INTRODUCTION

[redacted] College is a year 7-12 government secondary college located in Essendon, Victoria. It has a relatively high Socio-Educational Advantage (SEA) and is in a major city. As such, it offers the Higher Education Scored Study (HESS) subject algorithmics; a subject aimed at preparing students for tertiary-level computer science.

This unit of work is catered towards the year 12 cohort undertaking unit 3 of algorithmics. Students are assumed to have the mathematics knowledge that underpin the subject by being enrolled in or already completed VCE mathematical methods units 1 and 2. (Victorian Curriculum and Assessment Authority [VCAA], 2023). This results in a smaller class size than usual, with 13 students undertaking this subject. In this class, 3 students require additional support. There is a student with a hearing impairment, another diagnosed with autism spectrum disorder (ASD), and lastly a student who speaks English as an additional language (EAL).

The focus of this unit plan will be Unit Three, Area of Study (AoS) One 'Data Modelling with Abstract Data Types (ADTs)'. This will be the first topic they complete as the key knowledge learned will underpin the rest of units 3 and 4. The learning outcome of this AoS is to define and explain how ADTs are utilised to represent information and develop representations that are best suited for modelling different real-world problems (VCAA, 2023). This will be assessed through a summative task in the form of a written exam, where they will be tested on the key skills highlighted in the study design for this AoS (VCAA, 2023). The design of this unit of work is such that students who complete all assigned learning activities will have the capacity to be successful in completing the unit's summative assessment.

RATIONALE AND JUSTIFICATION

Part 1 - Pedagogical Decisions.

This unit of work was created using the backward design process to ensure the required learning outcomes were going to be met, & accountability was built into the unit of work design by ensuring analysis could be completed in the future to determine where it succeeded, and its shortcomings (Richards, 2013). The summative assessment was created targeting these outcomes, which then informed the selection of formative assessments that would be done within the classroom. The sequence of content was designed such that students would be introduced to the core skills underpinning the AoS – for example, beginning with general problem-solving and algorithmic thinking, before delving into the specific ADTs and complexities of real-world applications. This will allow teachers to effectively manage the students' cognitive load which is required when learning difficult concepts (Chang et al., 2015).

The pedagogical methods considered during the development of this unit of work were a constructivist framework implementing problem-based learning (PBL), and a mastery teaching approach. Implementing PBL is good for developing the critical thinking and

problem solving that will be required in computing and gives students and opportunity to take ownership in the learning. (Goh & Yew, 2016).

However, the nature of senior secondary school places much more emphasis on standardized testing due to the contribution the results make on students' ability to apply to universities. Therefore, students may thrive more in a structured, step-by-step guided style that can be found in a mastery approach to learning (Guskey, 2010). This allows students to know exactly what they must learn in each AoS to achieve their academic goals.

At the same time, if a pure mastery approach is implemented than this may conflict with our aspiration of student achievement, because it can increase the pressure on students to master every single concept. This rise in performance anxiety can decrease motivation if they struggle with a particular topic, or they believe they are falling behind the rest of the class (Persky & Winget, 2022)

This made it clear that integrating a blend of these approaches will be needed throughout the unit of work to counteract the negatives of each approach whilst simultaneously reaping the benefits. Because this is the first AoS for the subject at the VCE level for these students, using mastery teaching for learning specific skills (such as completing the exercise sets in week 3 for the specific ADTs covered) will be implemented initially as it is essential to successful programming learning (Waite, 2017). This will then allow teachers to incorporate PBL for other formative assessments. For example, in week 5, students will be given a train network and will have to use their knowledge of directed graphs to represent the scenario and come up with their own solutions for finding things like the shortest route (compared to say Dijkstra's algorithm), or maximum flow, creating deeper learning and developing critical thinking skills. This will also normalize making mistakes during the learning process. This allows them to see mistakes as growth opportunities and not barriers, helping to reduce the performance pressure of VCE.

Part 2 - Teaching Strategies, including Literacy, Numeracy and ICT.

There were several key design steps taken to ensure this unit of work will explicitly improve the literacy, numeracy, and ICT abilities for students.
For the literacy capability, students were provided with opportunities to create mind maps in week 6 and provided a key terminology resource. It also ensured that any new technical language is taught with Marzano's six step process framework in mind. For example, in week 3 when students are learning about stacks, part of a lesson would look something like this: *Explain*: discuss how stacks are like a stack of plates in the kitchen. *Restate:* get Ss to come up with an example in their own words (*e.g. pile of books) Show:* Demonstrate it in the classroom with a physical demonstration (e.g. using the pile of books example provided by Ss). *Discuss:* Discuss why and how stacks are used. *Refine:* Ss completed the associated learning activity. *Apply:* reinforce at the end of the lesson through a Kahoot (Marzano, 2007). This will increase students understanding of specialised vocabulary needed within computing by interpreting complex language (ACARA, n.d.-a)

For numeracy, the nature of algorithms has mathematical thought naturally ingrained. Many algorithms that students would already be familiar with without realising are designed to solve mathematical problems, e.g. finding averages and solving equations. This

will be taken to a more complex level throughout the unit of work, such as in week 5 where students will have to complete calculations associated with graphs. Tasks will include optimizing a route through a network, whether by shortest route, or smallest cost, and discussing the merits of different traversal algorithms. This will effectively increase students' abilities to recognise and generalise patterns, which in turn will build their numeracy expertise (ACARA, n.d.-a).
ICT will be utilized heavily to apply the concepts students will be covering throughout the unit of work. They will have the opportunity to implement the algorithms covered through abstract modelling or the python programming language for higher achieving students. This will allow them to make connections between theory and the application of concepts (ACARA, n.d.-a), deepening their understanding of how ICT is utilized in the real world.

As this unit of work has been underpinned by a mastery teaching/PBL pedagogical blend, it is important teachers are applying the HITS strategies during lessons to reinforce this. All will be used in some form, however explicit teaching, worked examples, feedback, & questioning should be used as a minimum to cover the learning outcomes described in the unit of work. By doing so, students will be clearly shown the steps required to solve a problem, help teachers gauge student understanding and performance, and stimulate interest in their own learning (Department of Education and Training [DET], 2022). Using the HITS 'differentiated teaching' is also a must. Regardless of whether students have started behind or above the expected level, the knowledge of every student needs to be extended and improved upon in some capacity to ensure all students master the specific learning outcomes that are set out by the teacher (DET, 2022).

Part 3 - Professional and Ethical Responsibilities

Due to the needs of the student diagnosed with ASD, key safety considerations were taken to ensure the students wellbeing within the classroom, addressing 4.4 of the teacher standards - maintaining student safety (AITSL, n.d., Standard 4.4). This student has a heightened sensitivity to loud noises, and so the classroom environment can get overwhelming. This is addressed in week 1 of the unit plan by ensuring the student is aware of the quiet space set out for them, which they can easily access whenever they feel over stimulated and distressed. Further, it outlines having noise-cancelling headphones somewhere in the classroom for them to use in case the student forgets their own pair, to maintain their feeling of security and wellbeing.

The professional and ethical responsibilities that need to be addressed within this subject are substantial and require to be looked at throughout all AoS for the subject. For this AoS, during week 3, students will be looking at the ADT 'stacks.' Teachers will use parts of their lesson to discuss how and why the stack can be exploited, through attacks such as buffer overflow attacks and code injection. This highlights the responsibility of creating efficient and thought-out solutions to reduce potential exploits that people may use for immoral purposes. This was interwoven into a learning activity by having students look at real world scenarios of stack implementations and determine where a vulnerability lies and how it could be exploited. They then evaluate the consequences of what would occur if these vulnerabilities were exploited. This will allow students to understand the strategies available for key issues covered to ensure they are safe and responsible when using ICT at

school or in the future. (Australian Institute for Teaching and School Leadership [AITSL], n.d., Standard 4.5)

Teachers implementing lesson plans for this unit of work will be encouraged to design lessons utilizing the Universal Design for Learning (UDL) principles to ensure the diversity within the classroom will be addressed. The unit of work supports this approach through the various formative assessments such as group discussions, digital or physical access of task sets, and quizzes, and also by accounting for the different requirements some students may have for summative tasks. By providing students with multiple ways of accessing content and demonstrating their knowledge, students will have been given the greatest chance of succeeding academically (Capp, 2017).

To ensure the EAL student was able to access the learning materials as easily as all other students in accordance with standard 1.3 – students with diverse linguistic, cultural, religious, and SES backgrounds (AITSL, n.d. Standard 1.3), several adjustments were accounted for. By providing a copy of the presentation alongside key terminology lists for the EAL student to study and refer to will help support literacy within computing, which is an advocated teaching approach for Second Language Acquisition (Premier, 2021).

VCE Unit Plan (*Adapted from sample weekly planner provided by VCAA)*

Study Design: VCAA 2023-2026 version 1.1 **Unit:** Algorithmics (HESS) – Unit 3 **Area of Study:** 1 – Data modelling with abstract data types

Outcomes/Learning Objectives: Students should be able to define and explain the representation of information using abstract data types, and devise formal representations for modelling various kinds of real-world information problems using appropriate abstract data types

Focus text/s: An Introduction Algorithmic Thinking by Gouros Georgia

Key assessment strategies: Diagnostic, Formative, & Summative assessment

School context/student cohort: *[redacted]*: Year 12. (13 students) **Duration of unit:** 6 weeks

Annotations Key (*colour coded)*:

1. Learning outcomes or objectives, including any relevant adjustments for students working below and above standard
2. Alignment with subject-specific syllabus/curriculum
3. Information about the nature, content and conditions of the summative assessment
4. Pedagogical sequencing of content and activities appropriate for your teaching area
5. Pedagogical strategies relevant to teaching in your subject area, the needs of learners, and including support for higher order learning
6. A variety of formative assessment strategies suitable for tracking and supporting student learning
7. Resourcing for selected teaching and assessment pedagogies
8. Planning for the development of students' subject-specific literacy, numeracy and digital skills
9. Diagnostic, formative and summative approaches to tracking and assessing student learning
10. Differentiation of teaching and assessment to consider implications for students with cognitive, physical, socio-economic, cultural, linguistic and religious diversity.

Week/ Lesson	**Links to outcome (knowledge, skills as per Study Design)**	**Topic/Lesson focus**	**Student activities and tasks What will the students do?**	**Required resources**	**Monitoring and assessment linked to Outcome** (formative and summative)
1	Key Knowledge: - N/A for Aos 1 Key Skills: - N/A for Aos 1 *These learning activities are more fitted to AoS 2; however, it develops the algorithmic thinking required for the entire unit, and is a better entry point*	Solving Problems	• Discuss the outcomes and inform students of Unit 3 SAC and SAT dates and conditions, as per school guidelines. • Introduction to real-world problem-solving, following recipes, flowcharts, representations of algorithms. • Show student with ASD a quiet space they can use when feeling overwhelmed	- Lesson presentations - Learning tasks - An Introduction Algorithmic Thinking (book) - have a copy of presentation for S w/ hearing impairment & EAL - Provide key terminology lists for EAL student to study and refer to - Noise cancelling headphones if student with ASD requires them - ROGER microphone and speaker system for S hearing aide to connect to	- Pre-class quiz - In class Kahoot - Think Pair share - Observations - Completion of learning activities

2	Key Knowledge: - N/A for AoS 1 Key Skills: - N/A for Aos 1 *These learning activities are more fitted to AoS 2; however, it develops algorithmic thinking required for the entire unit, and is a better entry point*	Algorithms in Pseudocode	• Class activities to introduce the writing of structured pseudocode algorithms for solving puzzles and games. (Allow S with ASD to work independently if they have issues with working with a group) • Use sequence, conditional and iterative actions in structured pseudocode to control steps actioned in algorithms.	- Lesson presentations - Learning tasks - Exemplars - An Introduction Algorithmic Thinking (book) - have a copy of presentation for S w/ hearing impairment & EAL	- Think Pair share - Observations - Exit ticket - Completion of learning activities

3	Key Knowledge: - Motivation for using ADTs - Signature specifications of ADTs using operator names, argument types and result types - Specification and uses stacks, queues, and dictionaries Key Skills: - Explain the role of ADTs for data modelling - Read and write ADT signature specifications - Use ADTs in accordance with their specifications - Apply ADTs to model real-world	ADTs	• Introduction to ADTs for holding information for actions and computations in variables, lists, stacks, queues, priority queues, dictionary ADTs. • Explore how real-world problem-modelling can be done using simple ADTs. • Review the formal signatures and standard operations of simple ADTs.	- Lesson presentations - Learning tasks - An Introduction Algorithmic Thinking (book) - have a copy of presentation for S w/ hearing impairment & EAL	- Exit tickets - Observations - Kahoot - Completion of learning activities - Those observed to be above standard will be given the opportunity to look at further ADTs and implementation such as priority queues, circular linked lists, heaps, and hash tables

	problems by selecting appropriate ADT and justifying suitability				
4	Key Knowledge: - features of graphs, including paths, weighted path lengths, cycles and subgraphs - categories of graphs, including complete graphs, connected graphs, directed acyclic graphs and trees, and their properties Key Skills: - identify and describe properties of graphs	ADTs (Graphs, directed graphs, trees)	• Discuss the features of graphs and how they are holding information for actions and computation in graph ADTs • Explore how real-world problem-modelling can be done using graphs. • Class activities on graph representations and properties. (Allow S with ASD to work independently if they have issues with working with a group) • Review the formal	- Lesson presentations - Learning tasks - Exemplars - An Introduction Algorithmic Thinking (book) - have a copy of presentation for S w/ hearing impairment & EAL	- In class quiz - Think Pair Share - Exit tickets - Observations - Completion of learning activities - Ss observed to be above standard will be given the opportunity to look at further types of trees, e.g. prefix trees & n-ary trees

			signatures of graph ADTs.		
5	Key Knowledge: - the structure of decision trees and state graphs - Modularisation and abstraction of information representation with ADTs Key Skills: - identify and describe properties of graphs - model basic network and planning problems with graphs, including the use of decision trees and state graphs - identify and describe properties of graphs	Searching/Traversing Graphs	• Apply graph traversal and searching algorithms (depth-first search, breadth-first search) on graph ADTs. • Discuss the merits of each traversal algorithm and compare traversal methods progression.	- Lesson presentations - Learning tasks - An Introduction Algorithmic Thinking (book) - have a copy of presentation for S w/ hearing impairment & EAL	- Group Discussions - Observations - Completion of learning activities - Those identified to be above standard will be provided the opportunity to implement these algorithms using python

6	Key Knowledge: - All associated with AoS 1 Key Skills: - All associated with AoS 1	Unit 3 Outcome 1 SAC	• Revision • Unit 3 outcome 1 School Assessed Coursework	- Revision materials - An Introduction Algorithmic Thinking (book) - EAL Student will be permitted a translation dictionary and 20 minutes extra-time if permitted by VCAA - Allow student with ASD extra break time if permitted/required	- Revision quiz - Mind maps - Key terminology/ definition resource - Provide opportunity for self-assessment

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