references to such topics is limited. In Greece, primary education guides mention climate change in two pages in the Curriculum of Environmental Education as a proposed topic (DEPPS-APS Environmental Education, pp. 640-641). Also, a reference is made to climate change in 2-3 pages in the textbooks of Geography (pp. 64-65) and Social and Political Education (pp. 35-37) of 5th grade. Apart from these statements, there is a lack of specific material on climate change that teachers can use interdisciplinary in their school lessons.

IV.1.2.1 The Learning Content of the “Climate change and me” theme area.

The structure of the unit on “Climate change and me” (as in any of the other units) includes material divided in three levels: 1st and 2nd grade (6-8 year old), 3rd and 4th grade (8-10 year old) and 5th and 6th grade (10-12 year old), and each of the three levels includes similar thematic areas but with a significance difference in the complexity and activities.

The general learning objectives of this thematic area are the following:

- How is climate change affecting children, their needs and their rights?
- How does climate change affect humans (diet, available water, health)?
- What are the social and economic implications of climate change? What policies have been developed for climate change nationally and internationally?
- What can children do to inform, prevent and address the effects of climate change on children, society and the economy locally, nationally and globally?

Students in 1st and 2nd grade explore how climate change affects children, their needs and their rights. They are also looking for what they can do at home and at school to anticipate and tackle climate change. In addition, they explore how climate change affects humans in terms of nutrition and health. Finally, children in 1st and 2nd grade are looking at how they can take action to fight climate change through sport.

The children in 3rd and 4th grade investigate the issue of climate change in the media and on the internet. They also explore the relationship between consumerism and climate change. Next, they plan actions to fight climate change with the help of the media, the internet, community-based self-help networks and their own artwork on climate change.

The students in 5th and 6th grade explore the social and economic effects of climate change and evaluate the policies that have been developed for climate change nationally and internationally. They also examine the relationship between climate change and disease transmission and the spread of migration. In addition, they assess whether climate change is man-made. Finally, students in 5th and 6th grade plan and take actions to inform, prevent and address the effects of climate change on children, society and the economy locally, nationally and globally.

IV.1.2.2 The Learning Content of the “Climate change in my area” theme area.

In the second thematic area “Climate change in my area” the general learning objectives are the following:

- Climate change in my area
- How will climate change affect my region (buildings, local products, transport, labour, industries, population)?
- What can children do to inform, prevent and tackle climate change in their area?

Students in 1st and 2nd grade explore how climate change can affect their neighborhood (buildings and environment). They also explore the relationship between climate change and the use of public transport as well as work in order to suggest new ways of using public transport in their neighborhood.

Students in 3rd and 4th grade explore the effects of climate change on their geographical area. In addition, through examples they consider how climate change is related to the purchase of local products mainly because of the transportation of products. Finally, they suggest solutions for purchasing and transporting products to their community.

The students in 5th and 6th grade explore climate change policies and services of their state. They learn about local industries that contribute negatively to climate change. At the same time, they are investigating the occupations that are flourishing in the area where they live and examine whether climate change will create other occupations in the future. They are also investigating how climate change can affect the Earth's population. Finally, students of all grades act to inform, prevent and address climate change in their area.

IV.1.2.3 The Learning Content of the “Climate Change and Ecosystems” theme area.

In the third thematic area “Climate Change and Ecosystems” the general learning objectives are the following:

- How will climate change affect ecosystems?
- How will animals and plants adapt to climate change?
- How will climate change affect the natural environment of Greece?
- How is climate change exacerbating our country's environmental problems?

- What do natural disasters have to do with climate change?
- What is the relationship between mythology and religion and nature and climate change?
- What can children do to inform, prevent and address the effects of climate change on ecosystems locally, nationally and globally?

"Climate Change and Ecosystems" is by far the largest unit because it is the most relevant to the existing curriculum and thus its thematic units are presented in detail.

1st and 2nd grade Thematic Focus Units:

1. Animals and plants of my area: Children seek and discover the animals and the plants of their area, calling upon their experience, exploring the local environment, reading a case study and searching the web. Then, they explore effects of climate change on animals and the plants in their area. At the end, students seek measures and activities to protect the animals and the plants of their area from climate change.
2. My area's ecosystem: Children find out about ecosystems and explore their area in order to define the type of their local ecosystem. Then, they explore the impact of climate change on their local ecosystem. At the end, students try to motivate others, seek measures and activities, and protect their local ecosystem from climate change.
3. Weather and climate: Children observe and write down information about the local weather. Then, they explore how typical weather changes can affect local plants and animals. Studying relevant web pages and case studies, students distinguish between climate and the weather. At the end, they explore how climate change can affect local plants and animals.
4. Seasons and months: Children remember through games the names of seasons and months. Then they study relevant web pages and case studies and explore how the change of seasons and months can affect plants and animals. They also search for Greek traditions about seasons and months. At the end, students seek measures and activities to protect the animals and plants of their local ecosystem from changes in the seasons or months pattern.

5. The Greek ecosystem: Children explore the characteristics of the Greek ecosystem. Then, they study relevant web pages and case studies and research climate change consequences involved with the Greek ecosystem.
6. Animal and plant families: Children explore the animals' and plants' families of their ecosystem and make relevant lists. Then, they investigate which animals' and plants' families will suffer or become endangered from climate change. Students also visit zoos and local organizations in order to find out what they can do to help the endangered plants and animals. At the end, they form local groups to act locally to protect the endangered plants and animals from climate change.
7. Needs of animals and plants: Children explore the animals' and plants' needs. Then they study relevant web pages and case studies. Students then conduct investigations about climate change and how it impacts of the needs of both plants and animals.
8. Characteristics of animals and plants: Children observe different animals and write down their characteristics. Then, they choose one animal or plant and investigate if it could survive after a climate change and why, referring to its characteristics.
9. Distribution of animals and plants in the area: Children observe images and investigate how animals and plants are distributed on Earth and why. Then, they investigate about how that distribution would be if a climate change occurs.
10. Contribution of animals and plants to our lives: Children find out about what animals and plants offer to people and observe how people treat them. Then, they search for ways to help them to mitigate people's abuse and climate change.

3rd and 4th grade Thematic Focus Units:

1. The natural environment of my country: Children observe their country's natural maps and search for geological terms such as planes, mountains, rivers, etc.
2. Administrative regions: Children learn about the administrative regions of their country. They also search for the natural and historical characteristics of their own region. Students complete maps and make a presentation of their region. Then,

they research which regions of their country could be affected by climate change and propose solutions and activities for their protection.

3. Humans' and nature's creations: Children make lists with humans' and natures' creations. They investigate which of the humans' creations in their area contribute to climate change and which of the natures' creations in their area are affected by climate change. Students then try to motivate people to act against climate change and propose measures and activities.
4. Environmental problems: Children explore their area to find out about local environmental problems and what climate change has to do with them. Then they propose strategies to improve and alleviate their area.
5. Plants of my area: Children find out about the plants of their country and explore how people use them in nutrition, medicine, etc. Then, they collect and observe some plants in order to find out about their anatomy and reproduction. Students also make a presentation of a plant they choose before and after a climate change in order to motivate people about climate change consequences on plants.
6. Animals of my area: Children find out about the animals of their country. They classify them into categories regarding if they are wild or tamed, etc. and then gather information about how people treat them, if they are in danger, etc. Students then investigate what would happen to animals due to climate change. They also learn about vertebrates and invertebrates and animals' reproduction. At the end, they examine which animals could survive a climate change and propose solutions and actions.
7. Energy in ecosystems: Children learn about the energy flow in ecosystems through food chains and webs. Then they examine how climate change could affect the energy flow in all kinds of ecosystems through food chains and webs.
8. Ecosystems of our country: Children learn about the kinds of ecosystems that exist in Greece and about their characteristics. Then, they examine how climate change affects these ecosystems. At the end, they take measures and act to protect or save their local ecosystem.

9. Green in the cities: Children explore the benefits of trees in the cities and search for ways to make cities greener. They make a presentation to show ways for people to make their cities greener.
10. Nature in mythology and religion: Children learn about gods and goddesses of nature in mythology and try to approach the ancients' way of thinking about nature. Then, they explore the relation of their religion with nature and modern ecological problems, such as climate change.

5th and 6th grade Thematic Focus Units:

1. Greece's geographical terrain: Children observe Greece's geographical terrain and become familiar with terms like coast, peninsula, cape, etc. Then, on a map, they draw in the Greek areas that they believe that will be affected by climate change. At the end, they cooperate with the local authorities to take measures to protect their region from climate change consequences.
2. Plants' functions: Children observe graphs and learn about photosynthesis, respiration and transpiration of the plants. Then, they investigate how climate change affects these 3 functions of the plants. At the end, they propose measures and actions to protect local plants from climate change.
3. Animal species: Children observe pictures and classify animals to species and categories, such as vertebrates or invertebrates. Then, they examine how changes in temperature and climate affect animal species. Students also learn about animal evolution and survival through ages. At the end, they propose measures and actions to protect local animals that are in danger from climate change.
4. Relations in ecosystems: Children explore the relations of organisms in ecosystems. Then, they visit a local ecosystem and investigate what would happen to it and its organisms if a climate change occurred. At the end, they propose measures and actions to protect their local ecosystem from climate change.
5. Oceans: Children investigate what would happen to oceans due to climate change, through a case study regarding the clown fish, the web, and the relevant articles. Then, they write a story about the future of oceans and get involved in climate

change art activities. At the end, they find out what the sea has to offer to people and they propose measures to preserve its beauties.

6. Forests: Children read a case study regarding pine trees and learn how these are affected by people's exploitation and climate change. Then, they visit a local forest and make a presentation to save its beauties in order to motivate others to take actions to save the forests from climate change.
7. Natural disasters: Children investigate the relation of climate change to natural disasters. Then, they cooperate with organizations that deal with natural disasters and become volunteers in order to help wherever needed. At the end, children participate in a debate, where one team tries to convince others that climate change brings upon natural disasters and another team tries to convince others exactly the opposite.
8. Religion and environment: Children explore ideas, myths, fears, rumors, etc. about the end of the world. They also investigate what positions Christianity and other religions take on this issue. At the end, they make their own conclusions about climate change and the scenarios of the end of the world.

IV.1.2.4 The Learning Content of the "Climate change and the atmosphere" theme area.

In the fourth thematic area "Climate change and the atmosphere" the general learning objectives are the following:

- What is the greenhouse effect and global warming? How can climate change affect the water cycle and the CO2 cycle?
- How does climate change relate to air pollution and the ozone hole?
- What can children do to improve their ecological footprint?
- What can children do to reduce CO2 emissions locally, nationally and globally?

Students in 1st and 2nd grade learn about the water cycle and explore how it can be disrupted by climate change. They also examine the concepts of weather and climate and

investigate how humans are affected by any changes in weather and climate due to climate change.

The children of 3rd and 4th grade examine how climate change is related to the phenomena of air pollution and the ozone hole and clarify the natural processes of the phenomena.

The students in 5th and 6th grade first clarify the concepts of climate and climate change. Next, they look at how climate change can affect the CO2 cycle and come across the greenhouse effect and the concept of global warming. At the same time, they learn what they can do to improve their ecological footprint. Finally, students in all grades develop strategies and actions on what children can do to reduce CO2 emissions locally, nationally and globally.

IV.1.2.5 The Learning Content of the "Climate change through time" theme area.

In the fifth thematic area "Climate change and the atmosphere" the general learning objectives are the following:

- How has man dealt with climate change in the past?
- What have been the causes of climate change in the past?
- How does climate change affect the Earth's current climate?
- How can we reduce or stop climate change in the present?
- How do you imagine the Earth's climate will be in the future?
- How do scientists predict the Earth's climate in the future?
- What would you like the Earth's climate to be like in the future?
- What can you do to make this dream come true?

Students in 1st and 2nd grade learn how to measure time. They then look for the changes that occur over time and explore the changes that climate change can cause over time.

The children of 3rd and 4th grade learn how humans have dealt with climate change in the past and try to suggest how to deal with it in the future. They also examine their local

history and local customs in relation to the climate of their area, in order to assess what climate change would bring to their place and way of life.

The students in 5th and 6th grade look for the causes of climate change in the past. They explore how climate change is affecting the Earth's current climate and how we can reduce or stop climate change in the present. In addition, after learning how scientists predict the Earth's climate to be in the future, they describe how they imagine it to be Earth's climate in the future. At the same time, they explain how they would like the climate of the earth to be in the future and make suggestions to make this dream come true. Finally, students of all grades are working to tackle climate change in the present.

IV.1.2.6 The Learning Content of the "Energy, fossil fuels and waste" theme area.

In the fifth thematic area "Energy, fossil fuels and waste" the general learning objectives are the following:

- What are renewable and non-renewable energy sources?
- How is waste managed?
- What can children do about waste management locally, nationally and globally?
- How will climate change affect the seas?
- What can children do to have clean seas locally, nationally and globally?
- How do fuels and minerals relate to climate change?
- What can children do to save energy locally, nationally and globally?

Students in 1st and 2nd grade learn about energy and how they can distinguish renewable and non-renewable energy sources. In addition, they learn about solar and wind energy. They investigate how climate change is related to the use of renewable and non-renewable energy sources and act on the use of renewable and non-renewable energy sources.

Students in 3rd and 4th grade deal with waste management processes and plan waste management activities locally, nationally and globally. They explore how climate change can affect the seas and act to have clean seas locally, nationally and globally.

The students in 5th and 6th grade explore how fuels and minerals are related to climate change and act to save energy locally, nationally and globally. They also learn all forms of renewable and non-renewable energy sources and propose actions for the spread of renewable energy sources.

Deliberations are being held to ensure that the school curriculum will integrate these units into fifth and sixth grade levels. An integration methodology ensures cross-disciplinary topics are aligned around emergent patterns and over coinciding concepts. In an integrated methodology, interdisciplinary topics are arranged around overlapping concepts and emergent patterns. This process results in a blend of disciplines found in attitudes, concepts and coinciding skills arranged in a synergistic way that makes knowledge from one subject relate directly to other subject/s (Makrakis and Kostoulas-Makrakis, 2012).

IV.1.3. The structure and the tools of the web-based learning environment.

This section provides an overview of the structure of the web-based learning environment, and the tools used within it.

The education material used for the units of climate change as well as the rights of children in learning about the environment had to use an easy to develop framework with power to handle complex context and flexibility to alter it at any time. Drupal is a content management system (CMS) that is open source, like Moodle and Joomla, and that provides an extensible and powerful framework for learning and teaching that is web-based. The reason for not using the Moodle CMS which is widely used to academic institution was the lack of Adobe flash content support. On the other hand, Joomla had a more difficult and not so straightforward development environment. Still the benefits of employing the CMS include: the learning curve is low and highly reliable, it provides an array of substantial tools for educators like forums, blogs, classroom management, and privacy options. The CMS can be used to host informative content in different data types such as images and videos that are classified and organized in hypertext mode, making them easy to find, as well as different associated nodes and non-linear ways of finding relevant information. The primary content of learning is comprised of learning objects (LOs). LOs were the specific type of learning resources that were made by using Adobe Flash as their authoring tool. All the learning

objects for this research study were made with Adobe Flash CS6. Every LO is built from different media assets like charts, sound narration, animation, and video established under a specific graphic user interface that works in an adaptable and dynamic learning environment.

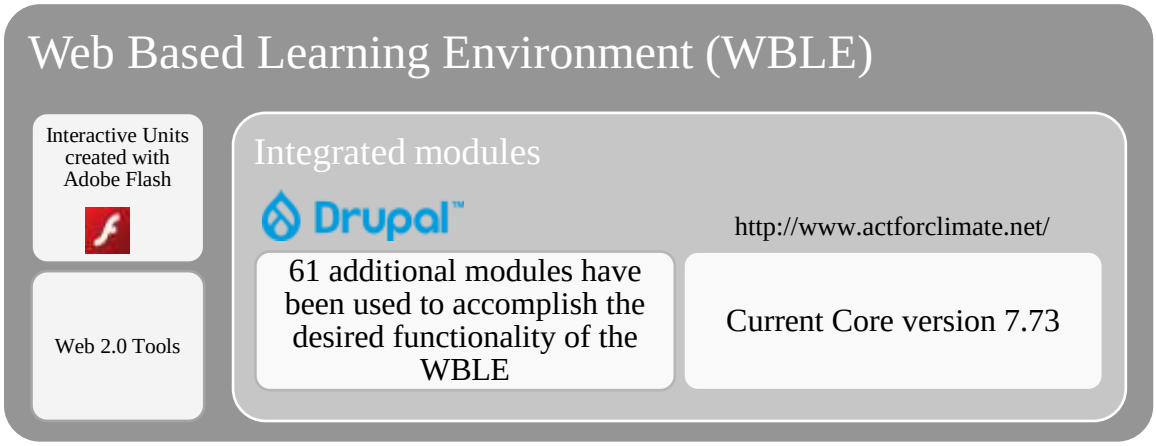

Figure 8. Architectural structure of the interactive learning environment.

In addition to this, a range of ICT tools for concept mapping (Text2Mindmap), word processing (Shutterborg), spreadsheet and presentation tools (Google Sheets, & Google Slides), paint tools like Pixlr and Venn diagrams (classtools.net) were used to support the web-based learning environment (WBLE). Both the principles of ESD-based instructional design and software engineering methods were used in the development of WBLE (Makrakis, 2008).

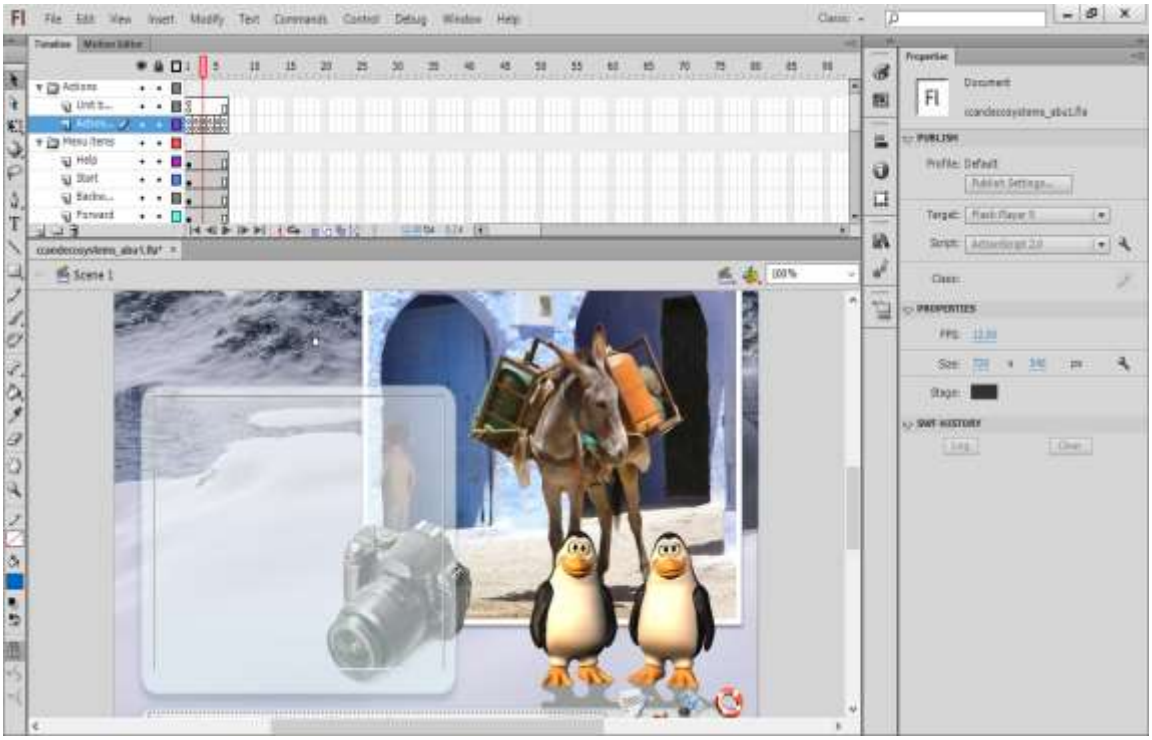

Figure 9.Adobe Flash development environment of LOs.

IV.1.4. Additional online learners' tools.

Within the WBLE, learners had access to four online tools (as shown in figure 13):

1. An online word processor, Shutterborg (http://shutterb.org), a free word processor that runs entirely in a web browser and makes online editing of documents possible.
2. The Dictionary of Standard Modern Greek (http://www.greek-language.gr/greekLang/modern_greek/tools/lexica/triantafyllides/), a comprehensive definitional, orthographic, and etymological dictionary of Modern Greek.
3. A concept-mapping tool, MindMup (https://www.mindmup.com/), an easy-to-use online concept-mapping tool. Learners design their concept map by simply entering their words and concepts. This tool can be used for brainstorming and organising thoughts around a topic. The final map can easily be saved or printed.

4. A paint tool, Pixlr https://pixlr.com/, which combines paint tools with image design and works in a browser.

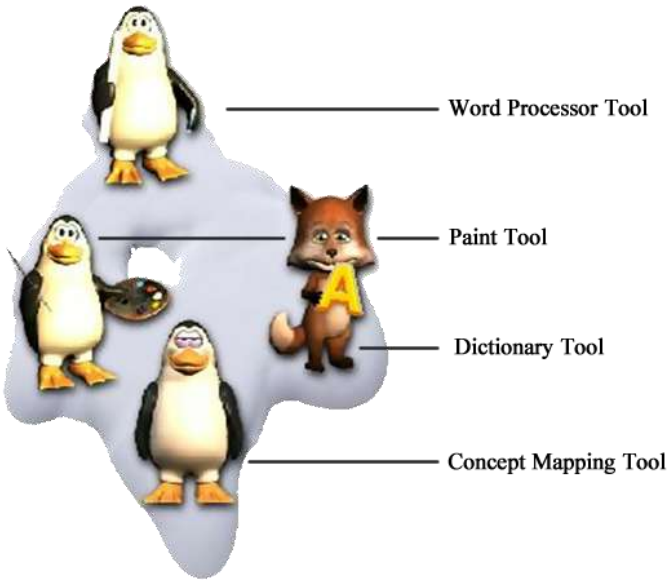

Figure 10. The additional online tools.

An important common feature of all the above tools is that they are ready to use without registration. Moreover, the digital content can be stored directly to the student's computer without requiring an advanced set of skills. This feature is of great importance, as the end users are young learners who may not have a personal email account.

Apart from the above tools within the six thematic areas, we also find the use of the following tools:

1. A spreadsheet tool, Google Sheets (https://docs.google.com/spreadsheets), to make various calculations. It also helps learners to reorganize data by sorting and applying filters.
2. A presentation tool, Google Slides (https://www.google.com/slides) that can be used by learners to create slide presentations with a variety of themes and rich animations.

3. A mapping tool, Google Maps (https://www.google.gr/maps) that is suggested to learners in order to identify countries and other places on the world map.

IV.1.5. The structure and interface of the web-based learning environment

The web site "Act for Climate" can be accessed at the url http://www.actforclimate.net. Its central interface consists of several parts. In the center of the interface the main learning environment can be found. There is an e-portfolio area available both to teachers and students along with training toolkits located at the bottom of the default page (see fig. 14 and 15). The e-portfolio provides an online environment where teachers and students can store their work. In addition, the CMSs integrated class module stores their progress and portrays certain achievements concerning learning. Educators can employ the e-portfolio through reviewing the work carried out by their students and offer informative and relevant feedback to students on the areas that they need to improve (Barrett, 2007). The users can add a document or an idea.

Figure 11. The e-portfolio is located at the top bar of the WBLE webpage.

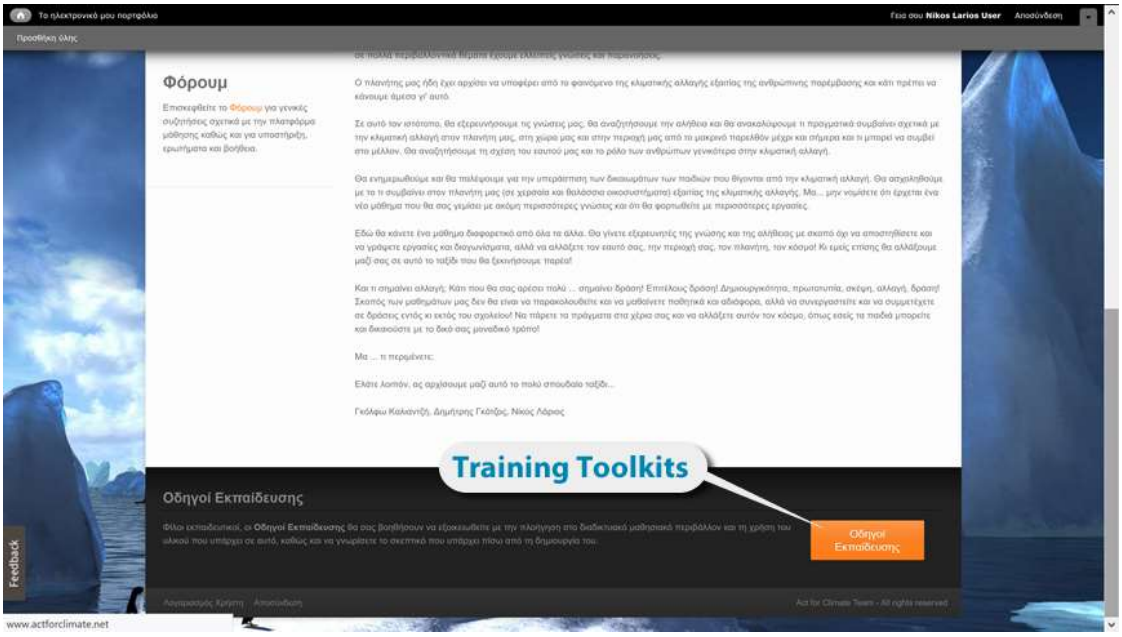

Figure 12. The Training Toolkits can be found at the bottom area of the WBLE.

If they use the document option, they can also upload it as a file attachment with any other type of file that they have created during their activities. The idea option gives students the opportunity to make their own suggestions regarding any issue related to the content or the structure of the WBLE (as recommended by Makrakis, 2010). Thus, it is much like a repository specifically focused on content created by students or an advanced homework archive. By using e-portfolio, learners can monitor their personal development, gain confidence and responsibility with their work, improve their ICT skills and adapt them to their future life (Tosun & Baris, 2011).

According to Monroe (2008), the toolkits are an assembly of resources of education programs that target specific issues or audiences. Our training toolkit contains guides for users providing several ways to navigate the learning environment as well as how to use the various learning tools, such as concept-mapping. Moreover, instructions have been included with detail information on the ways that the e-portfolio can be used.

As illustrated in Figure 16, on the left side of the main area of the WBLE, there is the menu that provides access to the additional tools as well as the menu to the main thematic

areas of the WBLE. In the middle at the top, there is the area that includes the content of each unit of the thematic areas of the WBLE and, at the bottom, there is the area of the accompanying material. The material at the middle is the main learning environment. On the right side, a menu provides access to all the subunits of the selected thematic area as well as a dedicated menu item that opens the intergraded glossary of the WBLE. In each thematic unit there are different icons for the unit's navigation menu.

At the bottom of the page there is a special section created from the Drupal core module book that enhances the navigation experience by giving to the WBLE an interactive e-book chapter like structure. The rest of the benefits that interactive e-books have like the engaging learning environment, the contextual and realistic learning experience, the provision of individual assessment to learners and the collaboration between teachers and students are fulfilled from the actual WBLE. The WBLE goes beyond the limits of an interactive e-book since it also includes web 2.0 tools, assessment tools, collaboration areas, and even a chat area for effective communication between the teachers and the students.

Figure 13. The main area of the WBLE

Within main learning environment of each unit of every thematic area, learners have three main accessories and many navigation options (See fig. 14).

Figure 14. Accessories and navigation options

The main accessories are:

1. A text button that shows the text of each scene of a main learning environment unit.
2. The narration button that enables learners either to hear or not hear characters' (penguin, fox, etc.) narration.
3. The help button that provides learners helpful information regarding the completion of each of the activities.

Regarding navigation, learners have the following options:

4. To move to the previous and next scene as well as to the first scene of the unit by clicking on the left and right arrow and the home button respectively.
5. To go directly to a specific scene by clicking on the circle with the number of the scene at the top of the interface (see figure 15).
6. To go to the home page of each thematic area or the previous or next unit by clicking on the symbol of the thematic area or the arrows entitled "previous" and "next". These buttons are available in the area at the bottom of the main area of the WBLE (See figure 16).

Figure 15. Navigation within a teaching unit.

Figure 16. Navigation in the teaching units of the thematic area “Energy, fossil fuels and waste”.

The main characters used within each unit in order to engage primary school students were the following:

Pagoulis Klimatoula Kokkinotrichis Chionoula

Figure 17. The characters that present the thematic areas.

On the right of the main learning environment there is the glossary icon. The glossary includes terms that represent concepts that are inside the main text and might pose difficulties for learners to comprehend. These concepts are explained inside the glossary in a multimodal

manner. A single word will have multiple learning aids attached to it. Learners at the beginning read a text with the definition of the term. Then they see an image that depicts the term and then they watch a video. Most of the times web links are provided for the learners to further investigate the meaning of the concept (See Figure 18). Within the text of the units, the terms that are included in the glossary are written in red font and have a hyperlink that leads directly to them.

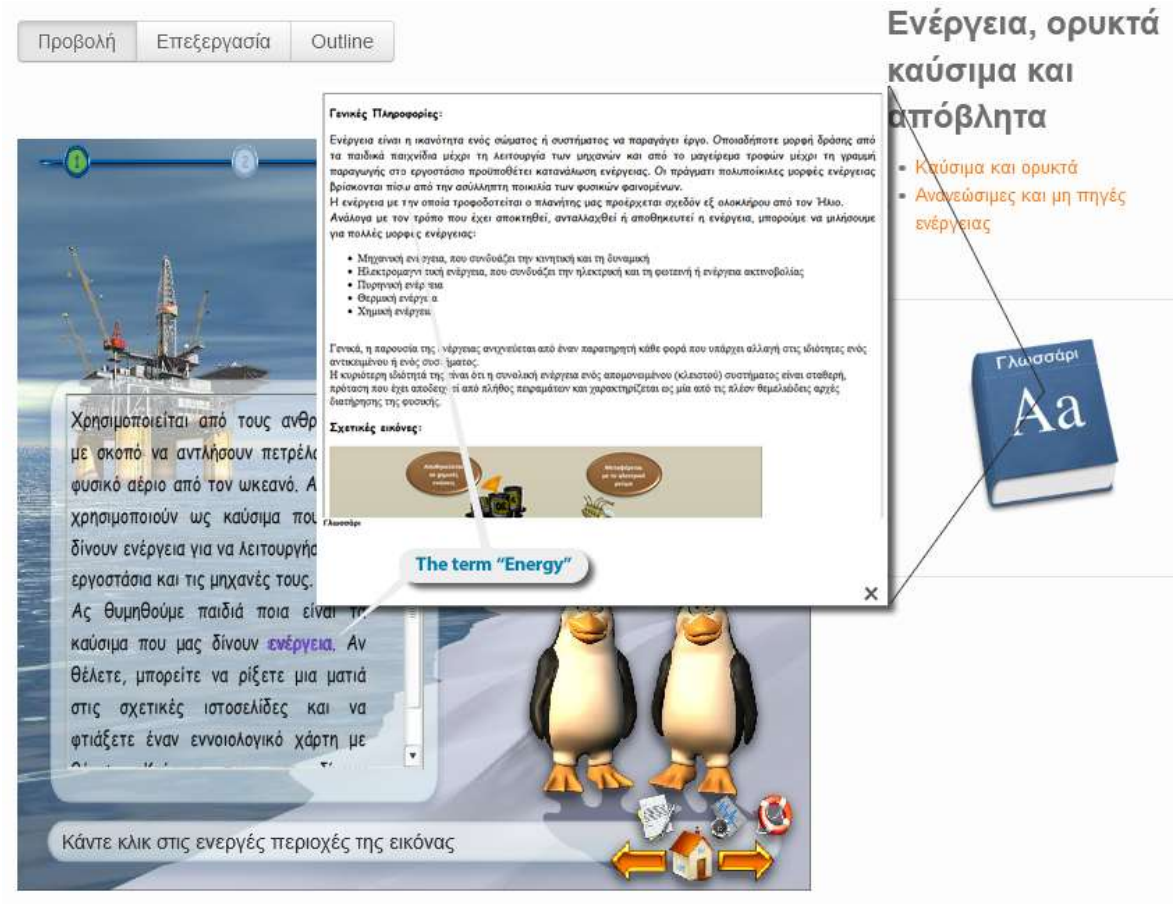

Figure 18. Glossary: The term "Energy".

At the bottom of the main area of the WBLE there is the accompanying material. (See Figure 19): It consists of the following elements:

1 **2** **3** **4** **5** **6**

Figure 19. Elements of the accompanying material.

1. Link to related webpages
2. Link to related articles
3. Link to related videos
4. Suggestions for taking immediate actions
5. Ideas
6. Curriculum connections

1. Links to web pages: includes links to certain web pages, which offer students supplementary information that could help them perform activities included in the WBLE.
2. Links to relative articles: includes links to certain articles in the form of pdf, which offer students supplementary information that could help them perform activities included in the WBLE.
3. Video: includes links to videos, which provide learners with supplementary audiovisual information. These videos are uploaded to YouTube in the Actforclimate channel https://www.youtube.com/user/Actforclimate (a YouTube channel was created in order to gather all the videos embedded in our WBLE).
4. Suggestions for taking immediate actions: includes suggestions for actions that students can do in their local environment.
5. Ideas: provides links to schoolbooks with supplementary information regarding the activities included in the WBLE or links to activities within the school books.

6. Curriculum connections: this option is mainly for teachers and includes the main concepts of the teaching unit, and the subjects and teaching units of the primary curriculum that are connected to it.

IV.2 The underpinning theory of "Act for Climate" Web-based Learning Environment

While the themes and the design for the curriculum chosen for this research project have been covered, it is equally important to understand the theoretical foundations underlying the choices. In this section, the guiding philosophy and the learning theories are explored in order to unveil their relevance in the design of the online learning environment as well as the design of the curriculum that were developed. The development of a new curriculum is not a morally neutral attempt. Every designer is based on a theory of educational teaching and learning that reflects their thoughts and beliefs. Generally, and despite the diversity of learning theories within specific learning paradigms, there are three basic categories of learning theory that are driving instructional and learning design models: 1) instructive; 2) constructive and 3) transformative. (Makrakis and Kostoulas-Makrakis, 2012).

IV.2.1 Instructive models

Instructive models are mainly based on behaviourism (Watson, Skinner, Pavlov, etc.) positivism and partly on cognitivism (labelled also as objectivism). These models are characterized by rationalism, specific knowledge, teacher-centred teaching methods leading to a mechanistic and deterministic approach to human learning (Baum and Wiley, 2017). The main goal of behaviourism and congnitivism instruction is to prescribe learning goals and deliver observable as well as measurable outcomes. Its main aim is to transfer a bank of knowledge to students (Makrakis and Kostoulas-Makrakis, 2012). Freire (2017) criticizes this bank of knowledge characteristic mainly because its view of learners as objects of learning. Further, cognitivists emphasize the acquisition of knowledge and internal mental processes and structures, while behaviourists focus on external environmental conditions.

This is achieved through the organisation of stimuli-response-reinforcement association to modify behavior.

IV.2.2 Constructive models

Constructive learning environments are based on the interpretive school of thought. The most well-known constructive learning models are Piaget's cognitive constructivism (Wadsworth, 2004), Bruner's discovery theory of learning (Bruner, 2009), Vygotsky's sociocultural constructivism (Rieber and Carton, 1988), and Glasersfeld's radical constructivism (Glasersfeld, 2013). Piaget's theory of constructivism argues that knowledge is built according to the child's experiences from its interaction with the environment. Bruner stresses the importance of constructing knowledge through the discovery of scientific principles and structures of a cognitive object by adopting the discovery method or guided discovery. In his point of view understanding and knowledge are connected and they should be driven from an internal motivation for learning by the child (Bruner, 2009). In Vygotsky's socio-cultural constructivism, knowledge is constructed because of the mediation of social events and cultural tools (such as the language and conceptual schemes of each culture) and the internalization of the meanings with which these cultural tools are loaded (Rieber and Carton, 1988). Glasersfeld argues that knowledge is not objective and does not exist independently of the observer. He emphasizes that knowledge is constructed by an individual in a specific historical-social context and it is the organization of our individual experiences (Glasersfeld, 2013).

As Jones and Brader-Araje (2000), Applefield, Huber and Moallem (2000) and Pagán (2006) remind us constructivism has a great influence on the development of educational theories mostly because of the shift from a teacher-centered to a more learner-devoted educational process. Constructive learning environments are described as being open, flexible, learner-centred and less prescriptive. The teacher in these environments is viewed as the facilitator so that the actual learners can be actively involved in making meaning and constructing knowledge. In other words, learning is deemed as social (negotiated) active, contextual (real-world based), authentic and meaningful (Makrakis and Kostoulas-Makrakis, 2012). Constructivism’s objective is not the bank of knowledge in the sense of just teaching

about the impacts of climate change and possible solutions to learners. Instead, the goal is to create socially active citizens, to change behaviors, attitudes and perceptions and make them act by themselves in order to stand against the impacts of climate change in order to achieve a sustainable future. In this sense, this approach has an emancipatory cognitive interest, as it will emphasize the active participatory action of learners to create a better world and a sustainable future, which constitutes the essential component of Habermas' emancipatory cognitive interest (Ford, & Profetto-McGrath, 1994 cited in Kostoulas-Makrakis and Makrakis, 2006).

In terms of designing the learning environment, constructivism gives more emphasis on learning and constructing knowledge through social negotiation as well as cognitive conflict for stimulating learning and less emphasis to the sequence of instruction (Jonassen et al., 1995). From the learning philosophy perspective, constructivism stresses the importance of learning as a process, of forming knowledge on individual basis and constructing meanings rather than banking knowledge (Jonassen and Reeves, 1996). That can be explained from the fact that learners have different social experiences and levels of understanding. There is not a single reality as objectivists assume, but rather multiple realities of how the world works and multiple ways of interpreting these realities. Constructivist learning environments can be enabled by a plethora of ICT tools that can enhance communication of learners, give them access to real-world examples, ease their reflective thinking, present to them multiple perspectives, allow modelling of complicated systems and ideas and assist them in problem solving (Jonassen, 1991).

IV.2.3 Transformative models

The transformative models include paradigmatic perspectives that are meant to be critical, emancipatory, participatory plus inclusive and are contained in critical constructivism and critical pedagogy (Giroux, 2020; Murphy and Fleming, 2012). Critical constructivism refers to a theoretical stance in education in which knowledge is constructed in a way that it enlightens and empowers individuals to transform social reality (Kostoulas-Makrakis and Makrakis, 2006). In critical constructivism the focus is on the learning of student instead of teacher. The educator teaches the student to think and act by giving him

the necessary tools to think and act on his own. In that sense teacher develops in students minds an understanding and disposition about knowledge that furthers democratic living. Consequently, the school enhances the creation of learning environments, where students control their own learning process in order to contribute to the democratization of society when they grow up. In these environments' students are empowered with tools, knowledge and skills and reflect on their own learning and action in order to change and overthrow established situations (Kostoulas-Makrakis and Makrakis, 2006). The aim of critical pedagogy is to awaken and develop critical awareness in students and teachers and to develop individual autonomy, individual initiative, social emancipation and social transformation through actions that lead to actions to change the status quo (Raptis and Rapti, 2017).

According to Habermas, critical pedagogy goes beyond mere criticism to critical practice and is not a mere listening and transmission, but a political act (Kostoulas-Makrakis and Makrakis, 2006). Critical pedagogy highlights the social role of the school, which now turns to society and tries to change it with actions inside and outside the school. Both the curriculum and the WBLE for climate change that were developed are determined by the theory of critical pedagogy, mainly due to the primary goal of this thesis which was change and action. This does not mean that there are no influences from behavioral and constructive learning models on the educational design that was followed. Those models they were not rejected but instead they were integrated in the educational planning by adding some of their elements, in the places were considered useful. That empowered the critical pedagogical character in the educational planning. After all, especially in the first educational design efforts, the influences of behavioral and constructive theories were particularly strong, due to the time of nurturing in these models.

Transformative models have their origins in the adult education that suggests ways in which adults can create a meaning based on their personal experiences. Mezirow (2000) defines transformative learning as a process of transforming our taken-for-granted references into a more inclusive, eclectic, open, version of them. That is necessary according to Mezirow because knowledge and beliefs are formed in childhood and are difficult to change after. Only if appropriate conditions exist for transforming already formed meanings into different mental shapes this change is possible. This change can be achieved by including not only the transformative but the political dimension as well in their views of teaching and learning.

That is introduced by adding politics and ethics in education by considering what the most valuable knowledge is that learners should acquire and what teaching and learning methods produce it. In other words, it is a kind of learning that cultivates critical reflection and problem solving (Mezirow,1997).

Critical reflection and problem solving concepts must be further clarified as they were key components in the design of the WBLE.

Mezirow (1991) distinguishes four levels of reflection. At the first level there are the actions of habit, the ones that are carried out without much thought or building new meanings. At the second level there is understanding. At this level there is the effort to understand what we have learned, without building new meanings. At the third level there is the reflection, where we re-evaluate an action for future improvement and resolution of similar problems. Fourth and superior of all is the critical reflection, where individuals question their ideas, knowledge, beliefs and actions so far. Cranton on the other hand (1994) suggests three types of reflection that requires movement toward the emancipatory sphere. The first type is content reflection which in its essence is an examination of a problem's content or description. The second type is process reflection which requires checking on the problem and the final one is the premise reflection which occurs when the problem itself is questioned.

Teachers, pre-service teachers and students that will use the WBLE, will deal with the impacts and problems that climate changes cause on human life and especially the natural environment. As such, this study considered it appropriate to also adopt a problem-based approach of learning where was possible. As implied by the term "problem-based", the main idea of the learning process is to solve a problem. Nilson (2010) describes problem-based learning (PBL) as a student-centered approach where students learn about a subject by working in groups, manage to develop knowledge and skills in order to solve an open-ended problem. Such a process can also take place in a constructivist learning environment, according to Neo and Neo (2009), as students develop creative skills, problem-solving and critical thinking techniques. Moreover, as Jonassen (1991, 1994, 1995 in Neo, & Neo, 2009) argues, the design of constructivist learning environments provides the opportunity for students to engage in solving essential, interesting and related problems. According to Kwan and Ko (2004), PBL includes aspects of Piaget's cognitive constructivism as well as social

constructivism of Piaget and Vygotsky respectively. Figure 20 shows the problem-solving process that takes place during PBL

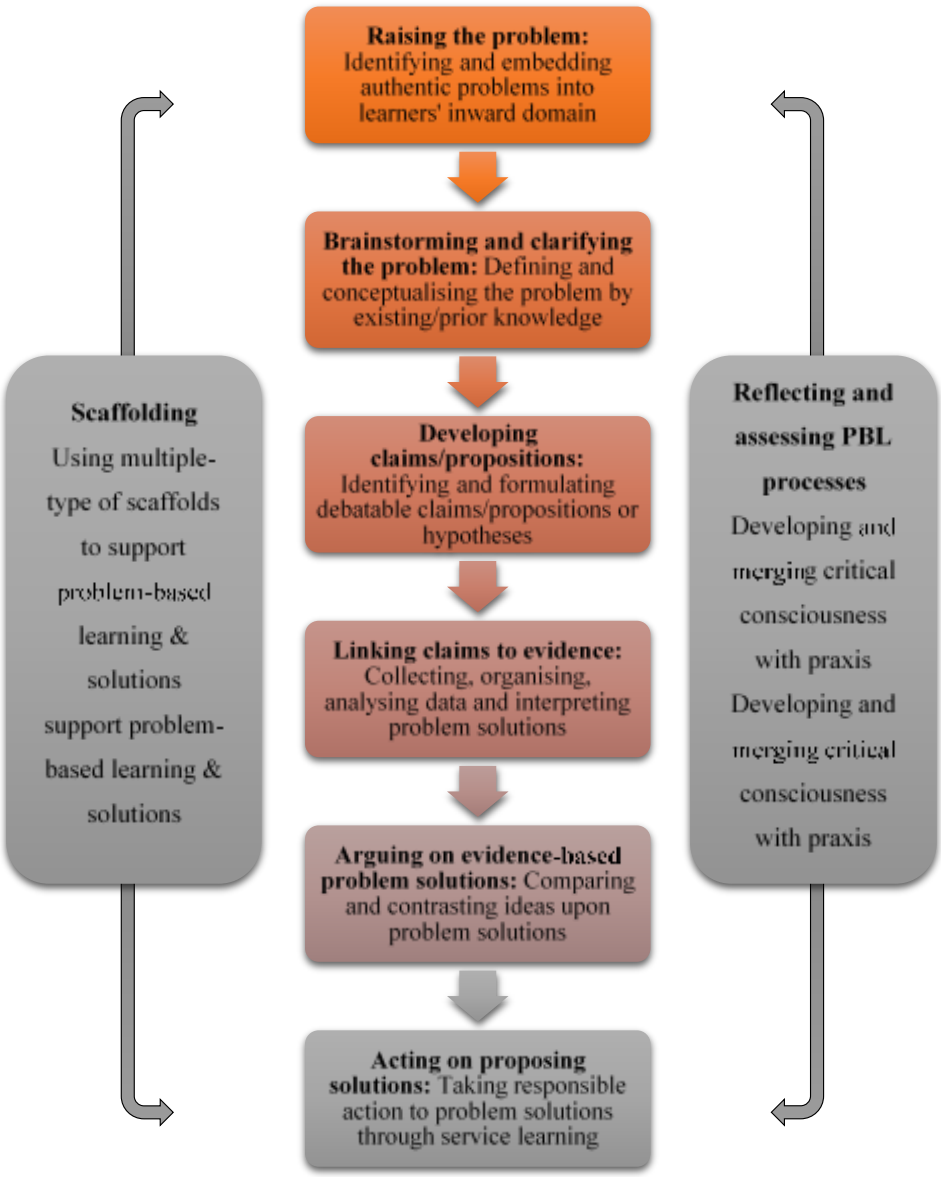

Figure 20. Makrakis, & Kostoulas-Makrakis (2017).

Transformative learning can be perceived as a change of consciousness that encompasses an understanding of the self, the environment, relationships with others,

alternative ways of living and an approach to social justice, peace and personal joy (O' Sullivan, 2004). Transformative learning changes the way we see the world and experience our experiences, our thoughts, feelings and actions change and along changes the way we perceive ourselves, others and the environment (Makrakis and Kostoulas-Makrakis, 2012) The role of the teacher is to transform his students with the help of appropriate tools in a community with individual and collective consciousness that through critical reflection will act with the aim of individual and social change. According to many researchers (Tilbury, Podger and Reid, 2004; Balsiger et al., 2017; Schnitzler, 2019), transformative learning and ESD not only have common goals but also both emphasize the change of values and behaviors (Makrakis and Kostoulas-Makrakis, 2012). The primary change pursued in ESD is to learn to value sustainable development and learn how to implement it (Carrington and Selva, 2010). This is something which can be achieved through transformative learning. In addition, critical thinking, critical reflection, change of thinking and emotions and action are key skills for both transformative learning and ESD (Makrakis and Kostoulas-Makrakis, 2012).

The ExConTra learning paradigm was developed by Makrakis & Kostoulas-Makrakis (2012) to reconcile the theories of experiential learning, constructivist learning and transformative learning. The name ExConTra came from the first syllables of each learning theory (**Ex**periential, **Con**structivist, **Tra**nsformative). It was presented in detail in chapter II. This learning model was the design framework of Climate Change Curriculum and the WBLE named "Act for Climate".

Chapter V.

Research Results

V.1. Introduction

As mentioned in first chapter, the purpose of this research was to explore pre-service teachers' experiences and impressions of the WBLE, and relationships between the pre-service teachers' worldviews in terms of active citizenship qualities (Intercultural communications, justice etc.) and educational philosophy. This chapter presents the research results as well as the analysis of the findings from the quantitative and qualitative data gathered in this study. The quantitative and qualitative data collected from the questionnaire was used to evaluate the relations and correlations of a number of factors regarding participants' perceptions, knowledge, and action on climate change issues and with the rights of children in relation to climate change.

V.2. Results

V.2.1. Quantitative Results

A questionnaire (see appendix 1) was sent to 200 pre-service teachers from the 3rd to the 7th semester who attended the courses a) Analytical Program: Theory and Practice and b) ICT in Education for Sustainable Development. Eighty-two point five of them (82.5%) were women and seventeen point five (17.5%) were men. The pre-service teachers were selected because of their previous knowledge of climate change issues due to the courses that they had attended in the past. The interventions were conducted in the hours of the university courses in the fall of 2017 and the questionnaire was given before the end of the semester in January 2018. The questionnaire was deployed with the aid of Google forms. It was constructed in Google Forms format, with 121 closed-type questions on a 4/degree Likert

scale (1=I totally disagree with 4=I totally agree) and 2 open questions. The questionnaire link was given to the students during the course. Although it was not obligatory all the pre-service teachers filled the questionnaires. As a result, there was a 100% response rate.

Results are presented in 6 models. Each model used the same 5 independent variables: intercultural communication, justice, self-awareness, global civic engagement, and social responsibility. The dependent variable of each model is as follows: 1st model: usability; 2nd model: satisfaction; 3rd model: content relevance; 4th model: progressivism; 5th model: neo-conservatism; and 6th model: reconstructionism.

Stepwise multiple regression (SMR) was used to analyze relationships between a single response variable (the dependent variable) and with two or more controlled (or independent) variables. SMR is appropriate for this analysis because it combines forward selection with backward elimination. It should be noted that one limitation of SMR is that it only looks at one step forward and one step backward at a time.

1st Model: Usability

Hypothesis 1: Inter-cultural communication, justice, self-awareness, civic engagement and social responsibility are expected to contribute significantly to the prediction of usability.

From the independent variables, the variables of intercultural communication and global civic engagement contribute significantly to the prediction of the variable usability. The variable intercultural communication is responsible for 23.2% of the variance of Usability ($F_{1,198} = 59.70$, $p < 0.001$). The variable global civic engagement is responsible for an additional 5.8% of its variance Usability ($F_{1,197} = 16.00$, $p < 0.001$). High levels of usability are associated with high levels of intercultural communication and global civic engagement (Table 5).

Table 4. Stepwise regression of predictive variables for usability (only significant predictors are included).

Variable	R-squared change	B	Typical error b	Beta	t	P
Intercultural communication	0.232	0.28	0.06	0.32	4.50	0.001
Global civic engagement	0.058	0.26	0.06	0.29	4.00	0.001

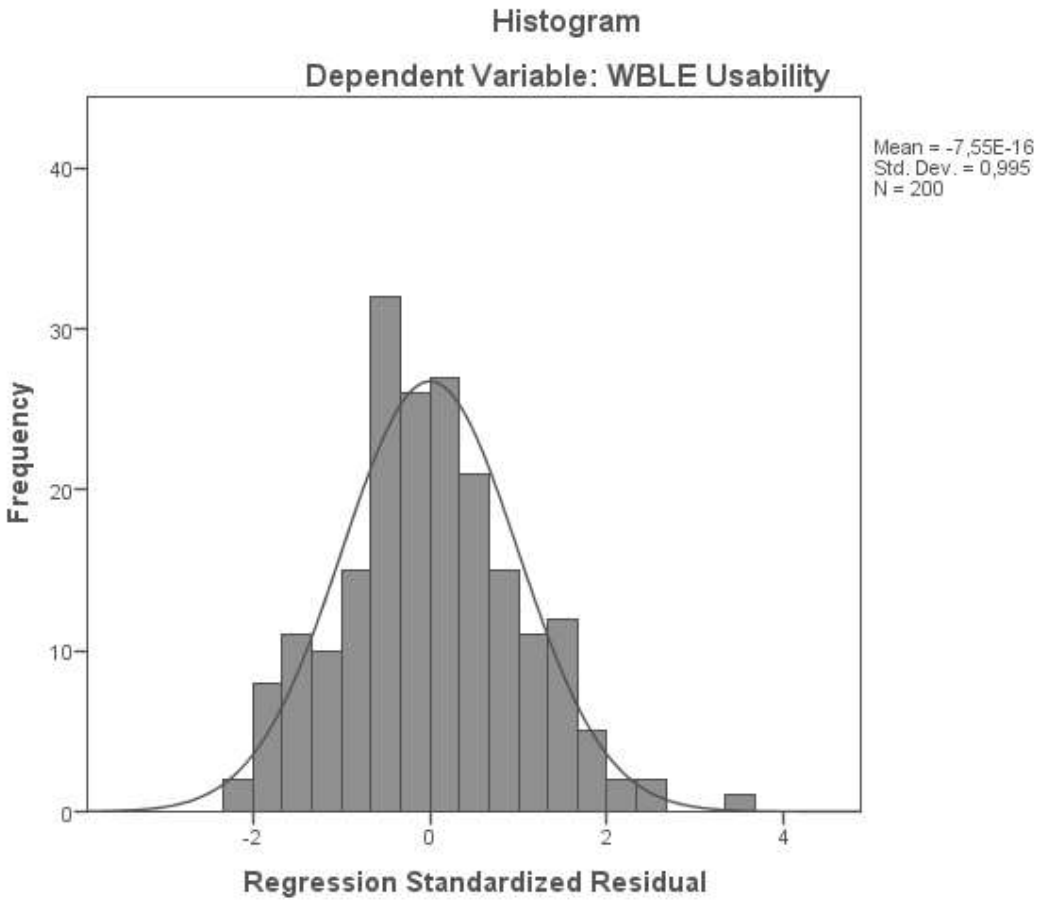

Figure 21. Histogram of dependent variable WBLE usability.

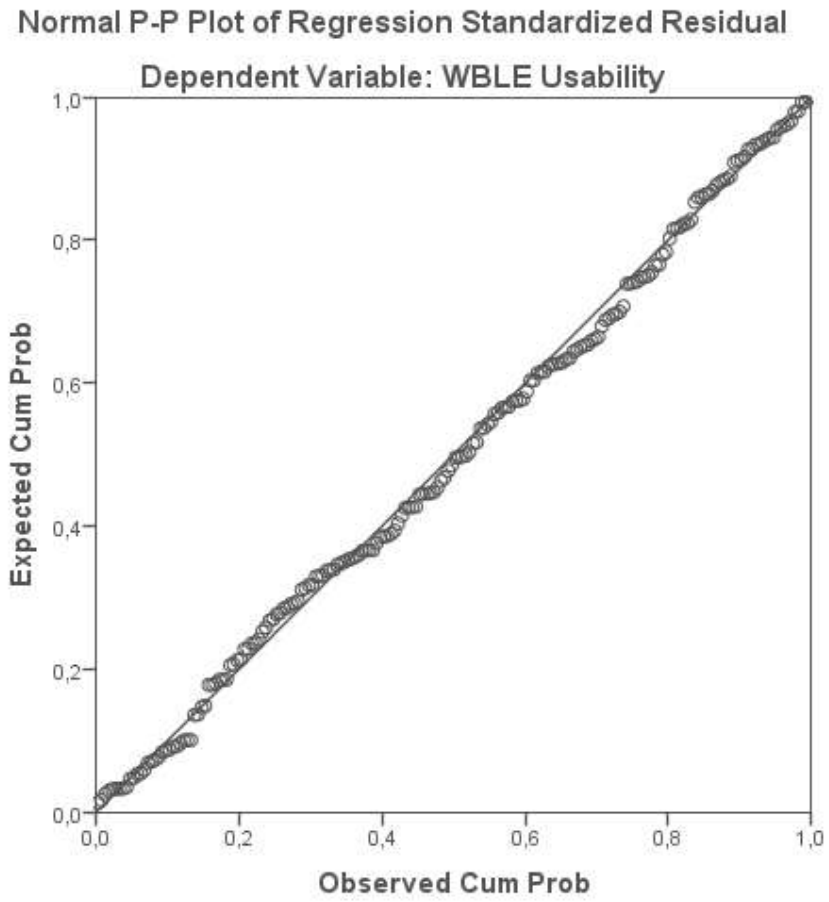

Figure 22. Normal P-P Plot of dependent variable WBLE usability.

2nd Model: Satisfaction

Hypothesis 2: Inter-cultural communication, justice, self-awareness, civic engagement and social responsibility are expected to contribute significantly to the prediction of pre-service teachers' satisfaction towards the 'Act for Climate' web-based learning environment. From the independent variables, only the global civic engagement variable contributes significantly to the prediction of the variable satisfaction. This variable is responsible for 10.4% of its variance of satisfaction ($F_{1,198} = 23.06$, $p < 0.001$). High satisfaction levels are associated with high levels of global civic engagement (Table 6).

Table 5. Stepwise regression of predictive variables for satisfaction (only significant predictors are included).

Variable	R-squared change	B	Typical error b	Beta	t	P
Global civic engagement	0.104	0.37	0.08	0.32	4.80	,0.001

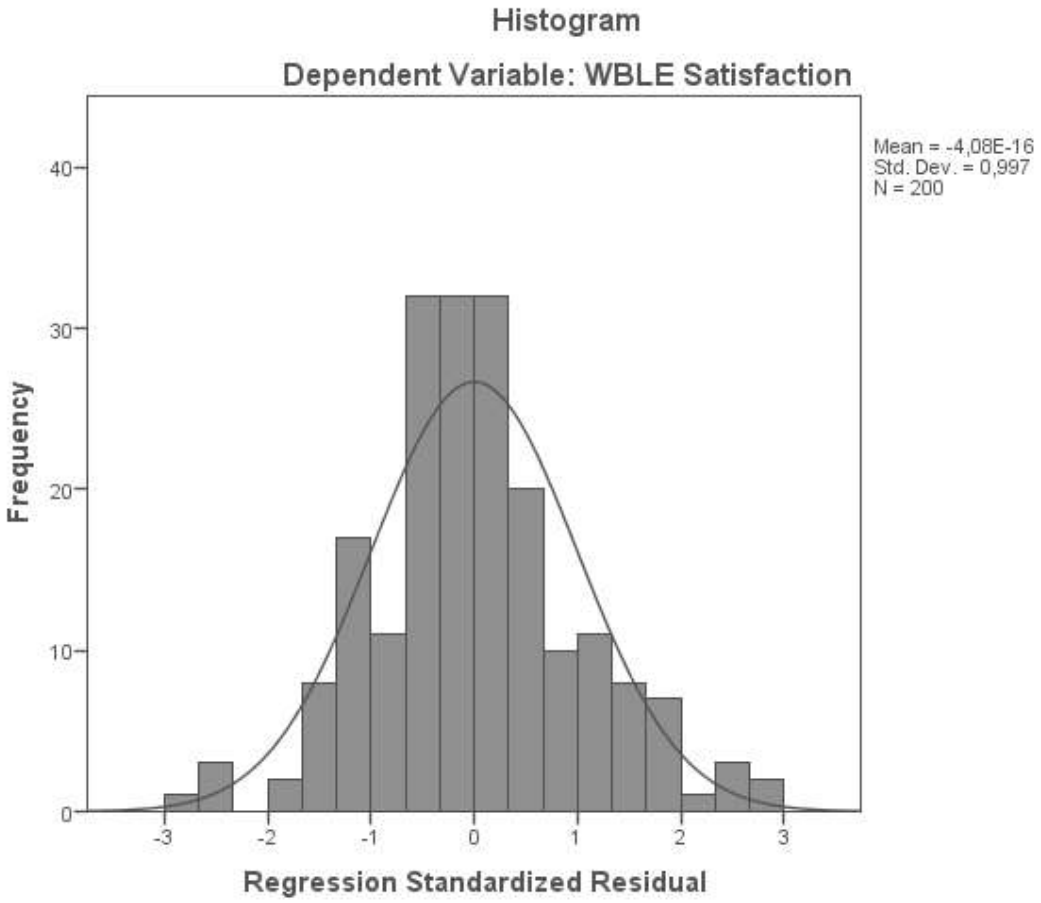

Figure 23.Histogram of dependent variable WBLE satisfaction.

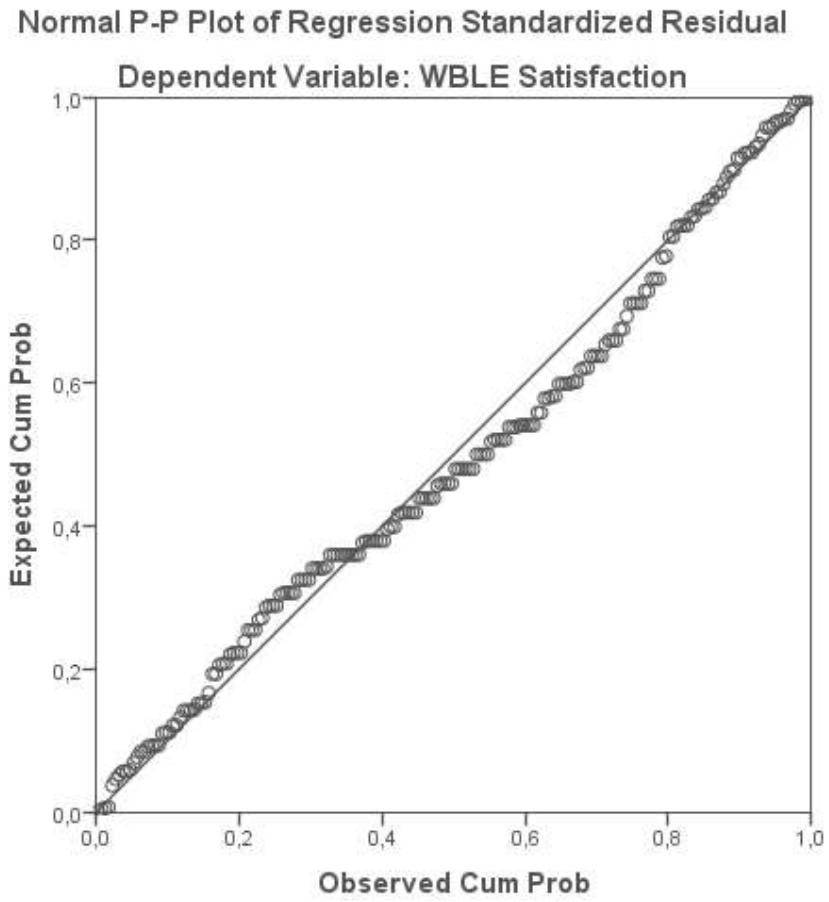

Figure 24. Normal P-P Plot of dependent variable WBLE satisfaction.

3rd Model: Content relevance

Hypothesis 3: Inter-cultural communication, justice, self-awareness, civic engagement and social responsibility are expected to contribute significantly to the prediction of 'Act for Climate' content relevance.

From the independent variables, the variables intercultural communication and global civic engagement contribute significantly to the prediction of the variable content relevance. The variable intercultural communication is responsible for 14.0% of its variance of content relevance ($F_{1,198} = 32.29$, $p < 0.001$). The variable global civic engagement is responsible for an additional 3.1% of its variance of content relevance ($F_{1,197} = 7.30$, $p = 0.008$). High

levels of content relevance are associated with high levels of intercultural communication and global civic engagement (Table 7).

Table 6. Stepwise regression of predictive variables for content relevance (only significant predictors are included.)

Variable	**R-squared change**	**B**	**Typical error b**	**Beta**	**T**	**P**
Intercultural communication	0.140	0.26	0.08	0.26	3.34	0.001
Global civic engagement	0.031	0.22	0.08	0.21	2.70	0.008

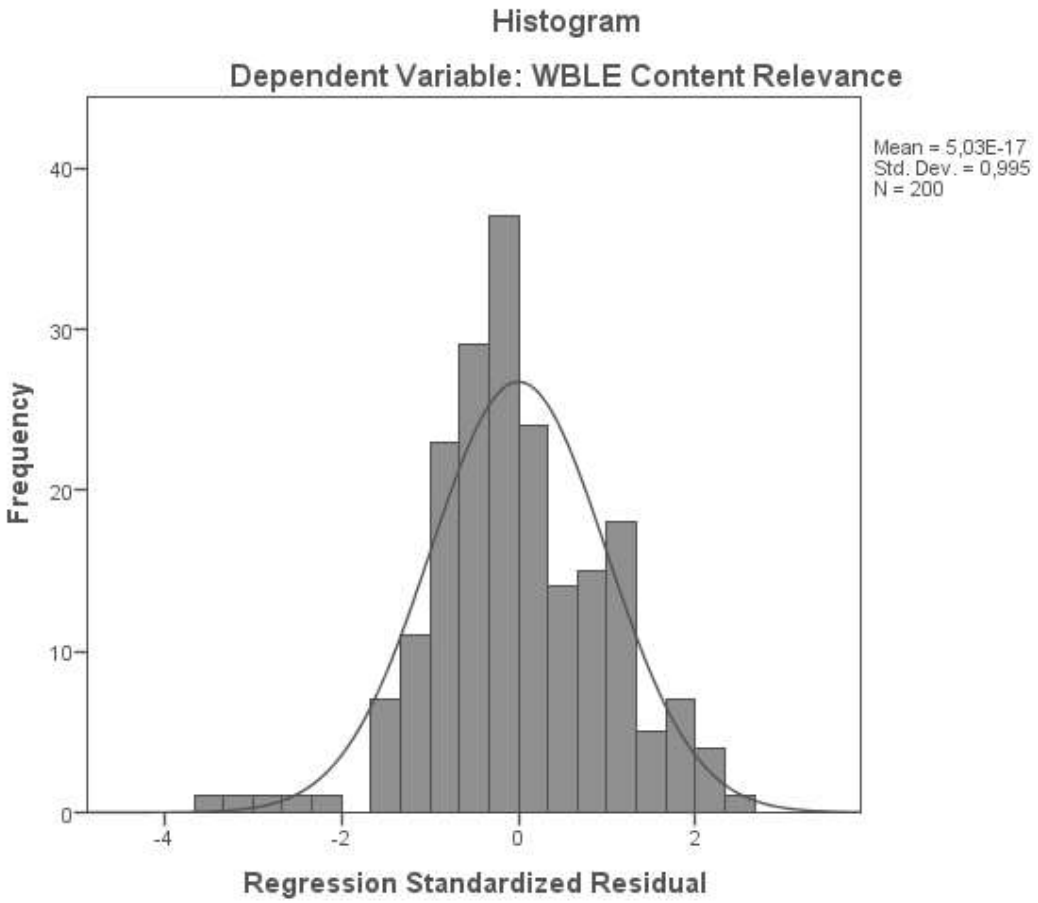

Figure 25. Histogram of dependent variable WBLE content relevance.

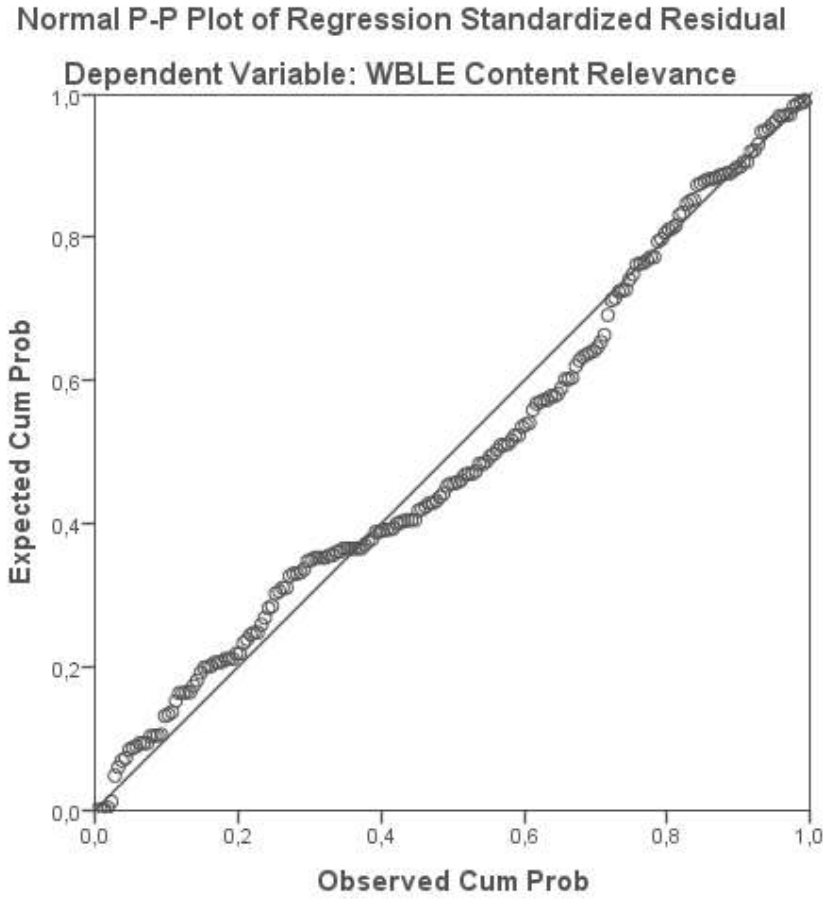

Figure 26. Normal P-P Plot of dependent variable WBLE content relevance.

4th Model: Neo-conservatism

Hypothesis 4: Inter-cultural communication, justice, self-awareness, civic engagement and social responsibility are expected to contribute significantly to the prediction of neo-conservative pre-service teachers' education philosophy.

From the independent variables, the variables intercultural communication and self-awareness contribute significantly to the prediction of the variable neo-conservatism. The variable intercultural communication is responsible for 10.9% of the variance of neo-conservatism ($F_{1,198} = 24.17$, $p < 0.001$). The variable self-awareness is responsible for an

additional 2.0% of the variance of neo-conservatism (F1,197 = 4.57, p = 0.034). High levels of neo-conservatism are associated with high levels of intercultural communication and self-awareness (Table 8).

Table 7. Stepwise regression of predictive variables for neo-conservatism (only significant predictors are included.)

Variable	**R-square change**	**B**	**Typical error b**	**Beta**	**t**	**P**
Intercultural communication	0.109	0.30	0.10	0.24	3.15	0.002
Self-awareness	0.020	0.18	0.09	0.17	2.14	0.034

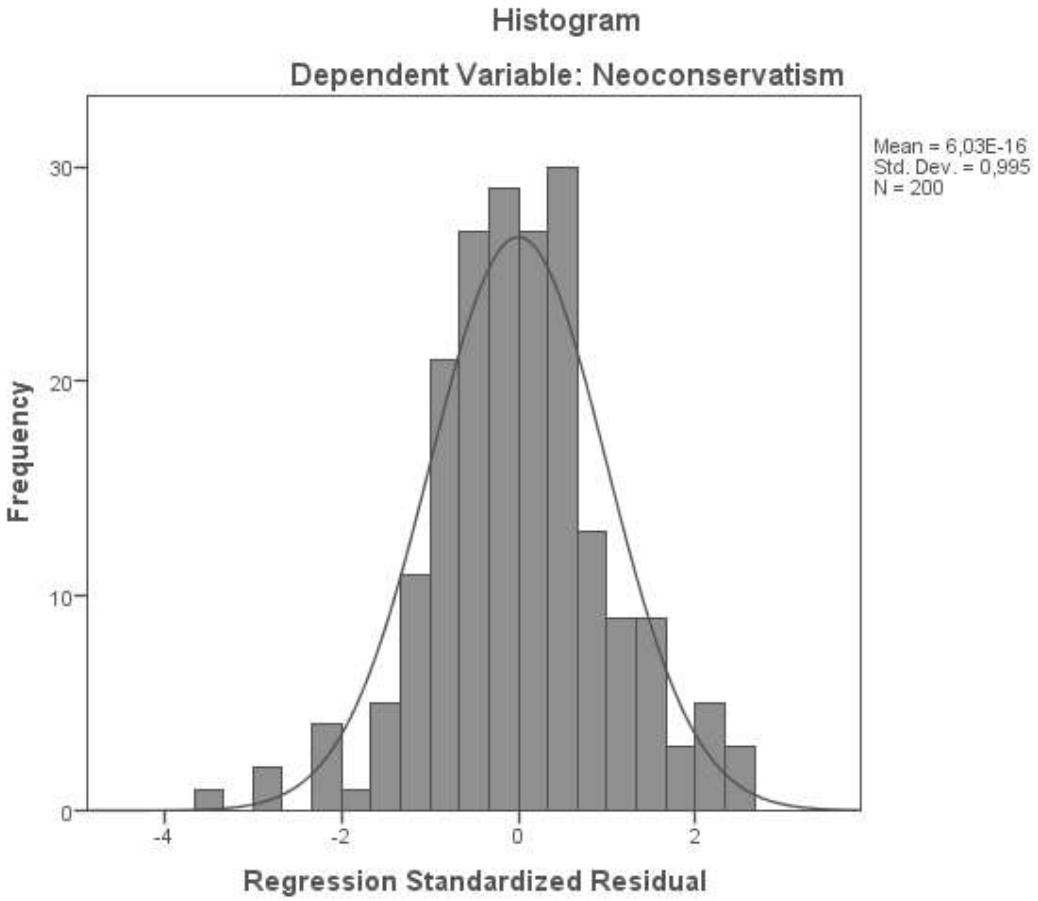

Figure 27. Histogram of dependent variable Neo-consevatism.

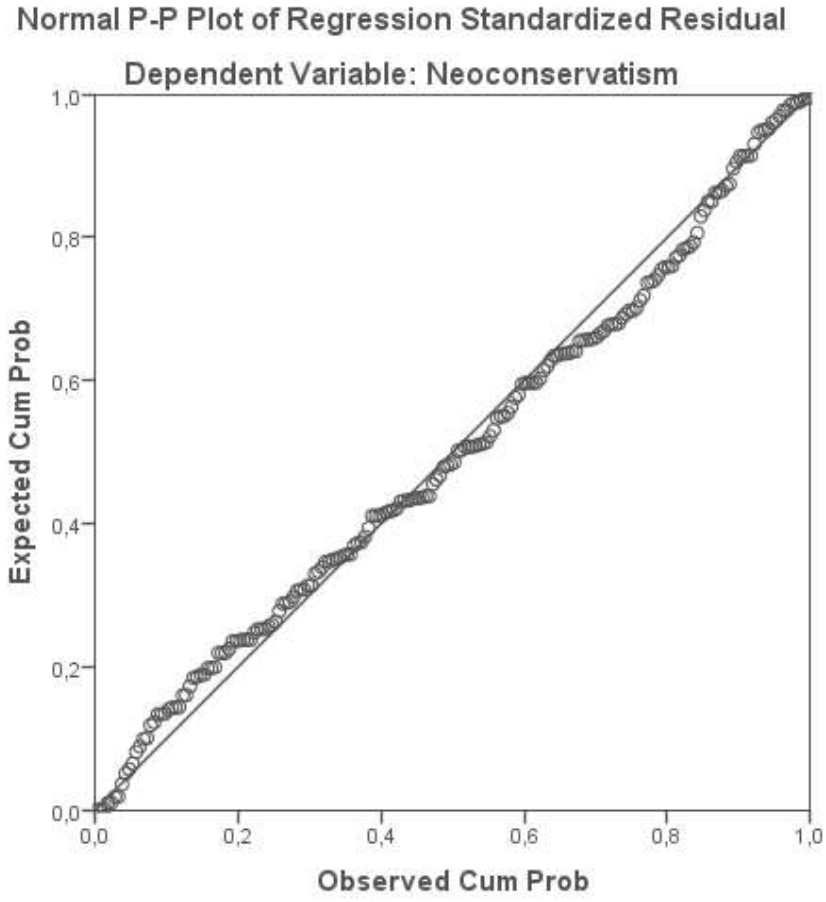

Figure 28. Normal P-P Plot of dependent variable Neo-consevatism.

5th Model: Progressivism

Hypothesis 5: Inter-cultural communication, justice, self-awareness, civic engagement and social responsibility are expected to contribute significantly to the prediction of the progressivist pre-service teachers' education philosophy.

From the independent variables, the variables intercultural communication, social responsibility, justice, and global civic engagement contribute significantly to the prediction of the variable progressivism. The variable intercultural communication is responsible for 19.3% of the variance of progressivism ($F_{1,198} = 47.30$, $p < 0.001$). The variable social

responsibility is responsible for an additional 11.3% of the variance of progressivism ($F_{1,197} = 32.15$, $p < 0.001$). The variable justice is responsible for another 4.0% of its variance of progressivism ($F_{1,196} = 11.91$, $p = 0.001$). The variable global civic engagement is responsible for an additional 2.8% of its variance of progressivism ($F_{1,195} = 8.84$, $p = 0.003$). High levels of progressivity are associated with high levels of intercultural communication, social responsibility, justice, and global civic engagement (Table 9).

Table 8. Stepwise regression of predictive variables for progressivism (only significant predictors are included).

Variable	**R-squared change**	**B**	**Typical error b**	**Beta**	**t**	**P**
Intercultural communication	0.193	0.23	0.07	0.24	3.50	0.001
Social responsibility	0.113	0.15	0.05	0.19	2.71	0.007
Justice	0.040	0.23	0.06	0.25	3.93	0.001
Global civic engagement	0.028	0.22	0.07	0.21	2.97	0.003

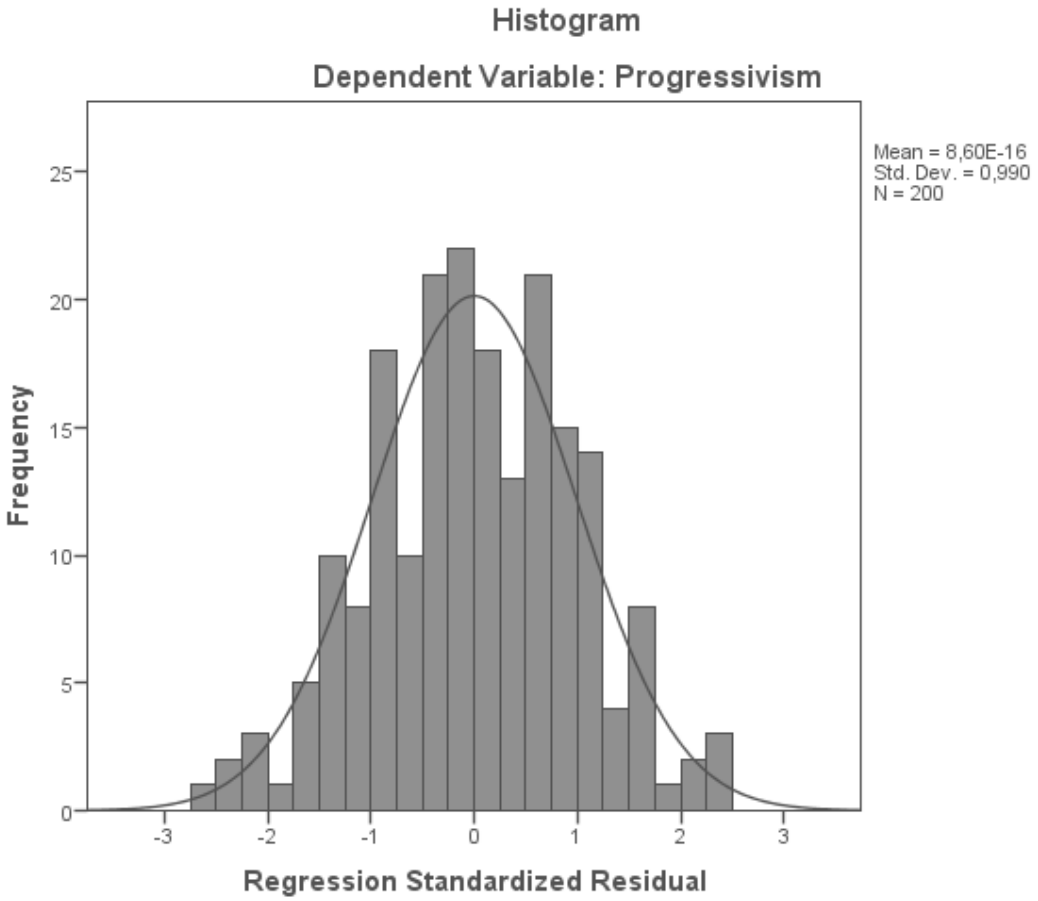

Figure 29. Histogram of dependent variable Progressivism.

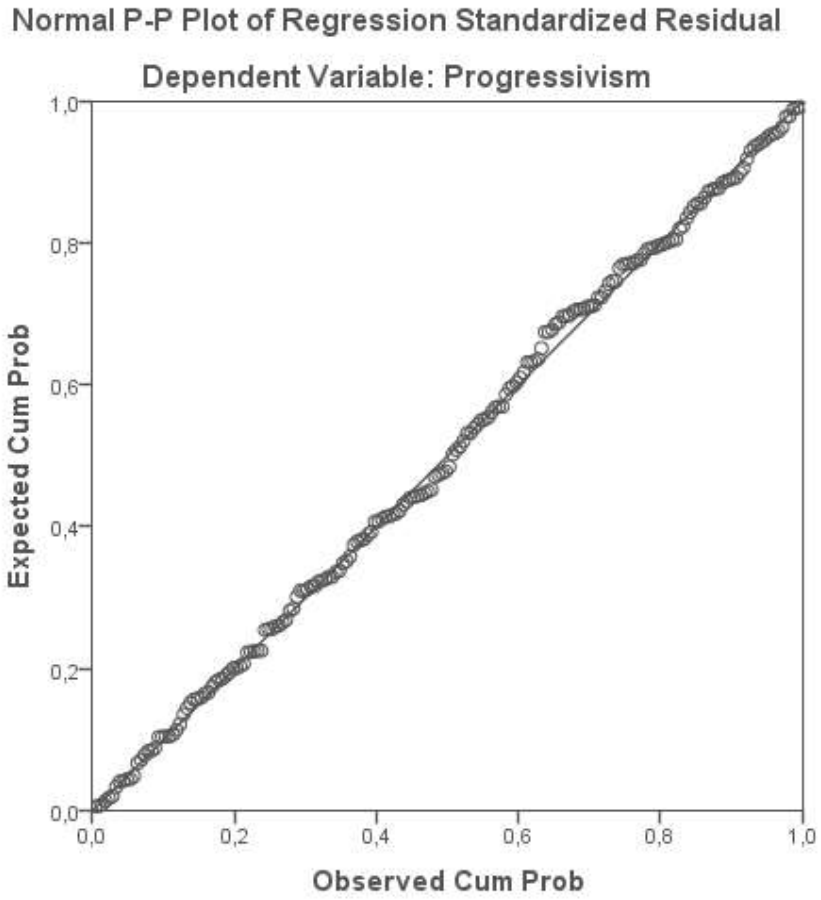

Figure 30. Normal P-P Plot of dependent variable Progressivism.

6th Model: Reconstructionism

Hypothesis 6: Inter-cultural communication, justice, self-awareness, civic engagement and social responsibility are expected to contribute significantly to the prediction of reconstructionist pre-service teachers' education philosophy.

From the independent variables, the variables social responsibility, intercultural communication, justice, and self-awareness contribute significantly to the prediction of the variable reconstructionism. The variable social responsibility is responsible for 21.9% of the variance of reconstructionism ($F_{1,198} = 55.60$, $p < 0.001$). The variable intercultural communication is responsible for an additional 9.90% of the variance of reconstructionism ($F_{1,197} = 28{,}69$, $p < 0.001$). The variable justice is responsible for 4.8% of the variance of

reconstructionism ($F1,196 = 14.76$, $p < 0.001$). The variable self-awareness is responsible for an additional 2.4% of the variance of reconstructionism ($F1,195 = 7.62$, $p = 0.006$). High levels of reconstructionism are associated with high levels of social responsibility, intercultural communication, justice, and self-awareness (Table 10).

Table 9. Stepwise regression of predictive variables of Reconstructionism (only significant predictors are included.)

Variable	**R-squared change**	**B**	**Typical error b**	**Beta**	**t**	**P**
Social responsibility	0.219	0.19	0.05	0.24	3.56	0.001
Intercultural communication	0.099	0.23	0.07	0.23	3.41	0.001
Justice	0.048	0.26	0.06	0.28	4.38	0.001
Self-awareness	0.024	0.17	0.06	0.19	2.76	0.006

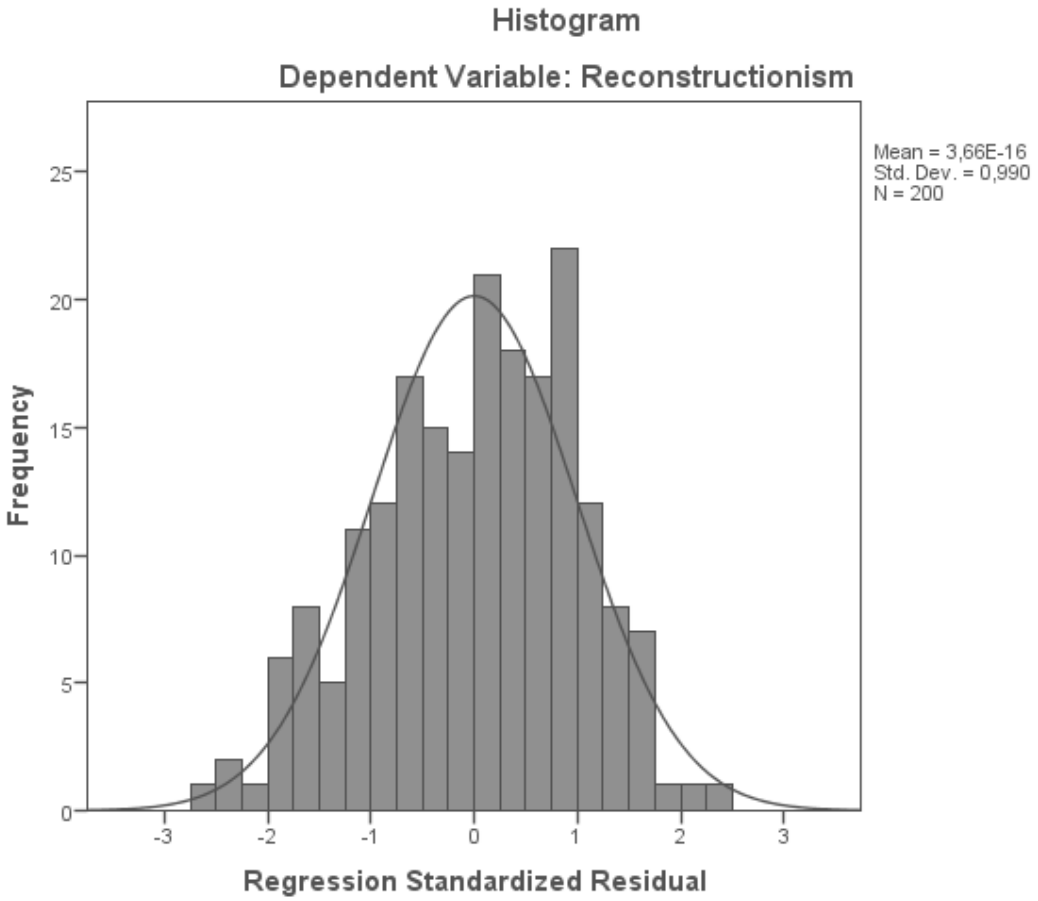

Figure 31. Histogram of dependent variable Reconstructionism.

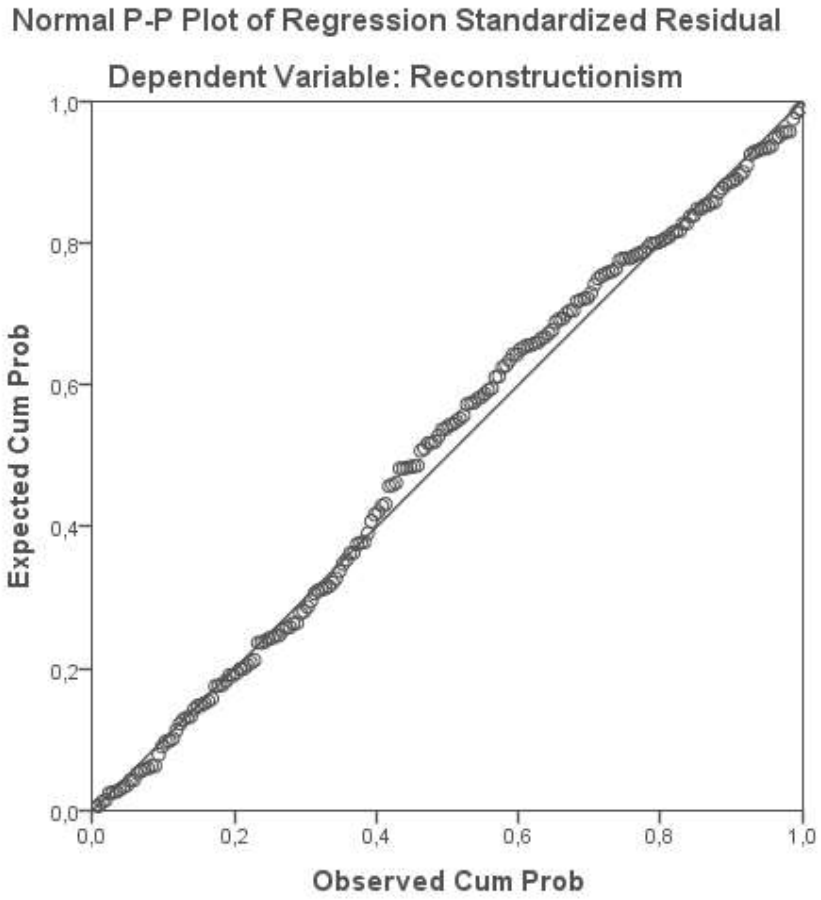

Figure 32. Normal P-P Plot of dependent variable Reconstructionism.

V.2.2. Qualitative Results

The same survey asked respondents for feedback on the WBLE itself. These responses are presented in two tables (See Tables 11 & 12), each with responses categorized within the following areas:

1. Positive general feedback
2. Website comments
3. Comments regarding the instructional materials

4. Language

Table 10 shows positive feedback and Table 11 indicates challenges expressed by survey respondents.

Table 10. Positive qualitative responses to questionnaire N = 62 in positive responses

CATEGORY	COMMENTS	NO. OF TIMES MENTIONED	% TIMES MENTIONED (% rounded)
General	It [website] refers to a variety of topics that are interesting. They seem useful for teaching and learning new things. Real issues of climate change engage students.	7	11%
	It [website] had important information about the environment and climate changes.	3	5%
	Consciousness development.	2	3%
	Content is correct and complete. Content is pleasant and approachable without being condescending.	8	13%
	Takes an interdisciplinary, cross-cultural approach.	1	2%
	TOTAL	21	
Website	Interesting and EASY TO USE both by teachers and students. There is a wealth of information that can be useful. Does not require content knowledge to use.	21	34%
	Gives teachers flexibility in teaching content.	1	2%
	It is interesting for students and makes lessons easier to understand.	2	3%

	Concepts presented in alphabetical order. Can click on “more” to obtain for information on topic.	4	7%
	Ability to learn through text and multimedia (graphics, videos, photos, etc.). WBLE keeps reader’s interest. Motivates students to learn.	15	24%
	TOTAL	43	
Instructional materials	Dictionary and glossary important.	2	3%
	Meets different learning styles of students through delivering information in different formats (e.g., writing, painting, etc.).	1	2%
	Development of teaching plans and training guide.	7	11%
	Interactive activities.	3	5%
	TOTAL	13	
Language	Easy to read.	1	2%
	TOTAL	1	

There were sixty-two qualitative responses categorized into general comments, website comments, comments regarding the instructional materials, and language.

1. Positive - General Feedback

Eight (13%) of the sixty-two positive responses indicated that the WBLE content was accurate and complete, was approachable by teachers and students without being condescending. Seven responses (11%) said that the website refers to a variety of topics that are interesting and that they seem useful for teaching and learning new things. Real issues of climate change presented engage students. The next three comments were as follows:

- It [website] had important information about the environment and climate changes. Three responses (5%)

- It [website] provided consciousness development [for students]. Two responses (3%)
- It [website] takes an interdisciplinary, cross-cultural approach. One response (2%)

2. Positive - Website Feedback

Of the sixty-two positive responses categorized in terms of the website, twenty-one (34%) mentioned that the WBLE was very easy to use both by students and teachers with a wealth of useful information regarding climate change-related issues. This group of respondents also indicated that learning to use the website does not require one to have content knowledge prior to its use. Fifteen (24%) of responses said that students seemed motivated to learn because of the use of text and multimedia (such as graphics, videos, and photos) which tends to keep students interested in learning about the topic. Four (7%) of the respondents were pleased that the concepts presented on the website were in alphabetical order, making finding information easier and that users were able to click on buttons that were labeled «more» to obtain additional information on the subject of interest. Two individuals (3%) said that the website made it interesting for students to learn, also making it easier for lessons to be understood. And, one individual (2%) said that the website design provided teachers with flexibility in teaching content.

Several individuals provided important feedback regarding the website:

«...The website meets its expectations...»

«Students can easily browse and spend their time creatively learning about climate changes...»

«The ‘Act for Climate’ website is a modern site appropriately structured.»

«It [the website] becomes a connection of learning with everyday life.»

«...I would like to applaud the age rating...»

«It is not difficult for someone to understand how this tool achieves the teaching of many cognitive issues...»

«...[online environment] encourages visitors to take action...»

«It [website] is an original and at the same time [an] interesting way to provide information...»

3. Positive - Instructional Materials Feedback

Of those who responded to the qualitative portion of the questionnaire, seven (11%) remarked the ability to develop teaching plans as well as having access to the training guide were both positive. Three (5%) respondents were positive towards having interactive activities available to further engage students in the teaching and learning process. Two (3%) individuals said having both a glossary and dictionary were very important for students to be able to easily access. And, 1 (2%) respondent commented that the WBLE was able to meet different learning styles of students through delivery of information in different formats of activities, such as through writing, painting, etc.

One individual provided an interesting comment regarding the instructional materials used in the website:

«Digital media available as conceptual mapping, simulations, audio, video contribute significantly to the pedagogical utilization of the material and attract the interest of children.»

4. Positive - Language Feedback

Only one (2%) respondent commented on the language used throughout the WBLE, indicating that the website was very easy for students and teachers to read.

5. Challenges - General Feedback

Fourty-four (63%) of those who responded in the category of ‘general’ described the website as being good. Seven (10%) indicated that more instruction on the use of the website for both students and teachers could be provided. Nine (13%) had technical issues such as a slow web connection or a computer that could not show graphics. Three (4%) said that the website should be promoted more widely so as to increase its use and two (3%) wanted the website to be more accessible to students, however the comment did not explain how accessibility should be expanded and/or improved. The remainder of the comments in this category were expressed by one person each and include:

- Teachers need to encourage students to go to the website often.
- Website content should be more objective and impartial, but the comment did not explain how this should be achieved.
- Make the website available to everyone worldwide.
- And have more help, but it is not clear what specific help should be added.

Broadly speaking, these general comments were quite positive, given that the WBLE design, construction, and implementation is in its early stages of development.

6. Challenges - Website Feedback

The responses to the website itself were a bit more emphatic than the general category feedback. Almost half, forty-four (45%) of the responses in this category indicated that the website needed more references and needed more art forms to be added, especially videos, images, and gaming. Gaming was indicated as being important to reach younger students to test their knowledge about the environment and climate change – thereby engaging them more in learning. Improving navigation on the website was offered by twelve (12%) of individuals responding to the survey; nine (9%) said to check links regularly to make sure that they worked, especially for links to videos; seven (7%) want more attractive graphics and a more modern interface; seven (7%) expressed the need to add more modules to the

existing ones; five (5%) responded that the website was not easy to use and that it should be made easier for kids to use, but provided no suggestions on how to do this; three (3%) expressed that the website needs to be more organized, but did not say how. Each of the following responses were provided by two individuals each:

- Indicated a need for more colors to be added;
- Adding links to social networks, especially for teachers and students to share information;
- Add headers and alt tags/texts on images for easier navigation;
- Make the website more interesting, but does not indicate how to do this;
- The website needs to work for people with less technical knowledge;
- And the structure of the website should be changed, but no offer of suggestions on how to do this was provided.

7. Challenges - Instructional Materials Feedback

The responses categorized in the instructional materials category were very insightful. Twelve (22%) of the respondents in this category expressed a desire for the addition of more interactive activities for students, such as Q & A questions; eight (15%) want more topics related to the environment added, such as the 17 Sustainable Development Goals; eight (15%) would like to see more information on climate change from experts; five (9%) would prefer that the materials for each class/grade be separated; and three (6%) thought it would be useful to add a calendar of activities so that students could participate in climate-change-related events.

Each of the following comments were provided by two (4%) individuals each:

- Expand the website to include other important issues, such as peace, war, and the economic crisis;
- Improve the quality of the voice over;
- Structure the material more, but did not indicate how to do this;

- Integrate textbook chapters on climate change to align more closely with the online modules;
- And, lessen the number of WORD documents.

Each of the comments below were provided by one (2%) individual each:

- Organize the website so that in-country environmental issues our listed first, then broaden out to other countries;
- Integrate the online learning about climate change across the curriculum more;
- Add sites to information where students can locate answers to their questions;
- Add information about area nonprofit organizations with environmental missions to encourage social activities;
- Add a different voice for some sections of the website so that it is not always a woman's voice;
- Add a news feed of articles related to the environment;
- Develop interactive activities for students and the community to learn together;
- And, review the material provided on a regular basis to make sure that it is current and accurate.

8. Challenges - Language Feedback

A total of seven individuals expressed some concern over the reading levels of text provided through the website. Three (43%) of the respondents want to lower the readability levels of text for elementary school students; three (43%) said there is a need to add more understandable texts; and one suggested a need to have translations from English into other languages.

Table 11. Challenging Qualitative Comments by Category.

CATEGORY	COMMENTS	NO. OF TIMES MENTIONED	% TIMES MENTIONED (% rounded)
General	Website is good as is.	44	63%

	More instruction on use of the website for students and teachers.	7	10%
	Could not access graphics on my computer.	5	7%
	WBLE slow to respond.	4	6%
	Promote website widely to increase use.	3	4%
	Accessible to students but doesn't say how.	2	3%
	Teachers need to encourage students to go to the website often.	1	1%
	To be more objective and impartial but doesn't indicate how.	1	1%
	Make website accessible to parents	1	1%
	Make website available to all worldwide.	1	1%
	More help (not clear what this is in reference to).	1	1%
	TOTAL	70	
Website	Add more references to and use of art forms (e.g., theater, art, music, games, tools) especially images, videos, and games to test knowledge.	44	45%
	Improve navigation.	12	12%
	Check links regularly to make sure they work, especially to videos.	9	9%
	Not attractive; needs more modern interface; better graphics.	7	7%
	Add more modules to existing ones.	7	7%
	Not easy to use; make easier for kids to use, but no suggestions on how to improve.	5	5%
	Needs to be more organized but doesn't say how.	3	3%
	More colors.	2	2%

	Add links to social networks; especially for teachers and students to share.	2	2%
	Add headers and alt text on images for easier navigation.	2	2%
	Make page more interesting but doesn't say how.	2	2%
	Needs to work for people with less tech knowledge.	1	1%
	Change structure of website but doesn't say how.	1	1%
	TOTAL	97	
Instructional Materials	Add more interactive activities, such as Q&A questions.	12	22%
	Add more topics related to the environment, such as the 17 Sustainable Development Goals.	8	15%
	Add more information on climate change from experts.	8	15%
	Separate ed material for each class/grade level	5	9%
	Add calendar of activities so that students could participate.	3	6%
	Expand to other issues such as peace, war, the economic crisis.	2	4%
	Improve voice over quality.	2	4%
	Divide material more.	2	4%
	Integrate textbook chapters on climate change more closely with online modules.	2	4%
	Too many Word docs.	2	4%
	Put in-country environmental issues first, then broaden to worldwide.	1	2%

	Integrate online learning about climate change across the curriculum more.	1	2%
	Add sites with other information where students can locate answers to their questions.	1	2%
	Add information about area nonprofit orgs with environmental mission to encourage social activities.	1	2%
	Add a different voice for some sections so that it is not always a woman's voice.	1	2%
	Add news feed of articles related to the environment.	1	2%
	Develop interactive activities for students and community to learn together.	1	2%
	Review material regularly.	1	2%
	TOTAL	54	
Language	Lower reading level of text for elementary students.	3	43%
	Add more understandable texts.	3	43%
	Have translations from English into other languages.	1	14%
	TOTAL	7	

V.3. Summary of research results

This research explored the development and use of interactive online materials related to climate change and exploring six models as possible predictors of certain categories of perceptions regarding educating and engaging learners in sustainable development. This actual research was conducted over a period of six months. The questionnaire, completed by 200 pre-service teachers who participated throughout this study, had a 100% return rate. This survey was divided into two sections. One section asked pre-service teachers to provide

qualitative feedback on the WBLE that was created and used in the instruction of climate change students to elementary school students in grades 1, 2, and 3. The other section asked respondents to indicate preferences, using a Likert-type scale, regarding various statements related to sustainable development education.

There were 62 qualitative responses received on the questionnaire. Qualitative responses were categorized into two distinct viewpoints – positive and challenging. Each viewpoint was further subdivided into four subcategories: 1.) general feedback; 2.) feedback on the WBLE; 3.) feedback on the instructional materials used in the WBLE; and 4.) feedback on the language level and type used on the website.

Of the 62 responses, 8 (13%) agreed, in general, that the WBLE was correct and complete, and was approachable by teachers and students without being condescending. Seven (11%) of the responses indicated that the website referred to a variety of interesting topics that seem to be useful for teaching and learning new things.

In terms of the website, 21 (34%) of the 62 responses mentioned that the WBLE was very easy to use by both students and teachers with a wealth of information regarding climate change-related issues provided. Fifteen (24%) of responses indicated that students seemed to be motivated to learn because of the use of text and multimedia (such as videos, graphics, and photos) which tended to keep students interested in learning about their topic.

Several individuals provided additional positive statements regarding the WBLE. Here are a few examples:

«...I would like to applaud the age rating...»

«...[online environment] encourages visitors to take action...»

«It [the website] becomes a connection of learning with everyday life.»

Of those who provided positive responses regarding the instructional materials used in the WBLE, 7 (11%) remarked the ability to develop teaching plans as well as having access to the training guide were useful and 3 (5%) of the respondents were positive towards having interactive activities available to further engage students in the teaching and learning process. Only 1 (2%) respondent commented on the language used in the WBLE, saying that the website was very easy for students and teachers to read.

Qualitative responses placed into the 'challenging' category were not at all negative, but provided suggestions on ways that the WBLE might be improved in the future. In the general challenging feedback category, 44 (63%) responded that the website was good with 7 (10%) indicating more instruction on the use of the WBLE could be provided to students and teachers. Nine (13%) respondents had technical issues such as a slow web connection or a computer that could not show graphics, and 3 (4%) said that the website should be promoted more widely to increase its use.

The challenges regarding the WBLE were more diverse. Almost half, 44 (45%) expressed that the website needed more references and more art forms (such as videos, images, and gaming-like instructional activities). Twelve (12%) of the respondents suggested that the website's navigation be improved, with 9 (9%) indicating that web links should be checked regularly to make sure that they worked, especially the links to videos; 7 (7%) wanted more attractive graphics and a more modern interface; and 7 (7%) expressed the desire to have more educational modules on climate change added. In terms of challenging feedback on the instructional materials used in the WBLE, 12 (22%) expressed a need to add more interactive activities for students; 8 (15%) wanted more topics regarding climate change added; and 8 (15%) expressed a need to add more information on climate change from experts in the field. Finally, 7 individuals responded to the language used in the WBLE. Here, 3 (43%) of the respondents wanted lower reading levels of text for elementary school students; 3 (43%) expressed a need to add more understandable texts; and one (1%) suggested that English language text be translated into other languages.

Several conclusions can be drawn from the qualitative feedback provided by the 200 pre-teachers who responded to the questionnaire questions regarding the development and use of the WBLE including the interactive online materials related to climate change used by teachers as well as students in grades 1, 2, and 3 in this study. Viewed in total, the overall response to the WBLE was quite positive. Respondents described the WBLE as being very user-friendly by both students and teachers; that the interactive instructional materials embedded in the WBLE held the students' attention, further engaging them in the content; and that the variety of topics offered were both interesting and useful in the teaching and learning process. Feedback in the challenging category was not at all negative, but positive in the way of providing suggestions for improvement. Some suggestions are outside the

control of this study, such as having a faster connection to the Internet or using a computer that is not capable of visually showing graphics. However, other comments provide useful suggestions for improvement of the WBLE, including making the graphics and user-interface look more professional, and integrating the chapters in the text more closely with the modules on climate change issues and activities in the WBLE.

One needs to be reminded that the entire WBLE was designed, developed, built, and implemented over the course of this study as a significant component of this research. Pre-service teacher feedback clearly demonstrates the need and desire to take the WBLE to the next level through revising the web interface, including the graphics, to be at a higher professional performance level, as well as to make the WBLE broadly avaiable to other educators located all over the world.

Exploring six different models as possible predictors of certain categories of perceptions regarding educating and engaging learners in sustainable development was the second major section and focus of this study. Two hundred pre-service teachers responded to various statements regarding perceptions of teaching. Respondents provided an indication of level of agreement based on a Likert-type scale. (The validity and reliability of the questionnaire's scale and subscales was completed prior to the survey being distributed. Instruments implemented in the survey were adopted, validated, and tested instruments published in the literature.)

Five independent variables (intercultural communication, justice, self-awareness, global civic engagement, and social responsibility) were analyzed against each of 6 dependent variables categorized as six different models: 1st Model: Usability; 2nd Model: Satisfaction; 3rd Model: Content relevance; 4th Model: Progressivism; 5th Model: Neo conservatism; and 6th Model: Reconstructionism.

Results of the SMR revealed that two independent variables – intercultural communication and global civic engagement – have significant probability in predicting usability (Model 1), where usability is the use of the WBLE designed and implemented to teach primary school-aged students about climate change issues. In Model 2: Satisfaction, the independent variable of global civic engagement was the only variable that has a significant probability in predicting satisfaction. In this study, satisfaction includes the expectations achieved in the use of the WBLE in the teaching and learning of climate change

at the elementary school level. The independent variables of intercultural communication and global civic engagement hold significant probability for predicting content relevance (Model 3), where content relevance comprises the content related to teaching issues of climate change using the WBLE in instruction. Intercultural communication, social responsibility, justice, and global civic engagement all show significant probability in predicting Progressivism (Model 4). In this model, progressivist individuals view education as being student-centric, teaching the whole child through active learning and engagement, as compared to models that are teacher-centric where the instructor plays the role of the «sage on the stage». Intercultural communication and self-awareness contribute to the significant probability of predicting neo-conservatism within the context of education. Neo-conservatists view global issues through a lens of a person's freedom based on the values of democracy and incorporate free market and capitalistic perspectives. Social responsibility, intercultural communication, justice, and self-awareness are the independent variables identified to contribute to the significant probability of predicting reconstructivism (Model 6). Reconstructivism is a critical theory that views education as a means to promote social reforms, such as actively addressing issues of climate change.

V.4. Discussion

Two-hundred pre-service teachers used the WBLE as the primary tool to build assignments for instruction for one semester. This group of educators was selected to be an integral part of this study because of their previous knowledge of climate change issues. Survey participants responded to 112 statements. For each statement, respondents selected from the following options on a Likert-type scale: strongly agree, agree, disagree, or strongly disagree. The quantitative results of the questionnaire completed by all 200 pre-service teachers was used to investigate the influence that the WBLE may have on active citizenship. Stepwise multiple regression (SMR) analysis (Makrakis, 2005a) was conducted to examine the relationship between the independent variables of intercultural communication, justice, self-esteem, global civic engagement, and social responsibility with each of the following dependent variables: Model 1: Usability, Model 2: Satisfaction, Model 3: Content relevance,

Model 4: Progressivism, Model 5: Neo-conservatism, and Model 6: Reconstructionism. It should be noted, again, that SMR is used when a theory to support the selection of variables is weak and to determine what predictors (independent variables) may be a good fit for a specific model.

V.4.1. Quantitative Results

The SMR results indicated that:

In Model 1: two independent variables – intercultural communication and global civic engagement – have significant probability in predicting usability, where usability is the use of the WBLE designed and implemented to teach students about climate change issues.

In Model 2: Satisfaction, the only independent variable of global civic engagement was shown to have significant probability in predicting satisfaction, where satisfaction includes the expectations achieved in the use of the WBLE in teaching and learning regarding climate change issues.

In Model 3: Content relevance, the independent variables of intercultural communication and global civic engagement were shown to have significant probability for predicting content relevance, where content relevance comprises the content related to teaching issues of climate change through the WBLE.

Intercultural communication, social responsibility, justice, and global civic engagement all show significant probability in predicting Progressivism (Model 4). Here, Progressivist individuals view education as being student-centric, teaching the whole child through active learning and engagement, versus being teacher-centric, where the instructor is viewed as all-knowledgeable on the topics being taught.

In Model 5: Neo-conservatism, both the independent variables of intercultural communication and self-awareness contribute to the significant probability of predicting neo-conservatism. Within the context of education, neo-conservatism views global issues through a lens of an individual's freedom based on values of democracy and incorporating free market and capitalistic perspectives.

Finally, with the 6th Model: Reconstructionism, the independent variables of social responsibility, intercultural communication, justice, and self-awareness all contribute to the

significant probability of predicting reconstructionism. Reconstructionism is a critical theory that views education as a mean to promote social reforms, such as actively addressing issues of climate change.

Each of the six models were named according to the dependent variable being studied:

- 1st Model: Usability,
- 2nd Model: Satisfaction,
- 3rd Model: Content relevance,
- 4th Model: Progressivism,
- 5th Model: Neo conservatism, and
- 6th Model: Reconstructionism.

The analysis of the results of the SMR for each model appears in Table 12.

Table 12. Analysis of 6 Models.

Independent Variables	Dependent Variables (Models 1-6)					
	1.	2.	3.	4.	5.	6.
	Usability	Satisfaction	Content Relevance	Progressivity	Neo-conservatism	Reconstructionism
Intercultural communications	✓	n.s.	✓	✓	✓	✓
Global civic engagement	✓	✓	✓	n.s.	✓	n.s.
Social responsibility	n.s.	n.s.	n.s.	n.s.	✓	✓
Justice	n.s.	n.s.	n.s.	n.s.	✓	✓
Self-awareness	n.s.	n.s.	n.s.	✓	n.s.	✓

A cross-comparative analysis of the results of the Stepwise multiple regression (SMR) illustrates the level of relationships between a single response variable (the dependent variable) with two or more controlled (or independent) variables. Models 1, 2, and 3: WBLE

Statistical analysis conducted on the data obtained in this study uncovers several important realizations to some degree of probable certainty. Models 1 – 3 concern the dependent variables of usability of the WBLE, satisfaction with the WBLE, and relevance of content provided in the WBLE. Survey respondents who agreed or strongly agreed with statements regarding intercultural communications are more apt to find the WBLE usable in teaching and learning, would be more satisfied with the WBLE in the classroom, and are more likely to view the content as being relevant to teaching about the issues surrounding climate change for students in the early years of their education.

Respondents agreeing or strongly agreeing with statements regarding global civic engagement are probably more likely to perceive the usability of the WBLE, being satisfied with the WBLE in instruction, and see the content of the WBLE being relevant to teaching climate change issues to elementary school students.

Models 4, 5, and 6: Educational Perspectives

Models 4, 5, and 6 focused on capturing the viewpoints towards three different educational perspectives from the 200 pre-service teachers who participated in this study: Progressivism, Neo-conservatism, and Reconstructionism. To reiterate, individuals with a progressivist ideology view education as being completely student-centric where the purpose of teaching is to engage the whole child through active learning pedagogies as opposed to the «all-knowing teacher-centric» philosophy where the teacher is the center of all knowledge. Those with a neo-conservative outlook perceive global issues through a lens of a person's individual freedom based on values of democracy while incorporating free market and capitalistic perspectives. Reconstructionists view education to promote social reforms, such as actively addressing issues of climate change.

Respondents agreeing or strongly agreeing to statements regarding intercultural communication, global civic engagement, social responsibility, and social justice are individuals who possess a progressive outlook toward education. In other words, these

individuals perceive the learning process to occur for its own sake. Moreover, they do not believe that education needs to be narrowed only to certain knowledge and skills that are useful for the occupational settlement of the primary school students. As a result, teachers in progressive education models typically serve as a guide to students' individually designed curricula. Here, students are involved in curriculum development and actively work on projects that address inequities. Education is a mechanism for the student to seek their own path in society, especially in terms of their beliefs.

What is interesting to note is that self-awareness – one of the cornerstones of Progressivism – did not emerge as a strong predictor in this model, given that progressive educational constructs involve student self-reflection. More investigation in future research may uncover why this occurred in this study.

Participants that responded agree or strongly agree to intercultural communication and self-awareness statements come from neo-conservative educational outlooks. These individuals see education teaching a common body of knowledge including instruction about the great thinkers of the past. Education is a means to teach future workers to productive in the marketplace. Here, students are expected to successfully complete all aspects of one grade level before going on to the next grade level. Moral values are taught as being important to transfer from generation-to-generation.

Respondents that indicated an agreement or strong agreement with intercultural communication statements, statements about social responsibility, social justice, and self-awareness may be more apt to align with the reconstructionist view of education in society. This specific point of view sees education as a means to teach understanding and acceptance of diverse individuals and cultures. Within the reconstructivist framework, students are taught to analyze social problems and address them. Active learning is seen as being a bridge between education and real-world situations in order to improve the lives of everyone.

Qualitative Results

It is important to place the feedback provided by respondents to the questionnaire in context. The curriculum structure used in this study centered on climate change based on the ExConTra design of thematic learning. A WBLE (web-based learning environment) was

developed and implemented as a major component of this study. As one of a number of student-centered interdisciplinary learning experiences, the WBLE was used to provide knowledge on various topics related to climate change and the environment, peer-tutoring, concept mapping, other collaborative learning activities, along with assessments to gauge levels of understanding.

The design of the WBLE was intentional to make it student-centered, as opposed to teacher-centered. Text, links to websites, videos, images, and other online tools engaged students with learning about the importance of healthy living environments. It is also very important to note that the WBLE used in this study was brand new and created in a very short period before being used in instruction. Respondents to the questionnaire provided insightful experiences, comments, and observations regarding the use of the WBLE in instruction. Taken the feedback, comments regarding the usefulness of the WBLE were mostly about how to make it a better teaching and learning tool.

Since this was the initial use of the WBLE, it is satisfying to learn that pre-service teachers in this study did not complain about what was wrong with the WBLE. Rather, respondents offered challenges and some suggestions for how to improve the online interactive environment. The takeaway from this feedback is that the WBLE is an effective teaching and learning tool. Participants expressed the need and desire to continue enhancing the WBLE with better graphics and upgraded visuals, while encouraging the expansion of this instructional method to others, not only within the country, but to the world.

The second major component of this study was to gain insight into the perceptions of pre-service teachers toward education, drawing some conclusions regarding future curriculum development for elementary school students in learning about sustainability and climate change. This goal was accomplished through both statistical analysis of quantitative results and analysis of qualitative results to several statements related to various viewpoints towards education.

In order to influence the direction of education towards teaching more comprehensively about climate change issues and sustainability, curricular development requires an incorporation of the concept of sustainable active citizens into a transformative model change process of learning. As found in this study, pre-service teachers educational philosophies play an important role across all decisions regarding pedagogy, teaching and

curriculum, as well as the quest for adopting a transformative learning perspective. This study found that respondents agreeing or strongly agreeing to statements regarding intercultural communication, global civic engagement, social responsibility, and social justice may, predictably, possess a progressivist outlook toward education. As a result, progressivist-model-focused educators may select and implement educational strategies where students are actively involved in curriculum development, and learn about projects that address inequities, such as climate change. Here, students are supported and encouraged to seek their own path in society through continual engagement in self-reflection.

Respondents with neo-conservatist viewpoints toward education agreed or strongly agreed to statements regarding intercultural communication and self-awareness. These individuals see education focused on teaching a body of knowledge and may, predictably, teach about the great thinkers of the past. Unlike progressivists, neo-conservatists expect students to successfully complete requirements at one grade level before graduating on to the next grade level. Education, in this model, is very proscribed. The statistical analysis of Models 4 through 6 was used to investigate the viewpoints of the 200 pre-service teachers who completed the survey in terms of three educational perspectives: Progressivism, Neo-conservatism, and Reconstructionism. Progressivist individuals view education as being one-hundred percent focused on the student. Curricula are built around the idea that the student is the center focus of teaching and learning. In comparison, neo-conservatist individuals see education as a means by which one learns about individual freedoms based on democratic values. Comparatively speaking, reconstructionists believe that education is a way to promote social reforms, such as actively and purposefully addressing climate change issues worldwide. The research results indicate that pre-service teachers who hold one of the three viewpoints used in this study may develop curricula and select specific pedagogies regarding teaching elementary school students about issues of climate change based on their preferred point of view (e.g., Progressivism, Neo-conservatism, or Reconstructionism) toward education.

Having this in mind, our attempt was to co-construct a web-based learning environment that can support teachers and students' transformations in building a more sustainable society (Makrakis and Kostoulas-Makrakis, 2012). The feedback received from pre-service teachers' participation in this study was proved to be very influential in

incorporating the characteristics of transformative learning, that included: active learning instructional strategies for students to be engaged in learning; the diversity of cultures and points of view recognized and accepted by all; ensuring that the selected course material is seen as a component of language and thought; encourages discussions on re-thinking and inspiring self-thinking among students; and focuses on the process of learning and research schema of «action-reflection-action» (e.g. Diduck, 1999). It is also worth pointing that the school climate plays a critical role in any pedagogical intervention (Babalis, 2013).

It is worth pointing out that one of the underlying impetus for pursuing this current line of inquiry was to obtain a more thorough understanding of the challenges faced by integrating sustainability into the theory of teaching, teaching methodologies, and course development. Indeed, some of the challenges identified in this study included a perception found often in the literature that education is an agent of change for reconstructing an unsustainable society. The need to change our attitude towards the environment and consumption, values, and education has primarily been ignored. Exploring possible factors that determine whether a person will act environmentally or not is crucial if society is to become environmentally sustainable.

It was our attempt to show the need for changing attitudes, perceptions, and actions and shift from mere awareness and sensitivities for sustainability issues towards actions, that is emphasizing human agency. Such an agency is driven from emancipatory and transformative learning pedagogies and technologies (Kostoulas-Makrakis and Makrakis, 2020; Makrakis, 2014a) are necessary for merging knowledge and action in building a more sustainable society as well as connecting technological artifacts with real life (Zaranis, Kalogiannakis and Papadakis, 2013). Time and curriculum constraints were also reported by teachers as the main obstacles to the proposed technological innovation (Karasavvidis, 2009). Many societies are at a point in time where individuals have some knowledge and understanding of the importance to living a sustainable lifestyle, yet these same individuals are not moving positive perceptions and attitudes into action. A new active form of citizenship is needed to affect change. This change can be achieved and continued through education. Acknowledging that transforming traditional educational methods into implementing curricula that is action-oriented is a step in the right direction.

Educators-in-training (or pre-service teachers) play a crucial role in this curriculum development process that applies transformative learning models (Makrakis, 2012b). As such, it is important to understand what impact these professionals may have on developing new curricula by gaining insight into the probability that a pre-service teacher possessing a certain point of view toward education may have on the development of a new action-oriented curriculum – a curriculum that requires teaching methods and strategies that are not based on non-linear models of teaching and learning, but based, instead, on a transformative vision of educational processes and practices.

This was the focus of the second part of this study. Transforming attitudes into action is one of the most critical factors in learning to develop a more sustainable society (Makrakis, 2012a; Makrakis and Kostoulas-Makrakis, 2005). Thus, climate change education and active global citizenship play a critical role. The relationship between global citizenship and sustainable development through education is significant if transformation is to occur in terms of living a sustainable life. As Kostoulas-Makrakis (2008) discovered, living sustainable lifestyles cannot be created if they are infested with perceptions and actions of exclusion, exploitation, social inequity, violation of human rights, racism, or violence towards the environment. As traditional political practices and measures are ineffective in addressing complex issues such as climate change (Ruggie, 2008) and even some argue that there is no need for the concept of global citizenship (Carter, 2006; Parekh, 2002; Davies, 2006), the results of this study support that in order to work effectively, interactive transformative learning interventions are needed to affect changes in people's behavior.

As Davies (2006) and Lim (2008) explain, one of the most significant characteristics of a global citizen is the ability to act. Successful active engagement on a global scale requires younger generations to hold core competencies to make Earth a place where all thrive and survive (Oxfam, 2015). As a result, climate change education and global citizenship are important drivers to turn our educational systems into learning environments that engage them in meaningful discussions regarding climate change issues; and who can make informed, responsible decisions that have an effect the climate through understanding of what occurs if actions by individuals are not taken (U.S. Global Change Research Program, 2006).

Summing-up, the results of the statistical analysis conducted in this study revealed several important perspectives that may be present to some degree of probable certainty. In

models 1 through 3, survey respondents who agreed or strongly agreed with statements concerning intercultural communication may perceive the WBLE as being usable in teaching and learning, may be more satisfied with the WBLE and its use in the classroom, and are more likely to view the WBLE content as being relevant to teaching about the issues of climate change for students in the early stages of their education.

Chapter VI.

Conclusion and Implications

VI.1 Introduction

The conclusions and implications of this study are set forth in this section. This chapter begins with an overview of the intervention, then moves forward to highlight the main contributions and limitations of the research study.

VI.2 Overview of the Research Study

This study explores possible factors that determine whether a person will act environmentally or not – which is crucial to achieve an environmentally sustainable society. Studies described throughout this research indicate that there is inconsistency between how people think about the environment, how they interact with the environment, and how they would like to interact with the environment. The purpose of this study was to explore the pre-service teachers' experiences with the WBLE, the relationships between the pre-service teachers' worldviews and qualities, and how this is related to their educational philosophy.

Quantitative and qualitative data collected from responses to the survey. These responses were used to evaluate the relations and correlations of several factors regarding pre-service teachers' perceptions of the "Act for Climate" WBLE and their beliefs. This resource was a web-based learning environment used to support knowledge-building, and action on climate change issues and on the rights of children in relation to climate change. The structure and thematic focus of the WBLE was as follows:

- The structure of the curriculum designed for this study was based on the thematic structure of learning using a horizontal approach to organize the curriculum and

- The theme selected – climate change – concerns real-life issues on a global scale that affects everyone to some degree regardless of geographic location, so it is very relatable to both students and teachers.

The selection of climate change was important because it is meaningful to the human experience. According to Sung, Chang and Liu (2016) thematic learning through an interactive web-based interface: 1) makes positive impacts on students' concepts of learning, 2) provides students with a structure to take related concepts and develop their own understanding of the various facets of the issues, and 3) and meets the different learning styles students' possess.

The curriculum design was based on an integrated learning model enabling students and teachers to focus on participant-driven interactive choices such as acting as a facilitator to students, among peers, and between the learner and the course content. An effective learning environment needs to be richly textured to address various learning styles using a multitude of communication channels, engaging design, and collaborative and interactive activities throughout the curriculum (Boettcher, 2007). As a result, ExConTra was selected as the learning paradigm on which the design of thematic learning was created. ExConTra (experiencing, conceptualising, transforming) allows for a deep and transformative learning experience which can be reused, adapted, and generalised to teaching and learning materials (Makrakis and Kostoulas-Makrakis, 2012).

Within this study, the interactive online material was created on six topics including: 1.) climate change and me, 2.) energy, fossil fuels, and waste, 3.) climate change through time, 4.) climate change and eco systems, 5.) climate change and the atmosphere, and 6.) climate change.

The theoretical and methodological framework for the instructional design of the WBLE included the following:

- Curriculum structure: One that is theme-based and includes the use of WBLE (web-based learning environment) model. The selection of the theme of climate change is meaningful and purposeful as it is easily conceptualised.

- Planned integration of the curriculum: with the development of sub-themes related to climate change issues.
- Design of instruction and learning: was intentional with the use of the ExConTra learning principle based on thematic learning.
- Implementation of the integrated curriculum: this included inter-curricular projects across topics related to social studies, science, mathematics, and the arts. This enabled students to see links between skills and knowledge, across and between several diverse subjects, then applying learning to real life situations and scenarios.
- Student-centered learning: was the focus throughout this study, as opposed to implementing a teacher-centered learning model. Long-term, student-centered, interdisciplinary learning activities included projects both inside and outside of the classroom.
- Collaborative learning opportunities: were abundant, including peer-tutoring and the use of various online tutorials and tools, such as creating concept maps, Venn diagrams, and the use of the semantic web.

A multiple assessment approach was implemented throughout the integrated curriculum. The initial phase of the project used diagnostic assessment. This was followed by formative assessment where specific processes were assessed through peer-learning support as well as self-assessment while the curriculum was being established. This approach was used so that the curriculum could be improved based on early identification issues or concerns through the process of curriculum development, of what was not working, and then to change it. A summative assessment was conducted after process implementation.

In addition, authentic assessment methods were incorporated into all processes to determine effect(s) (if any) on the integrated curriculum. Merging strategies and tools from ExConTra and other learning theories, different assessments were linked so students could actively participate in the planning and use of structured knowledge representation techniques and concept maps as visualization tools, working on building their own self-awareness of the critical thinking process.

VI.3 Limitations of the Study

Even though this study's contribution was significant to the area of ICT use in teaching along with pre-service teachers acceptance according to their educational philosophy, it has some limitations that should be noted.

VI.3.1 The sample

The sample used in this study consisted only of pre-service teachers of the Pedagogical Department of Primary Education of the University of Crete. The implementation of the WBLE and the study was not conducted to any other university of the country and that doesn't allow the safe generalization of results. Moreover, from the two courses Analytical Program: Theory and Practice and b) ICT in Education for Sustainable Development the first one is mandatory, and all students must attend it while the second one is a selection seminar in which students enroll voluntarily. The mandatory nature of course also affects the integrity of the results. The population of students registered in the courses were about three hundred and the pre-service teachers that completed the survey was approximately two hundred. In addition, the students that enrolled in the seminar had very positive attitudes towards ICT and Sustainable Development. Furthermore, the sample mostly consisted of females. The composition of the sample therefore limits the gender results. However, this small number of men can be explained through the fact that most of the Pedagogical Departments of Primary Education all over Greece mainly are selected from females as a professional career choice. Future studies could overcome the sample limitations by been conducted on a more diverse sample of participants that can include more departments, more universities and more male participants. Including a diverse sample and using both quantitative and qualitative methods is highly recommended, as it could enable us to further examine the benefits from the WBLE.

VI.3.2 The WBLE

The WBLE used cutting-edge technologies at the time of its development and it was updated three times during the conducted studies with new data regarding climate change and its implications. The first unit was developed in 2011 and the last revision of the material was in the summer of 2017, just before its use from the pre-service teachers. It's a fact that due to its complexity it is hard to be maintained by limited number of individuals. Moreover, Adobe Flash, one of its key components for displaying the rich media content of the developed units in web browsers and mobile devices, is scheduled for an end of its support from Adobe, thus a migration of Flash content to the new standards will be required in the future. The e-book structure that was achieved with the use of the book module in Drupal makes this transition a lot easier though a significant amount of time will be required.

VI.3.4 The questionnaire and its analysis

The survey method that was selected for this study was the questionnaire and it has some limitations by its nature. In addition, respondents completed the questionnaire on their own in separate computers in a google form format and without having an individual to guide them or answer their questions. When an individual does not have the opportunity to correct misunderstandings, ask questions, receive explanations there is always the concern that the answers may not be accurate. Moreover, as we have seen in Chapter III the one hundred twenty-three items used in this research were validated in previous studies (Morais, & Ogden, 2011, Conti, 2007). In this study, these items were translated and adopted for the Greek pre-service teachers. Cronbach's alpha varied from 0.67 to 0.84 which is between 0.65 and 0.8 that many methodologists recommend as a minimum α coefficient. Social Responsibility was not higher than 0.65 which is the lower limit of Cronbach alpha required to generalise results. The subscales with low Cronbach alpha were the Social Responsibility, Content Relevance, Intercultural Communication, Content Satisfaction and Neo-consevatism. Therefore, these variables were the weakest component of the questionnaire and they could be modified before being used in further research studies. Individual responses were then collected and analysed

using the stepwise multiple regression (SMR) statistical process. Stepwise multiple regression is used when a theory to support the selection of variables is thin and is used as an exploratory tool to determine what predictors (independent variables) may be a good fit for a specific model. SMR was conducted to examine the relationship between independent variables (or predictors) and dependent variables (or criterion). In this study, SMR was used to analyze relationship(s) between a single response variable (the dependent variable) with two or more controlled (or independent) variables. SMR is appropriate for this analysis because it combines forward selection with a backward elimination method. However, one limitation of SMR is that it only looks at one step forward or one step backward at a time. In addition, the qualitative feedback analyzed from the survey may be skewed – either positively or negatively or a combination of both – since the pre-service teachers may not have provided feedback from an objective stance. Typically, individuals involved in a research study that was held for a significant amount of time, can be more subjective than objective, something to note as a limitation here.

VI.3 Contributions of the Study

The results of this study provide important information to assist us in understanding the use of information and communication technologies, specifically the WBLE, as learning tools. Study results also offer insight into the perspectives that pre-service teachers held that had significant probability in determining how those individuals may view education and, as a result, may develop curricula regarding climate change issues in teaching elementary school students. Pre-service teachers will be responsible for teaching the next generation on how to tackle and solve environmental and sustainability issues, how to work together in various ways to implement successful solutions, and how to live sustainable lives is very critical to the survival of the planet. As a result, this research was timely in its importance and contribution not only to educating primary school students using effective pedagogies of a contemporary nature as the study of Kaliantzi (2016) and Gkotzos (2017) showed but to also reveal the possible relations and correlations that the use of WBLE has, based on the education philosophies and set of values that pre-service teachers already possess. To obtain some insight into these larger questions and considerations, this study set out to demonstrate

the necessity and benefits of taking full advantage of a dynamic online environment for primary school students' education on issues of sustainability and climate change.

Information and Communication Technologies (ICTs) were used to develop the WBLE and implement it in the teaching of elementary school students in comprehending the impacts and causes of climate change. Active learning through the use of the WBLE that was closely aligned with student learning outcomes can be used by other educators as a basis in possibly altering current attitudes towards more sustainable behaviors and practices. Class activities provided students with opportunities to apply content knowledge and to learn critical thinking skills while thinking about creative, impactful solutions to difficult climate change issues based on real world scenarios. The process of building the WBLE, essentially from the ground up, included the investigation, review, and consideration of best practices in effective teaching and learning using ICTs. Several important take-aways have emerged from the development and implementation of the WBLE.

The theme of climate change is contemporary and meaningful, especially to the residents of Greece. Instruction and learning activities were designed on ExConTra (Makrakis and Kostoulas-Makrakis, 2013ab) which was determined to be the best model to use after consulting the literature. The ExConTra model provided an effective pedagogical framework for active learning to take place. Broadening the curriculum across various subject areas provided students the opportunity to consider climate change from different points of view. This approach enhances the teaching and learning process so that students can participate in much deeper levels of thinking in working on creating solutions to challenging issues of climate change. In this study, the curriculum structure was theme-based housed within a web-based learning environment (WBLE). An integrated curriculum was put into place in which climate change was learned and evaluated from the perspectives of social studies, science, mathematics, and the arts. Inter-curricular projects were used to demonstrate links between skills and knowledge across and between several topical areas, and also applied to real life scenarios and situations. Curriculum development was based on a student-centered (as opposed to a teacher-centered) model. Long-term, student-centered, interdisciplinary learning activities included projects both inside and outside of the classroom. Collaborative learning, peer-tutoring, and a variety of online tools (e.g., concept maps, semantic web, Venn diagrams, etc.) were all a part of the learning process for the elementary school students.

Overall, based on the analysis of the qualitative responses provided by the population of 200 pre-service teachers, this model of curriculum development applied to teaching climate change and sustainability across-the-curriculum was accepted positively – both from the students' as well as the teachers' perspectives. As other researchers look to this current study, designing elementary school climate change curriculum across different subject areas using the interactivity of a WBLE is one to consider as a best practice. Most comments regarding the WBLE were overwhelmingly positive. There were no negative comments, per se, but feedback that provides future researchers and other educators with practical suggestions on how to improve the web-based learning tool.

The research experience gained in developing an interactive (instead of static) learning environment on the web connected to Greek elementary level curricula goals and objectives expanded knowledge and experience, both at the researcher's level and the pre-service teachers participated in this study. Such an intense project required searching for, reading, understanding, and then applying best practices, but also at certain points decisions in understanding and selecting an educational learning model considered to be a 'best fit' to help meet the goals and outcomes of this study was not an easy task. Undoubtedly, this experience was not without its trials and tribulations. Student learning resources outcomes, instructional pedagogies, and active learning activities required adjustment and refinement throughout the study itself. In addition to that, while the selection of e-resources used to build the WBLE were easy to use, technological troubleshooting did need to take place on occasion. Pre-service teachers who were somewhat unfamiliar with how to use a WBLE environment effectively, or who were brand new to using this type of information technology, needed training up front in order to be able to use the WBLE effectively.

Although most researchers may not have taken the approach to build a brand new WBLE instructional experience (selecting instead to use an out-of-the-box, open source, or other ICT product) having this development as part of this project was critically important. If today's learners are going to be tomorrow's active citizens, learning environments need to be created that:

- Follow best practices preserving their cultural and natural heritage;
- Have values and strategies to develop principles and ethics of sustainability;

- Have the opportunity to participate in the development of their own teaching and learning;
- Learn and engage in responsible individual and collective decision making;
- Engage in activities that encourage equal participation, teamwork, and collaboration;
- And learning and experience ways to work together to solve challenging and controversial issues, understanding and respecting that others may have alternative perceptions, opinions, and solutions (Kostoulas-Makrakis, 2008; Makrakis, 2006).

The model used in this study integrates the emancipatory knowledge interest advanced by Habermas (1972) who specifies three categories of knowledge: teaching, emancipatory, and practical. This model provides the necessary framework to transform critical reflection into action, establishes a custom that makes learners function as agents of change – in this case, to fully change societies' perceptions and ways of living to be routine in terms of sustainability. Such a model is in stark contrast to product and process approaches to education that currently exist worldwide. The results of this study bring forth new knowledge to education research and practice. Relationally analyzed, this research uncovered the impact that a robust information technology environment, created to intentionally teach primary school students has on the engagement of pre-service teachers, with issues of climate change and sustainability. The pre-service teachers are going to be the ones that will implement the WBLE in their courses and can potentially have also impact on developing next generations attitudes and beliefs. That means that pre-service teachers should not only concentrate on the information that their students get on such issues, but also on a set of learned and practiced skills to critically assess information retrieved. This is particularly essential as through creativity and problem-solving primary school students develop and implement solutions to climate change issues within the world in which we all live.

Sund and Pashby (2018) report that educators need to take time to seriously reflect and explore their own perspectives in regard to complex issues, such as those presented with climate change and sustainability. As these researchers explain, "Applying a global ethical dimension in education is both complex and contentious, yet, it is arguably at the heart of

education that takes up and responds to the issues contributing to the earth's sustainability crisis" (ibid, p. 2). These researchers also note that transformative education will need to infuse hope for a better future along with a deep concern about today's world inequalities in the pedagogy (Pashby and Sund, 2019), results that are also substantiated by Makrakis (2014ab), especially in the context of ICTs.

Considering historical educational methods, Scott (1995) and Bauman (2001; 2012) promulgate that such methods might have worked in decades past, but that the world has changed so dramatically that it is now time to advance education using different and more effective teaching and learning strategies, rather than holding on to educational practices that are based on a set of traditionally perceived set of universal truths that have been looked upon as absolute and unwavering.

A key component of educational transformation is the education of the next generation of teachers (Makrakis, 2005b). Tomas, Girgenti, and Jackson (2015) echo this study's outcomes in terms of the need to expose pre-service teachers to teaching education for sustainability effectively before they move into professional positions. This means learning how and in what ways complex climate change and sustainability issues are to using pedagogies proven to be effective and move well beyond regurgitating perceived prior un-questionable truths regarding our environment. It also means that pre-service teachers can develop knowledge, skills, and confidence in teaching sustainability and, more importantly, to connect theory with practice.

VI.4 Suggestions for Further Research

Climate change is one of the most critical issues that must be researched, understood, and solutions developed and implemented before it is too late for future generations to survive. To address the impacts of climate change, this study supports the need for the creation of a new kind of citizenship – one where people actively engage, together, to implement effective solutions to problems we face. This new kind of citizen can be developed and sustained through education. In the broadest sense, education (specifically education for sustainable development) can be designed to improve people's ability to understand, put

forth, and implement solutions addressing environmental, developmental, and cultural diversity issues (Vare and Scott, 2007).

Employing active learning pedagogies engages students in learning to recognizing and accepting diverse individuals and cultures; and provides a way for students to understand and develop actions to address such issues as climate change. Such a model enables students to self-reflect on themselves in relation to their peers in formulating and implementing solutions to societal challenges. The process of learning, then, becomes one of action-reflection-action (Diduck, 1999).

Research reveals that using ICT in authentic learning along with problem-based learning pedagogies is closely associated with effective sustainable educational development (UNESCO, 2010; Summers and Kruger, 2003; Fien and Tilbury, 1996) instead of a rigid curriculum model which is teacher-centric. The primary objective of this study was mainly to create and offer an authentic learning environment based on problem-solving scenarios engaging learners and teachers via broadly available ICT technologies integrated in a WBLE. Studies of this type are usually focused on a small segment of larger issues, problems, and challenges. The results of this thesis provide some suggestions for further actions and research opportunities including:

- Revising the WBLE based on the qualitative feedback provided by participants in the study. Some of the suggestions included the change of Flash Elements with newer technologies and standards, the replacement of current graphics with more engaging and professionally developed ones, the re-alignment of activities to the textbook and the separation of the content and activities by exact grade level. After the revision is complete, replicating this study using the new version of the WBLE and comparing results would be advisable.
- Make the WBLE multilingual and available to other countries around the world. Compare and contrast results by analyzing usage in different areas of the world, with pre-service teachers of different background and students that face climate change differently.

- Conduct a longitudinal study, following the same pre-service teacher participants over several years to determine trends in learning and instruction. Researchers may want to also consult Green and Somerville (2014) who completed a 3-year longitudinal study on how elementary school teachers effectively integrated sustainability education at the primary school level curriculum in Victoria, Australia.
- Compare classes of the same grade level where one class uses the WBLE and the other class uses other form(s) of instruction.
- Develop a partnership between a class(es) and area environmentally focused organizations. Design climate change-related activities. Conduct a before-and-after activity survey collecting qualitative and quantitative data to determine if, and to what degree, perceptions and behaviors towards climate change occurred in teachers and students.

It is clear, from this initial list of further research areas, that this study can serve as a solid launching point to explore the difficult task of educating the next generation of teachers and students about the environment and climate change in a meaningful and essential way. More importantly its development philosophy concentrates on the personal transformation in order to address the critical issues of our time and in a sense, it follows the quote of Mahatma Gandhi that says “Be the change you want to see”.

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Appendices

Appendix 1.

Questionnaire

The purpose of this questionnaire is to evaluate the educational process during the course and should be answered individually by each student. Please kindly consider that answering to the questionnaire would greatly contribute to the research results. Of course, the answers are not rated or evaluated though the responsible completion is necessary. **Completing your registration number is mandatory only for the purpose of avoiding double anwswers.**

Registration Number: ……

V2 Gender: Male ..... Female .....

V3 Semester of Studies: .....

V4 Course Lectures Attendance: (Put an X next to the answer)

Less than 5 lectures	
6-9 lectures	
10-13 lectures	

For the following questions, please choose what it represents to a greater extent (**Put an X in your choice**):

V5 The time you dedicated to the course was:

Much more than other courses	
Same with the other courses	
Fewer than the other courses	
Much less than the other courses	

V6 What best describes your level of expertise in ICT?

I feel very uncomfortable with the use of technology _____
I feel quite uncomfortable with the use of technology _____
I feel comfortable with the use of technology _____
I feel very comfortable with the use of technology _____

V7 How familiar you are with the "interactive whiteboard"?

Not at all ----------
A little bit ----------
Enough ----------
Very well ....

V8 How frequently did you visit the web environment "Act for Climate" during the course?

Daily _____
1-2 times a week _____
2-3 times a month _____
Rarely _____
Never _____

V9 When you visited the web environment "Act for Climate", how long did you stay logged in?

Less than 5 minutes _____
6-10 minutes _____
11-15 minutes _____
16-20 minutes _____

More than 20 minutes _____

The web environment "Act for Climate"	Strongly Agree	Agree	Disagree	Strongly disagree
V10 Helped me develop my personal teaching plan				
V11 Helped me organize my thoughts				
V12 Helped me structure my own assignment.				
V13 It covered my needs by utilizing climate change units and digital material.				
V14 With its use I gained time to write my own assignment				

The web environment "Act for Climate"	Strongly Agree	Agree	Disagree	Strongly disagree
V15 I found the web environment easy to use and navigate.				
V16 It is flexible and does not require much effort to find what you are looking for.				
V17 You can use all its functions without any instructions of use.				
V18 I believe that the primary school students can use it with ease.				
V19 I am satisfied with the educational content of the web environment.				
V20 It works exactly the way I want it to work.				
V21 I found the climate change units very interesting and well structured.				

V22 I needed to learn a lot of things before I started using the content of the web environment.				
V23 The web environment has kept my interest constantly.				
V24 The organization of the material in each thematic unit helped me to study it with ease.				
V25 The content of the climate change units is suitable for the age of the students that are addressed.				
V26 The tools that are used within the web environment are enough to support the content of the climate change units.				
V27 The visual and graphic environment is consistent with the educational content.				
V28 Digital media and tools that are available in the web environment such as concept mapping, simulations, audio, video, etc. contribute significantly to the pedagogical use of the material.				
V29 The hyperlinks used in the web environment are active.				

The web environment "Act for Climate"	**Strongly Agree**	**Agree**	**Disagree**	**Strongly disagree**
V30 The hyperlinks are consistent with the content they refer to.				
V31 The texts are easy to read.				
V32 The climate change units can be used without a predetermined order.				

V33 The content of the hyperlinks is directly related to the unit section in which they are mentioned.				

Please mention all the negative things that you noticed in the "Act for Climate" web environment

Please mention all the positive things that you noticed in the "Act for Climate" web environment

Read carefully and put an X	Strongly Agree	Agree	Disagree	Strongly Disagree
V48 I like to have conversations with people whose ideas and values are different from mine.				
V49 The world is ruled by a few people who have power and the average individual cannot do anything about it.				
V50 I like to choose courses that challenge my beliefs and values.				
V51 I feel that I can have a positive impact on the community that I live in.				
V52 It is easy for me to neglect my personal interest for the common good.				
V53 Knowing how to use the modern technology makes me feel better integrated into society.				
V54 It is very important for me to give 3% or more of my income to help people in need.				
V55 It is very important for me to develop a philosophy of life which promotes personal and social changes.				
V56 I feel that I can make a difference in the world.				
V57 I believe that I have enough power to influence social development decisions.				

V58 When I work in a group project, I can easily accept the criticism for my work from the others.				
V59 I would be interested in seeking practices in charitable organizations or different places from the school practice.				
V60 I feel that I can play an important role in improving the well-being of my community.				
V61 The course content is more interesting when there are links to real life situations.				
V62 I have the feeling that social problems are not my concern.				
V63 The provision of social services is something I prefer to let others do.				
V64 I think that most people around the world get what they are entitled to have.				
V65 It is OK if some people in the world have more opportunities than others.				
V66 I think that people around the world get the rewards and punishments they deserve.				
V67 In times of scarcity, it is sometimes necessary to use force against others to get what you need.				
V68 The world is generally a fair place.				
V69 No one country or group of people should dominate and exploit others in the world.				
V70 The needs of the worlds' most fragile people are more pressing than my own.				

V71 I think that many people around the world are poor because they do not work hard enough.				
V72 I respect and am concerned with the rights of all people, globally.				
V73 Developed nations have the obligation to make incomes around the world as equitable as possible.				
V74 Greeks should emulate the more sustainable and equitable behaviors of other developed countries.				
V75 I do not feel responsible for the world's inequities and problems.				
V76 I know several ways in which I can make a difference on some of this world's most worrisome problems.				
V77 I am able to get other people to care about global problems that concern me.				
V78 I unconsciously adapt my behavior and mannerisms when I am interacting with people of other cultures.				
V79 I often adapt my communication style to other people's cultural background.				
V80 I am able to communicate in different ways with people from different cultures.				
V81 I am fluent in more than one language.				
V82 I welcome working with people who have different cultural values from me.				

V83 I feel comfortable expressing my views regarding a pressing global problem in front of a group of people.				
V84 I am able to write an opinion letter to a local media source expressing my concerns over global inequalities and issues.				
V85 Over the next 6 months, I plan to do volunteer work to help individuals and communities abroad.				
V86 Over the next 6 months, I will participate in a walk, dance, run, or bike ride in support of a global cause.				
V87 Over the next 6 months, I plan to get involved with a global humanitarian organization or project.				
V88 Over the next 6 months, I plan to help international people who are in difficulty.				
V89 Over the next 6 months, I will work informally with a group toward solving a global humanitarian problem.				
V90 Over the next 6 months, I will pay a membership or make a cash donation to a global charity.				
V91 Over the next 6 months, I will contact a newspaper or radio to express my concerns about global environmental, social, or political problems.				
V92 Over the next 6 months, I will express my views about international politics on a website, blog, or chat room.				

V93 Over the next 6 months, I will sign an e-mail or written petition seeking to help individuals or communities abroad.				
V94 Over the next 6 months, I will participate in a campus forum, live music, or theater performance or other event where young people express their views about global problems.				
V95 If at all possible, I will always buy fair-trade or locally grown products and brands.				
V96 I will deliberately buy brands and products that are known to be good stewards of marginalized people and places.				
V97 I will boycott brands or products that are known to harm marginalized global people and places.				

Read carefully and put an X	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
V98 A school curriculum should include a common body of knowledge that all students should know				
V99 The curriculum should focus on the great ideas that have survived through time and related to present day challenges.				
V100 Schools should prepare students for analyzing and solving the social problems that they will face as adults.				

V101 Each student should determine his or her individual curriculum, and teachers should guide and help them.				
V102 Students should be taught about the changes that take place in their society and how they can contribute to the social being.				
V103 Teachers and schools should emphasise academic rigour, discipline, hard work and respect for authority				
V104 Schools should develop students' ability to think deeply and analytically instead of focusing on superficial learning				
V105 In order for a country to compete successfully on the global market, schools' aim should be to produce citizens who can respond effectively to market requirements				
V106 Since students learn effectively through social interaction, schools should seek to promote social interaction in the curriculum and the educational process				
V107 Students are too immature to decide what they need to learn and so the school should decide for them.	-			
V108 The gap between the real-world situations and school education should be bridged through extracurricular activities and practical exercises in workplaces				
V109 Education is not primarily concerned with producing future				

workers but should emphasize learning for its own sake and students should enjoy, learning and discussing interesting ideas.				
V110 Education should enable students to recognize injustices in society, and schools should promote projects to redress social inequalities.				
V111 Students should be active participants in the learning process, involved in democratic class decision making and reflective thinking.				
V112 Students should be taught to be more sensitive to race, gender, ethnicity, and differences in general.				
V113 Students should not be promoted from one class to another unless they have conquered learning the material of the previous class				
V114 The school curriculum should be designed by teachers to better respond to students' experiences and needs				
V115 Teachers should be able to deconstruct and reconstruct the school curriculum				
V116 The purpose of the school is to help students understand themselves, appreciate their own particular abilities and ideas, and seek their own unique path into the society				
V117 Students should learn political literacy and learn how to improve the quality of life for all people				

V118 Schools should emphasize into the transfer of knowledge and moral values that prevail from generation to generation				
V119 Teachers should help students to critically assess their values and redefine them, even when they come to conflict with traditional and dominant values				
V120 The main objective of the teacher is to help students unlock the great ideas they have learned over time so they can gain wisdom from the great thinkers of the past				
V121 Students should not be pressured to study a lot when they do not want to.	-			
V122 Teachers should help students review their beliefs constantly. Especially help them look for the gaps, silences, distortions and exclusions of persons, ideas and things from the school curriculum.				
V123 Education should be a family and community responsibility rather than formal and impersonal school teaching.				

Thank you

Appendix 2.

WBLE screenshots

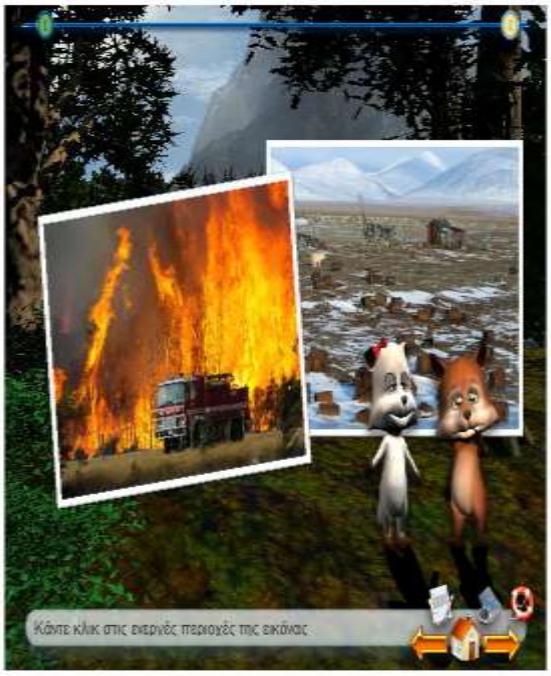
Δράσε για το κλίμα - Act for climate

Περιβαλλοντικά προβλήματα

Αρχική σελίδα / Κλιματική αλλαγή Γ' - Δ' / Η κλιματική αλλαγή και τα οικοσυστήματα » Περιβαλλοντ...

Εργαλεία

Προβολή | Επεξεργασία | Outline



Συνοδευτικό υλικό:

Κλιματική αλλαγή

- Εγώ και η κλιματική αλλαγή
- Η κλιματική αλλαγή στην περιοχή μου
- Η κλιματική αλλαγή και τα οικοσυστήματα
- Ατμόσφαιρα και κλιματική αλλαγή
- Ενέργεια, ορυκτά καύσιμα και απόβλητα
- Η κλιματική αλλαγή στο χρόνο

Η κλιματική αλλαγή και τα οικοσυστήματα

- Δημιουργήματα φύσης και ανθρώπου
- Περιβαλλοντικά προβλήματα
- Φυτά του τόπου μου
- Ζώα του τόπου μου
- Οικοσυστήματα του τόπου μας
- Πράσινο στις πόλεις
- Η φύση στη μυθολογία και στη θρησκεία

Δράσε για το κλίμα - Act for climate

Δημιουργήματα φύσης και ανθρώπου

Αρχική σελίδα / Κλιματική αλλαγή Γ΄ - Δ΄ / Η κλιματική αλλαγή και τα οικοσυστήματα » Δημιουργήματα ...

Εργαλεία

Προβολή | Επεξεργασία | Outline

Συναδευτικό υλικό:

Κλιματική αλλαγή

- Εγώ και η κλιματική αλλαγή
- Η κλιματική αλλαγή στην περιοχή μου
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- Ενέργεια, ορυκτά καύσιμα και απόβλητα
- Η κλιματική αλλαγή στο χρόνο

Η κλιματική αλλαγή και τα οικοσυστήματα

- Δημιουργήματα φύσης και ανθρώπου
- Περιβαλλοντικά προβλήματα
- Φυτά του τόπου μου
- Ζώα του τόπου μου
- Οικοσυστήματα του τόπου μας
- Πράσινο στις πόλεις
- Η φύση στη μυθολογία και στη θρησκεία

‹ Η κλιματική αλλαγή και τα οικοσυστήματα | up | Περιβαλλοντικά προβλήματα ›

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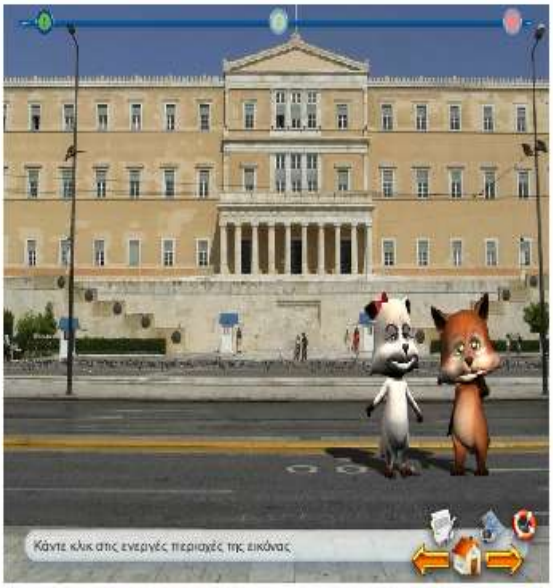
Δράσε για το κλίμα - Act for climate

Το κράτος και οι υπηρεσίες του

Αρχική σελίδα / Κλιματική αλλαγή Ε΄ - ΣΤ΄ / Η κλιματική αλλαγή στην περιοχή μου » Το κράτος και ...

Εργαλεία

Προβολή | Επεξεργασία | Outline



Συνοδευτικό υλικό:

Κλιματική αλλαγή

- Εγώ και η κλιματική αλλαγή
- Η κλιματική αλλαγή στην περιοχή μου
- Η κλιματική αλλαγή και τα οικοσυστήματα
- Ατμόσφαιρα και κλιματική αλλαγή
- Ενέργεια, ορυκτά καύσιμα και απόβλητα
- Η κλιματική αλλαγή στο χρόνο

Η κλιματική αλλαγή στην περιοχή μου

- Το κράτος και οι υπηρεσίες του
- Οι βιομηχανίες
- Τα επαγγέλματα
- Ο πληθυσμός

‹ Η κλιματική αλλαγή στην περιοχή μου up Οι βιομηχανίες ›

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Appendix 3.

WBLE structure

WBLE Units Structure		
The 6 main units	Grade Level	Subunits
Climate change and me	1st – 2nd	• I'm the kid • My school and my home • Our diet • Sport and health
	3rd – 4th	• Public media, internet and climate change • Arts and climate change • Mutual Assistance Networks • Consumerism and climate change
	5th – 6th	• Social impacts of climate change • Politics, economy and climate change • Diseases and climate change • Family, migration and climate change • Man-made climate change
Climate change in my area	1st – 2nd	• My neighborhood • Means of transport
	3rd – 4th	• Geographical districts • Local products and transport
	5th – 6th	• The State and its services • Industries • The professions • The population
Climate change and ecosystems	1st – 2nd	• Animals and plants of my area • The ecosystem of my region • Weather and climate • Seasons and months

		• The Greek ecosystem • Families of animals and plants • The needs of animals and plants • Characteristics of animals and plants • Distribution of animals and plants in the landscape • The contibution of animals and plants in our lives
	3rd – 4th	• The geophysical environment of my country • Creations of nature and man • Environmental problems • Plants of my place • Animals of my place • Energy in ecosystems • Ecosystems of our country • Green in cities • Nature in mythology and religion
	5th – 6th	• The natural environment of Greece • Plant functions • Species of animals • Relationships in ecosystems • The oceans • Forests • Natural disasters • Religion and environment
Climate change and the atmosphere	1st – 2nd	• The cycle of water • Weather, climate and humans
	3rd – 4th	• Air pollution • The ozone hole
	5th – 6th	• Climate and climate change

		• The CO2 cycle • The greenhouse effect
Energy, fossil fuels and waste	1st – 2nd	• Solar power • Wind power
	3rd – 4th	• Waste management • Clean seas
	5th – 6th	• Fuels and minerals • Renewable and non-renewable energy sources
Climate change through time	1st – 2nd	• How we measure time • Changes over time
	3rd – 4th	• Humans and time • Local history, customs and climate
	5th – 6th	• Climate in the past • Climate in the present • Climate in the future

Appendix 4.

SPSS Output for Statistical Analysis of Model 1 in Chapter 5

Descriptive Statistics

	Mean	Std. Deviation	N
Usability	3,14	,364	200
Justice	3,28	,454	200
Global civic engagement	2,86	,349	200

Correlations

		Usability	Justice	Global civic engagement
Pearson Correlation	Usability	,481	,249	,550
	Justice	,251	1,000	,364
	Global civic engagement	,465	,364	1,000
Sig. (1-tailed)	Usability	,000	,000	,000
	Justice	,000	.	,000
	Global civic engagement	,000	,000	.
N	Usability	200	200	200
	Justice	200	200	200
	Global civic engagement	200	200	200

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Intercultural communication	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Global civic engagement	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Usability

Model Summary[c]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	,481[a]	,232	,228	,274	,232	59,704	1	198	,000
2	,538[b]	,289	,282	,264	,058	16,000	1	197	,000

a. Predictors: (Constant), Intercultural communication

b. Predictors: (Constant), Intercultural communication, Global civic engagement

c. Dependent Variable: Usability

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4,468	1	4,468	59,704	,000[b]
	Residual	14,819	198	,075		
	Total	19,287	199			
2	Regression	5,581	2	2,791	40,113	,000[c]

	Residual	13,706	197	,070
	Total	19,287	199	

a. Dependent Variable: Usability

b. Predictors: (Constant), Intercultural communication

c. Predictors: (Constant), Intercultural communication, Global civic engagement

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	1,725	,169		10,233	,000	1,393	2,058					
	Intercultural communication	,412	,053	,481	7,727	,000	,307	,517	,481	,481	,481	1,000	1,000
2	(Constant)	1,418	,180		7,888	,000	1,064	1,773					
	Intercultural communication	,276	,061	,323	4,496	,000	,155	,398	,481	,305	,270	,698	1,433
	Global civic engagement	,256	,064	,288	4,000	,000	,130	,383	,465	,274	,240	,698	1,433

a. Dependent Variable: Usability

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics: Tolerance	VIF	Minimum Tolerance
1	Justice	,140[b]	2,199	,029	,155	,938	1,066	,938
	Global civic engagement	,288[b]	4,000	,000	,274	,698	1,433	,698
2	Justice	,077[c]	1,186	,237	,084	,864	1,157	,643

a. Dependent Variable: Usability

b. Predictors in the Model: (Constant), Intercultural communication

c. Predictors in the Model: (Constant), Intercultural communication, Global civic engagement

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Intercultural communication	Global civic engagement
1	1	1,993	1,000	,00	,00	
	2	,007	17,375	1,00	1,00	
2	1	2,987	1,000	,00	,00	,00
	2	,007	20,112	,84	,02	,56
	3	,006	22,119	,16	,98	,44

a. Dependent Variable: Usability

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,24	3,48	3,02	,167	200
Residual	-,582	,888	,000	,262	200
Std. Predicted Value	-4,668	2,763	,000	1,000	200
Std. Residual	-2,207	3,366	,000	,995	200

a. Dependent Variable: Usability

Appendix 5.

SPSS Output for Statistical Analysis of Model 2 in Chapter 5

Descriptive Statistics

		Mean	Std. Deviation	N
Satisfaction		3,14	,364	200
Justice		3,28	,454	200
Global civic engagement		2,86	,349	200

Correlations

			Satisfaction	Justice	Global civic engagement
Pearson Correlation	Satisfaction		,276	,249	,550
	Justice		,190	1,000	,364
	Global civic engagement		,323	,364	1,000
Sig. (1-tailed)	Satisfaction		,000	,000	,000
	Justice		,004	.	,000
	Global civic engagement		,000	,000	.
N	Satisfaction		200	200	200
	Justice		200	200	200
	Global civic engagement		200	200	200

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Global civic engagement	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Satisfaction

Model Summary[b]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	,323[a]	,104	,100	,379	,104	23,062	1	198	,000

a. Predictors: (Constant), Global civic engagement

b. Dependent Variable: Satisfaction

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3,309	1	3,309	23,062	,000[b]
	Residual	28,410	198	,143		
	Total	31,719	199			

a. Dependent Variable: Satisfaction

b. Predictors: (Constant), Global civic engagement

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF

1	(Constant)	2,008	,221		9,075	,000	1,571	2,444						
	Global civic engagement	,369	,077	,323	4,802	,000	,218	,521	,323	,323	,323	1,000	1,000	

a. Dependent Variable: Satisfaction

Excluded Variables[a]

						Collinearity Statistics		
Model		Beta In	t	Sig.	Partial Correlation	Tolerance	VIF	Minimum Tolerance
1	Intercultural communication	,141[b]	1,766	,079	,125	,698	1,433	,698
	Justice	,034[b]	,499	,618	,036	,995	1,005	,995
	Self-awareness	,127[b]	1,478	,141	,105	,611	1,636	,611
	Social responsibility	,083[b]	1,152	,251	,082	,867	1,153	,867

a. Dependent Variable: Satisfaction

b. Predictors in the Model: (Constant), Global civic engagement

Collinearity Diagnostics[a]

				Variance Proportions	
Model	Dimension	Eigenvalue	Condition Index	(Constant)	Global civic engagement
1	1	1,993	1,000	,00	,00
	2	,007	16,460	1,00	1,00

a. Dependent Variable: Satisfaction

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,59	3,43	3,06	,129	200
Residual	-1,116	1,117	,000	,378	200
Std. Predicted Value	-3,656	2,828	,000	1,000	200
Std. Residual	-2,946	2,950	,000	,997	200

a. Dependent Variable: Satisfaction

Appendix 6.

SPSS Output for Statistical Analysis of Model 3 in Chapter 5

Descriptive Statistics

	Mean	Std. Deviation	N
Content Relevance	3,14	,364	200
Justice	3,28	,454	200
Global civic engagement	2,86	,349	200

Correlations

		Content Relevance	Justice	Global civic engagement
Pearson Correlation	Content Relevance	,374	,249	,550
	Justice	,253	1,000	,364
	Global civic engagement	,352	,364	1,000
Sig. (1-tailed)	Content Relevance	,000	,000	,000
	Justice	,000	.	,000
	Global civic engagement	,000	,000	.
N	Content Relevance	200	200	200
	Justice	200	200	200
	Global civic engagement	200	200	200

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Intercultural communication	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Global civic engagement	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Content Relevance

Model Summary[c]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	,374[a]	,140	,136	,343	,140	32,288	1	198	,000
2	,413[b]	,171	,162	,338	,031	7,295	1	197	,008

a. Predictors: (Constant), Intercultural communication

b. Predictors: (Constant), Intercultural communication, Global civic engagement

c. Dependent Variable: Content Relevance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3,806	1	3,806	32,288	,000[b]
	Residual	23,339	198	,118		
	Total	27,145	199			
2	Regression	4,639	2	2,320	20,305	,000[c]

	Residual	22,506	197	,114
	Total	27,145	199	

a. Dependent Variable: Content Relevance

b. Predictors: (Constant), Intercultural communication

c. Predictors: (Constant), Intercultural communication, Global civic engagement

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	1,986	,212		9,383	,000	1,568	2,403					
	Intercultural communication	,380	,067	,374	5,682	,000	,248	,512	,374	,374	,374	1,000	1,000
2	(Constant)	1,720	,230		7,464	,000	1,265	2,174					
	Intercultural communication	,263	,079	,259	3,337	,001	,108	,418	,374	,231	,216	,698	1,433
	Global civic engagement	,222	,082	,210	2,701	,008	,060	,384	,352	,189	,175	,698	1,433

a. Dependent Variable: Content Relevance

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics: Tolerance	VIF	Minimum Tolerance
1	Justice	,170[b]	2,534	,012	,178	,938	1,066	,938
	Global civic engagement	,210[b]	2,701	,008	,189	,698	1,433	,698
2	Justice	,130[c]	1,868	,063	,132	,864	1,157	,643

a. Dependent Variable: Content Relevance

b. Predictors in the Model: (Constant), Intercultural communication

c. Predictors in the Model: (Constant), Intercultural communication, Global civic engagement

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Intercultural communication	Global civic engagement
1	1	1,993	1,000	,00	,00	
	2	,007	17,375	1,00	1,00	
2	1	2,987	1,000	,00	,00	,00
	2	,007	20,112	,84	,02	,56
	3	,006	22,119	,16	,98	,44

a. Dependent Variable: Content Relevance

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,46	3,60	3,18	,153	200
Residual	-1,174	,875	,000	,336	200
Std. Predicted Value	-4,686	2,755	,000	1,000	200
Std. Residual	-3,474	2,590	,000	,995	200

a. Dependent Variable: Content Relevance

Appendix 7.

SPSS Output for Statistical Analysis of Model 4 in Chapter 5

Descriptive Statistics

	Mean	Std. Deviation	N
Progressivism	3,41	,356	200
Intercultural communication	3,14	,364	200
Justice	3,37	,396	200
Self-awareness	2,96	,410	200
Global civic engagement	2,86	,349	200
Social responsibility	3,28	,454	200

Correlations

		Progressivism	Intercultural communication	Justice	Self-awareness	Global civic engagement	Social responsibility
Pearson Correlation	Progressivism	1,000	,439	,385	,339	,429	,435
	Intercultural communication	,439	1,000	,145	,515	,550	,249
	Justice	,385	,145	1,000	-,013	,070	,449
	Self-awareness	,339	,515	-,013	1,000	,623	,272
	Global civic engagement	,429	,550	,070	,623	1,000	,364
	Social responsibility	,435	,249	,449	,272	,364	1,000
Sig. (1-tailed)	Progressivism	.	,000	,000	,000	,000	,000
	Intercultural communication	,000	.	,020	,000	,000	,000
	Justice	,000	,020	.	,426	,162	,000
	Self-awareness	,000	,000	,426	.	,000	,000
	Global civic engagement	,000	,000	,162	,000	.	,000
	Social responsibility	,000	,000	,000	,000	,000	.
N	Progressivism	200	200	200	200	200	200
	Intercultural communication	200	200	200	200	200	200
	Justice	200	200	200	200	200	200
	Self-awareness	200	200	200	200	200	200

Global civic engagement	200	200	200	200	200	200
Social responsibility	200	200	200	200	200	200

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Intercultural communication	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Social responsibility	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Justice	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	Global civic engagement	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Progressivism

Model Summary[e]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	,439[a]	,193	,189	,321	,193	47,302	1	198	,000
2	,553[b]	,306	,299	,298	,113	32,145	1	197	,000
3	,588[c]	,346	,336	,290	,040	11,906	1	196	,001

4	,612[d]	,374	,361	,285	,028	8,844	1	195	,003

a. Predictors: (Constant), Intercultural communication

b. Predictors: (Constant), Intercultural communication, Social responsibility

c. Predictors: (Constant), Intercultural communication, Social responsibility, Justice

d. Predictors: (Constant), Intercultural communication, Social responsibility, Justice, Global civic engagement

e. Dependent Variable: Progressivism

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4,865	1	4,865	47,302	,000[b]
	Residual	20,365	198	,103		
	Total	25,231	199			
2	Regression	7,722	2	3,861	43,444	,000[c]
	Residual	17,508	197	,089		
	Total	25,231	199			
3	Regression	8,725	3	2,908	34,535	,000[d]
	Residual	16,506	196	,084		
	Total	25,231	199			
4	Regression	9,441	4	2,360	29,149	,000[e]
	Residual	15,790	195	,081		
	Total	25,231	199			

a. Dependent Variable: Progressivism

b. Predictors: (Constant), Intercultural communication

c. Predictors: (Constant), Intercultural communication, Social responsibility

d. Predictors: (Constant), Intercultural communication, Social responsibility, Justice

e. Predictors: (Constant), Intercultural communication, Social responsibility, Justice, Global civic engagement

Coefficients[a]

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	Correlations	Collinearity Statistics

		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2,060	,198		10,422	,000	1,670	2,450					
	Intercultural communication	,430	,062	,439	6,878	,000	,306	,553	,439	,439	,439	1,000	1,000
2	(Constant)	1,432	,215		6,674	,000	1,009	1,855					
	Intercultural communication	,345	,060	,352	5,751	,000	,227	,463	,439	,379	,341	,938	1,066
	Social responsibility	,273	,048	,347	5,670	,000	,178	,368	,435	,375	,337	,938	1,066
3	(Constant)	1,033	,239		4,326	,000	,562	1,504					
	Intercultural communication	,337	,058	,345	5,773	,000	,222	,452	,439	,381	,334	,936	1,068
	Social responsibility	,196	,052	,249	3,770	,000	,093	,298	,435	,260	,218	,764	1,309
	Justice	,201	,058	,223	3,451	,001	,086	,316	,385	,239	,199	,797	1,254
4	(Constant)	,814	,245		3,317	,001	,330	1,298					
	Intercultural communication	,234	,067	,240	3,504	,001	,102	,366	,439	,243	,199	,686	1,457
	Social responsibility	,145	,054	,185	2,706	,007	,039	,251	,435	,190	,153	,687	1,455
	Justice	,227	,058	,252	3,932	,000	,113	,341	,385	,271	,223	,779	1,284
	Global civic engagement	,217	,073	,213	2,974	,003	,073	,361	,429	,208	,168	,628	1,593

a. Dependent Variable: Progressivism

Excluded Variables[a]

Model						Collinearity Statistics		
		Beta In	t	Sig.	Partial Correlation	Tolerance	VIF	Minimum Tolerance
1	Justice	,347[b]	5,670	,000	,375	,938	1,066	,938
	Global civic engagement	,269[b]	3,630	,000	,250	,698	1,433	,698
2	Justice	,087[c]	1,246	,214	,089	,712	1,404	,712
	Global civic engagement	,170[c]	2,317	,022	,163	,643	1,556	,643
3	Justice	,141[d]	2,027	,044	,144	,684	1,463	,684
	Global civic engagement	,213[d]	2,974	,003	,208	,628	1,593	,628
4	Justice	,064[e]	,842	,401	,060	,555	1,803	,509

a. Dependent Variable: Progressivism

b. Predictors in the Model: (Constant), Intercultural communication

c. Predictors in the Model: (Constant), Intercultural communication, Social responsibility
d. Predictors in the Model: (Constant), Intercultural communication, Social responsibility, Justice
e. Predictors in the Model: (Constant), Intercultural communication, Social responsibility, Justice, Global civic engagement

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Intercultural communication	Social responsibility	Justice	Global civic engagement
1	1	1,993	1,000	,00	,00			
	2	,007	17,375	1,00	1,00			
2	1	2,981	1,000	,00	,00	,00		
	2	,012	15,472	,04	,32	,88		
	3	,006	21,915	,96	,67	,12		
3	1	3,972	1,000	,00	,00	,00	,00	
	2	,013	17,375	,03	,46	,37	,10	
	3	,009	20,629	,05	,10	,63	,52	
	4	,005	27,881	,92	,44	,01	,38	
4	1	4,963	1,000	,00	,00	,00	,00	,00
	2	,016	17,583	,00	,13	,15	,21	,15
	3	,010	21,807	,08	,03	,65	,22	,08
	4	,006	29,345	,14	,84	,10	,01	,47
	5	,005	32,196	,78	,00	,09	,56	,30

a. Dependent Variable: Progressivism

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,85	3,99	3,41	,218	200
Residual	-,733	,679	,000	,282	200
Std. Predicted Value	-2,563	2,678	,000	1,000	200
Std. Residual	-2,577	2,385	,000	,990	200

a. Dependent Variable: Progressivism

Appendix 8.

SPSS Output for Statistical Analysis of Model 5 in Chapter 5

Descriptive Statistics

	Mean	Std. Deviation	N
Neo_conservattism	2,88	,449	200
Intercultural communication	3,14	,364	200
Justice	3,37	,396	200
Self-awareness	2,96	,410	200
Global civic engagement	2,86	,349	200
Social responsibility	3,28	,454	200

Correlations

		Neo_conservattism	Intercultural communication	Justice	Self-awareness	Global civic engagement	Social responsibility
Pearson Correlation	Neo_conservattism	1,000	,330	-,038	,292	,253	,065
	Intercultural communication	,330	1,000	,145	,515	,550	,249
	Justice	-,038	,145	1,000	-,013	,070	,449
	Self-awareness	,292	,515	-,013	1,000	,623	,272
	Global civic engagement	,253	,550	,070	,623	1,000	,364
	Social responsibility	,065	,249	,449	,272	,364	1,000
Sig. (1-tailed)	Neo_conservattism	.	,000	,299	,000	,000	,180
	Intercultural communication	,000	.	,020	,000	,000	,000
	Justice	,299	,020	.	,426	,162	,000
	Self-awareness	,000	,000	,426	.	,000	,000
	Global civic engagement	,000	,000	,162	,000	.	,000
	Social responsibility	,180	,000	,000	,000	,000	.
N	Neo_conservattism	200	200	200	200	200	200
	Intercultural communication	200	200	200	200	200	200

	Justice	200	200	200	200	200	200
	Self-awareness	200	200	200	200	200	200
	Global civic engagement	200	200	200	200	200	200
	Social responsibility	200	200	200	200	200	200

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Intercultural communication	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Self-awareness	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Neo_conservattism

Model Summary[c]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	,330[a]	,109	,104	,425	,109	24,170	1	198	,000
2	,359[b]	,129	,120	,421	,020	4,565	1	197	,034

a. Predictors: (Constant), Intercultural communication

b. Predictors: (Constant), Intercultural communication, Self-awareness

c. Dependent Variable: Neo_conservattism

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4,365	1	4,365	24,170	,000[b]

	Residual	35,757	198	,181		
	Total	40,122	199			
2	Regression	5,175	2	2,587	14,585	,000[c]
	Residual	34,947	197	,177		
	Total	40,122	199			

a. Dependent Variable: Neo_conservattism

b. Predictors: (Constant), Intercultural communication

c. Predictors: (Constant), Intercultural communication, Self-awareness

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	1,605	,262		6,128	,000	1,088	2,122					
	Intercultural communication	,407	,083	,330	4,916	,000	,244	,570	,330	,330	,330	1,000	1,000
2	(Constant)	1,399	,277		5,055	,000	,853	1,945					
	Intercultural communication	,301	,096	,244	3,150	,002	,113	,490	,330	,219	,209	,735	1,361
	Self-awareness	,181	,085	,166	2,137	,034	,014	,349	,292	,150	,142	,735	1,361

a. Dependent Variable: Neo_conservattism

Excluded Variables[a]

						Collinearity Statistics		
Model		Beta In	t	Sig.	Partial Correlation	Tolerance	VIF	Minimum Tolerance
1	Justice	-,018[b]	-,262	,794	-,019	,938	1,066	,938
	Global civic engagement	,103[b]	1,279	,203	,091	,698	1,433	,698
2	Justice	-,045[c]	-,645	,520	-,046	,910	1,099	,712
	Global civic engagement	,028[c]	,309	,758	,022	,540	1,851	,540

a. Dependent Variable: Neo_conservattism

b. Predictors in the Model: (Constant), Intercultural communication

c. Predictors in the Model: (Constant), Intercultural communication, Self-awareness

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Intercultural communication	Self-awareness
1	1	1,993	1,000	,00	,00	
	2	,007	17,375	1,00	1,00	
2	1	2,984	1,000	,00	,00	,00
	2	,010	17,627	,43	,04	,88
	3	,006	21,707	,57	,96	,12

a. Dependent Variable: Neo_conservattism

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,33	3,33	2,88	,161	200
Residual	-1,424	1,079	,000	,419	200
Std. Predicted Value	-3,451	2,770	,000	1,000	200
Std. Residual	-3,381	2,562	,000	,995	200

a. Dependent Variable: Neo_conservattism

Appendix 9.

SPSS Output for Statistical Analysis of Model 6 in Chapter 5

Descriptive Statistics

	Mean	Std. Deviation	N
Reconstructionism	3,43	,366	200
Intercultural communication	3,14	,364	200
Justice	3,37	,396	200
Self-awareness	2,96	,410	200
Global civic engagement	2,86	,349	200
Social responsibility	3,28	,454	200

Correlations

		Reconstructionism	Intercultural communication	Justice	Self-awareness	Global civic engagement	Social responsibility
Pearson Correlation	Reconstructionism	1,000	,422	,416	,364	,380	,468
	Intercultural communication	,422	1,000	,145	,515	,550	,249
	Justice	,416	,145	1,000	-,013	,070	,449
	Self-awareness	,364	,515	-,013	1,000	,623	,272
	Global civic engagement	,380	,550	,070	,623	1,000	,364
	Social responsibility	,468	,249	,449	,272	,364	1,000
Sig. (1-tailed)	Reconstructionism	.	,000	,000	,000	,000	,000
	Intercultural communication	,000	.	,020	,000	,000	,000
	Justice	,000	,020	.	,426	,162	,000
	Self-awareness	,000	,000	,426	.	,000	,000
	Global civic engagement	,000	,000	,162	,000	.	,000
	Social responsibility	,000	,000	,000	,000	,000	.
N	Reconstructionism	200	200	200	200	200	200

	Intercultural communication	200	200	200	200	200	200
	Justice	200	200	200	200	200	200
	Self-awareness	200	200	200	200	200	200
	Global civic engagement	200	200	200	200	200	200
	Social responsibility	200	200	200	200	200	200

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Social responsibility	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Intercultural communication	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Justice	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	Self-awareness	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Reconstructionism

Model Summary[e]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	,468[a]	,219	,215	,324	,219	55,597	1	198	,000
2	,564[b]	,318	,312	,304	,099	28,689	1	197	,000
3	,605[c]	,366	,357	,294	,048	14,759	1	196	,000
4	,625[d]	,390	,378	,289	,024	7,624	1	195	,006

a. Predictors: (Constant), Social responsibility

b. Predictors: (Constant), Social responsibility, Intercultural communication

c. Predictors: (Constant), Social responsibility, Intercultural communication, Justice

d. Predictors: (Constant), Social responsibility, Intercultural communication, Justice, Self-awareness

e. Dependent Variable: Reconstructionism

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5,841	1	5,841	55,597	,000[b]
	Residual	20,802	198	,105		
	Total	26,643	199			
2	Regression	8,485	2	4,243	46,030	,000[c]
	Residual	18,158	197	,092		
	Total	26,643	199			
3	Regression	9,757	3	3,252	37,750	,000[d]
	Residual	16,886	196	,086		
	Total	26,643	199			
4	Regression	10,392	4	2,598	31,175	,000[e]
	Residual	16,251	195	,083		
	Total	26,643	199			

a. Dependent Variable: Reconstructionism

b. Predictors: (Constant), Social responsibility

c. Predictors: (Constant), Social responsibility, Intercultural communication
d. Predictors: (Constant), Social responsibility, Intercultural communication, Justice
e. Predictors: (Constant), Social responsibility, Intercultural communication, Justice, Self-awareness

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	2,190	,168		13,060	,000	1,860	2,521					
	Social responsibility	,378	,051	,468	7,456	,000	,278	,477	,468	,468	,468	1,000	1,000
2	(Constant)	1,377	,219		6,302	,000	,946	1,808					
	Social responsibility	,312	,049	,387	6,373	,000	,216	,409	,468	,413	,375	,938	1,066
	Intercultural communication	,327	,061	,325	5,356	,000	,207	,447	,422	,357	,315	,938	1,066
3	(Constant)	,928	,241		3,841	,000	,451	1,404					
	Social responsibility	,225	,052	,279	4,294	,000	,122	,329	,468	,293	,244	,764	1,309
	Intercultural communication	,318	,059	,317	5,391	,000	,202	,435	,422	,359	,307	,936	1,068
	Justice	,226	,059	,245	3,842	,000	,110	,342	,416	,265	,218	,797	1,254
4	(Constant)	,727	,248		2,928	,004	,237	1,217					
	Social responsibility	,190	,053	,235	3,564	,000	,085	,295	,468	,247	,199	,719	1,392
	Intercultural communication	,228	,067	,226	3,410	,001	,096	,359	,422	,237	,191	,709	1,410
	Justice	,259	,059	,280	4,381	,000	,142	,375	,416	,299	,245	,765	1,307
	Self-awareness	,166	,060	,187	2,761	,006	,048	,285	,364	,194	,154	,684	1,463

a. Dependent Variable: Reconstructionism

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics: Tolerance	VIF	Minimum Tolerance
1	Intercultural communication	,325[b]	5,356	,000	,357	,938	1,066	,938

	Justice	,258[b]	3,788	,000	,261	,798	1,252	,798
	Self-awareness	,255[b]	4,060	,000	,278	,926	1,080	,926
	Global civic engagement	,241[b]	3,693	,000	,254	,867	1,153	,867
2	Justice	,245[c]	3,842	,000	,265	,797	1,254	,764
	Self-awareness	,127[c]	1,838	,068	,130	,712	1,404	,712
	Global civic engagement	,094[c]	1,277	,203	,091	,643	1,556	,643
3	Self-awareness	,187[d]	2,761	,006	,194	,684	1,463	,684
	Global civic engagement	,138[d]	1,943	,054	,138	,628	1,593	,628
4	Global civic engagement	,066[e]	,845	,399	,061	,509	1,963	,509

a. Dependent Variable: Reconstructionism

b. Predictors in the Model: (Constant), Social responsibility

c. Predictors in the Model: (Constant), Social responsibility, Intercultural communication

d. Predictors in the Model: (Constant), Social responsibility, Intercultural communication, Justice

e. Predictors in the Model: (Constant), Social responsibility, Intercultural communication, Justice, Self-awareness

Collinearity Diagnostics[a]

				Variance Proportions				
Model	Dimension	Eigenvalue	Condition Index	(Constant)	Social responsibility	Intercultural communication	Justice	Self-awareness
1	1	1,991	1,000	,00	,00			
	2	,009	14,567	1,00	1,00			
2	1	2,981	1,000	,00	,00	,00		
	2	,012	15,472	,04	,88	,32		
	3	,006	21,915	,96	,12	,67		
3	1	3,972	1,000	,00	,00	,00	,00	
	2	,013	17,375	,03	,37	,46	,10	
	3	,009	20,629	,05	,63	,10	,52	
	4	,005	27,881	,92	,01	,44	,38	
4	1	4,959	1,000	,00	,00	,00	,00	,00

2	,019	16,180	,00	,11	,06	,17	,29
3	,011	21,630	,08	,72	,09	,13	,09
4	,007	27,487	,04	,13	,79	,15	,50
5	,005	31,821	,89	,04	,07	,55	,12

a. Dependent Variable: Reconstructionism

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2,84	4,01	3,43	,229	200
Residual	-,767	,661	,000	,286	200
Std. Predicted Value	-2,586	2,551	,000	1,000	200
Std. Residual	-2,658	2,291	,000	,990	200

a. Dependent Variable: Reconstructionism