Software Engineering Stage 6 (Year 11) – sample program of learning

Programming mechatronics

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# Rationale

The NSW Department of Education publishes a range of curriculum support materials, including samples of lesson sequences, scope and sequences, assessment tasks, examinations, student and teacher resource booklets, and curriculum planning and curriculum evaluation templates. The samples are not exhaustive and do not represent the only way to complete or engage in each of these processes. Curriculum design and implementation is a dynamic and contextually specific process. While the mandatory components of syllabus implementation must be met by all schools, it is important that the approach taken by teachers is reflective of their needs and faculty/school processes.

NESA defines [programming](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming) as the process of ‘selecting and sequencing learning experiences which enable students to engage with syllabus outcomes and develop subject specific skills and knowledge’ (NESA 2022). A program is developed collaboratively within a faculty. It differs from a unit in important ways, as outlined by NESA on their [advice on units](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/programming/advice-on-units) page. A unit is a contextually specific plan for the intended teaching and learning for a particular class for a particular period. The organisation of the content in a unit is flexible and it may vary according to the school, the teacher, the class, and the learning space. They should be working documents that reflect the thoughtful planning and reflection that takes place during the teaching and learning cycle. There are mandatory components of programming and unit development, and this template provides one option for the delivery of these requirements. The NESA and department guidelines that have influenced this template are elaborated upon at the end of the document.

This resource has been developed to assist teachers in NSW Department of Education schools to create learning that is contextualised to their classroom. It can be used as a basis for the teacher’s own program, assessment, or scope and sequence, or be used as an example of how the new curriculum could be implemented. The resource has suggested timeframes that may need to be adjusted by the teacher to meet the needs of their students.

# Overview

**Description**: this sample program of learning addresses the syllabus content area Programming mechatronics. The lessons and sequences in this program of learning are designed to allow students to develop the knowledge and skills to create working mechatronic systems using microcontrollers.

During Weeks 1 to 3 of the learning sequence, students will gain an understanding of a range of hardware used to build mechatronic systems. Students will explore a range of microcontroller boards, sensors, actuators, and end effectors. To gain experience connecting, coding, and accessing working with data from sensors and actuators, students will simulate simple circuits and apply code to physical circuits.

During Weeks 4 and 5 of the learning sequence, students will experiment with code to control combinations of subsystems. Students gain experience implementing a small mechatronic game using procedural paradigm code samples. Students will combine their knowledge of mechatronics with object-orientation to create, design, document, and code a similar game using a different programming paradigm.

An assessment task combining object-oriented programming with introductory mechatronics may be completed at this time. The assessment task asks students to use OOP principles to code an interface to sensors and actuators for a simple game.

During Week 6 of the learning sequence, students will investigate mechatronic control algorithms. Students will modify the logic of an existing system to convert it to a single player game. Students will explore a range of different algorithmic patterns used in mechatronic control systems including different open loop and closed loop algorithms.

During Weeks 7 to 10 of the learning sequence, students will develop a range of skills by creating, coding, and enhancing 2 mechatronic projects. Students will implement and modify code to develop and test a closed loop system and an open loop mechatronic system.

**Duration**: this program of learning is designed to be completed over a period of approximately 10 weeks in 60-minute lesson sequences but can be adapted to suit the school context.

**Explicit teaching**: suggested learning intentions and success criteria are available for some lessons provided. Learning intentions and success criteria are most effective when they are contextualised to meet the needs of students in the class. The examples provided in this document are generalised to demonstrate how learning intentions and success criteria could be created.

# Outcomes

A student:

* describes methods used to plan, develop, and engineer software solutions **SE-11-01**
* explains how structural elements are used to develop programming code **SE-11-02**
* describes how current hardware, software and emerging technologies influence the development of software engineering solutions **SE-11-03**
* applies tools and resources to design, develop, manage, and evaluate software **SE-11-06**
* implements safe and secure programming solutions **SE-11-07**
* applies language structures to refine code **SE-11-08**
* manages and documents the development of a software project **SE-11-09**

[Software Engineering 11–12 Syllabus](https://curriculum.nsw.edu.au/learning-areas/tas/software-engineering-11-12-2022/overview) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2022.

**Prior to planning for teaching and learning, please consider the following:**

**Engagement**

* How will I provide authentic, relevant learning opportunities for students to personally connect with lesson content?
* How will I support every student to grow in independence, confidence, and self-regulation?
* How will I facilitate every student to have high expectations for themselves?
* How will I identify and provide the support each student needs to sustain their learning efforts?

**Representation**

* What are some different ways I can present content to enable every student to access and understand it?
* How will I identify and address language and/or cultural considerations that may limit access to content for students?
* How will I make lesson content and learning materials more accessible?
* How will I plan learning experiences that are relevant and challenging for the full range of students in the classroom?

**Expression**

* How will I provide multiple ways for students to respond and express what they know?
* What tools and resources can students use to demonstrate their understanding?
* How will I know every student has understood the concepts and language presented in each lesson?
* How will I monitor if every student has achieved the learning outcomes and learning growth?

# Lesson sequence and details

## Week 1 – microcontrollers

Table 1 – lesson sequence and details

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcomes and content | Teaching and learning activities | Evidence of learning | Differentiation/ adjustments | Registration and evaluation notes |
| **Outcomes**  **SE-11-01**  **SE-11-03**  **Content**  Students:   * outline applications of mechatronic systems in a variety of specialised fields * identify the hardware requirements to run a program and the effect on code development including assessing the relationship of microcontrollers and the central processing unit (CPU), the influence of instruction set and opcodes, and the use of address and data registers | **Learning intention**  Understand the nature of microcontroller applications and the interrelationship of microcontroller hardware and software.  **Success criteria**  I can:   * describe how mechatronic applications are used in different industries * explore a range of different types of microcontrollers * recognise a method used to program an available microcontroller * understand the relationship between the microcontroller, microprocessor, instruction set and format.   **Teaching and learning activities**  **Activity 1**: as a class, students watch [describing mechatronic systems (2:45).](https://www.linkedin.com/learning/top-10-skills-for-robotics-engineers/mechatronics) Teacher leads discussion on applications of mechatronic systems and students complete question and table.  **Activity 2**: microcontroller boards  Students research a range of microcontroller boards and check requirements for running code on microcontrollers available at school.  **Activity 3**: comparing microprocessors and microcontrollers  Students differentiate between microcontrollers and microprocessors.  **Activity 4**: programming a microprocessor  Students research machine code and assembly language and apply this to understanding assembly code for a given microprocessor.  **Activity 5**: Arduino Uno registers  Students research processor registers and experiment with code in a simulator to control signals on an Arduino Uno. | Students can identify a range of applications of mechatronics systems in different fields.  Students demonstrate understanding on the nature of mechatronic systems including hardware and software via contributions to class activities, demonstrations, and discussions.  Students’ complete activities 1–5 from the Teacher Support Resource (TSR).  Students contribute to discussions and respond correctly to pop quiz reviews of previous lessons work. | Suggested adjusted activities. This section is also for use in school when adjusting support all students to achieve in their learning.  Prompt student discussion with real-world scenarios and examples.  Include multiple opportunities to respond, for example:   * verbally * individually * partners turn and talk * non-verbally * gesture * response cards.   **Extension**:  Students develop a metaphor or roleplay to explain the difference between a microcontroller and a microprocessor.  Students justify the selection and use of one microcontroller board over another for a given scenario.  [Students revise](https://education.nsw.gov.au/teaching-and-learning/curriculum/tas/tas-curriculum-resources-7-12/tas-7-10-curriculum-resources/crack-the-code) the meaning of bits and bytes to appreciate differences between 8-bit and 32-bit registers. |  |

## Week 2 – sensors, actuators, and end-effectors

Table 2 – lesson sequence and details

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcomes and content | Teaching and learning activities | Evidence of learning | Differentiation/ adjustments | Registration and evaluation notes |
| **Outcomes**  **SE-11-02**  **SE-11-03**  **Content**  Students:   * identify and describe a range of sensors, actuators and end effectors/manipulators within existing mechatronic systems including motion sensors, light level sensors, hydraulic actuators, and robotic grippers | **Learning intention**  Understand the nature of a range of sensors, actuators, and end-effectors.  **Success criteria**  I can:   * describe and differentiate between different input and output devices in existing systems * describe and explore the operation of a range of sensors, actuators, and end effectors * understand how a variety of sensors can be used to perform similar logical tasks.   **Teaching and learning activities**  **Activity 6**: sensors and actuators  As a class watch a video describing [sensors and actuators (2:35)](https://www.linkedin.com/learning/top-10-skills-for-robotics-engineers/familiarity-with-sensors-and-actuators).  Teacher leads discussion on examples of sensors and actuators.  Students split into small groups to choose a project from a given list to study.  **Activity 7**: sensors in mechatronic systems  As a class, watch [Sensors explained (8:52)](https://www.youtube.com/watch?v=gizihSJ63o4). Students brainstorm and record potential uses of sensors.  As a class, watch [Motion sensors (1:45)](https://www.youtube.com/watch?v=SJDE36an3xk) and discuss ideas for their use in a mechatronic system.  **Activity 8**: motion sensing with a passive infra-red sensor  Students use simulation to investigate PIR sensor operation.  **Activity 9**: accelerometer axes  As a class, watch [Accelerometer on micro:bit (5:48)](https://www.youtube.com/watch?v=byngcwjO51U).  Teacher-led class discussion on ways accelerometers can be used.  **Activity 10**: motion sensing with gyroscope  Students use online simulation and extend code to detect movement in different axes.  **Activity 11**: ultrasonic distance sensor simulation  Students watch [Ultrasonic Distance Sensor (1:00)](https://www.youtube.com/shorts/O5l7IOmnD2Q).  Students use online simulator and investigate relationship of supplied code to system behaviour.  **Activity 12**: light level sensing simulation  Students use online simulations, adding in provided code to monitor analog values received by microcontroller pins.  **Activity 13**: actuators and end effectors  Students brainstorm ways to use end effectors available in their school.  **Activity 14**: rotary and linear actuator research  Students interact with a servo control simulation and brainstorm possible uses for different types of rotary and linear actuators in mechatronic systems.  **Activity 15**: hydraulics research  Students research and explain the design and operation of hydraulic and pneumatic actuators.  **Activity 16**: grippers and end effectors  Students research, classify and describe a range of gripper types. Students optionally assemble a 3D-printed gripper.  **Activity 17**: input/output revision  Students classify different transducers, sensors, actuators and end effectors as input or output devices. | Student can identify and describe a range of sensors, actuators, and end effectors.  Students can describe a range of methods for detecting motion using different sensors.  Students complete and participate in **Activities 6–17** of the TSR.  Students contribute to discussions and respond correctly to pop quiz reviews of previous lessons’ work.  Students add, edit and debug code in online mechatronic simulations to achieve desired effects.  Students construct and code simple physical mechatronic circuits.  Students run and debug code and share their solutions with the class. | Teachers employ the PRIMM strategy in teaching coding:  Predict what the code will do, Run the code, Investigate how the code works, Modify the code to do something else or differently, and Make your own code to produce a different outcome or function.  Students are encouraged to test and play with these simulations.  Teachers may use paired programming to assist with peer tutoring and helping students who are less experienced.  Students could also view videos for homework as a flipped classroom strategy to free class time.  **Extensions**: students research and submit their own mechatronic videos.  **Activities 6–17** of the TSR could be delivered as [jigsaw activities](https://app.education.nsw.gov.au/digital-learning-selector/) where small groups of students attempt each activity to develop expertise and share findings with students rotating between groups.  Extension activities could include deeper investigation of the physical sciences that underpin each of these devices including developing metaphors and models for how each works. Students may have experience and background knowledge from science and STEM lessons on the workings of sensors and actuators which could provide foundations for these lessons and discussions. |  |

## Week 3 – using devices with differing data types

Table 3 – lesson sequence and details

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcomes and content | Teaching and learning activities | Evidence of learning | Differentiation/ adjustments | Registration and evaluation notes |
| **Outcomes**  **SE-11-02**  **SE-11-04**  **SE-11-05**  **Content**  Students:   * use different types of data and understand how it is obtained and processed in a mechatronic system, including diagnostic data and data used for optimisation | **Learning intention**  Understand how sensors and actuators with different data types can be used with a microcontroller.  **Success criteria**  I can:   * understand the use of a range of sensors and actuators with differing data types * use code to process data * simulate small mechatronic circuits showing system data * build and program small mechatronic circuits.   **Teaching and learning activities**  As a class, watch a video on connecting [I/O devices and peripherals (3:01)](https://www.linkedin.com/learning/iot-foundations-operating-systems-fundamentals/i-o-devices-and-peripherals?contextUrn=urn%3Ali%3AlearningCollection%3A7140549818396880896&u=74950778) to microcontrollers. Teacher leads discussion on types of data used and how analog and digital data differ.  Students watch [Understanding analog to digital converters (1:50)](https://www.linkedin.com/learning/learning-arduino-interfacing-with-analog-devices/understanding-analog-to-digital-converters?contextUrn=urn%3Ali%3AlearningCollection%3A7140549818396880896&standalone=true&u=74950778) and then work in small groups to complete the following activities.  **Activity 18**: collecting analog sensor data  Students add provided code to an online simulation and monitor the serial output.  Students identify parts of code and .investigate sampling of analog voltages.  Students construct a matching physical circuit.  **Activity 19**: collecting digital sensor data  Students add code to an online simulation to investigate the collection of single-bit binary data. Students construct a matching physical circuit.  **Activity 20**: I2C protocol research  Students research the I2C protocol and use it in an online simulation to collect and monitor multi-bit binary data.  **Activity 21**: analog (PWM) LED control  Students create code to add to an online simulation of ‘analog’ (PWM) control of a light emitting diode. Students construct a matching physical circuit.  **Activity 22**: motor control simulation  Students use provided pseudocode to control a DC motor more smoothly in an online simulation.  **Activity 23**: servo control  Students use an online simulation to investigate the use of pulse-width modulated signals in controlling servos.  Students construct a matching physical circuit.  **Activity 24**: digital LED control  Students research command to set pin mode and use this to help code a LED to turn on and off in an online simulation.  Students construct a matching physical circuit.  **Activity 25**: LCD simulation using I2C  Students add code to an online simulation to test sending data to an I2C device. | Students can describe the collection and sending of data between a microcontroller and a connected device.  Students add, edit and debug code in online mechatronic simulations to achieve desired effects.  Students construct and code simple physical mechatronic circuits.  Students complete and participate in **Activities 18–25** of the TSR.  Students contribute to discussions and respond correctly to pop quiz reviews of previous lessons’ work | Teachers employ the PRIMM strategy in teaching coding:  Predict what the code will do, Run the code, Investigate how the code works, Modify the code to do something else or differently, and Make your own code to produce a different outcome or function.  Students are encouraged to test and play with these simulations. |  |

## Week 4 – assessment task – mechatronic control using OOP

Table 4 – lesson sequence and details

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcomes and content | Teaching and learning activities | Evidence of learning | Differentiation/ adjustments | Registration and evaluation notes |
| **Outcomes**  **SE-11-06**  **SE-11-08**  **Content**  Students:   * experiment with software to control interactions and dependencies within mechatronic systems including motion constraints, degrees of freedom and combination of subsystems. | **Learning intention**  Describe and control movement in a mechatronic system with more than one degree of freedom.  **Success criteria**  I can:   * describe movement in mechatronic systems * use code to control movement of components for a small mechatronic game.   **Teaching and learning activities**  **Activity 26**: constrained motion systems  Students watch a series of videos to help understand how motion constraints affect mechatronic systems.  Students answer questions to show understanding.  **Activity 27**: investigate servo motion constraints  Students use and modify an online simulation to determine how pulse widths affect servo rotation.  Students construct a matching physical circuit adapting provided pseudocode to control a servo with a potentiometer.  **Activity 28**: degrees of freedom research  Students research degrees of freedom and answer questions.  **Activity 29**: combine sensors and servos  Students begin construction and coding of a small game following conceptual steps and online simulation provided.  **Activity 30**: complete sensor and servo game  Students complete construction and coding of game following conceptual steps and online simulation provided. | Students can describe the relationship between microcontroller, program code and servo behaviour.  Students experiment with code in online simulations to monitor mechatronic system behaviours.  Students experiment with code in a physical system to control the rotation of servos using potentiometers.  Students complete **Activities 26–30** of the TSR. |  |  |

## Week 5 – assessment task – mechatronic control using OOP

Table 5 – lesson sequence and details

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcomes and content | Teaching and learning activities | Evidence of learning | Differentiation/ adjustments | Registration and evaluation notes |
| **Outcomes**  **SE-11-05**  **SE-11-06**  **SE-11-07**  **SE-11-08**  **SE-11-09**  **Content**  Students:   * experiment with software to control interactions and dependencies within mechatronic systems including combination of sensors, actuators, and end effectors to create viable sub-systems * determine power, battery, and material requirements for components of a mechatronic system * develop wiring diagrams for a mechatronic system, considering data and power supply requirements * determine specialist requirements that influence the design and functions of mechatronic systems designed for people with disability. | **Learning intention**  Control dependencies in a mechatronic system with code. Understand requirements for a mechatronic system.  **Success criteria**  I can:   * complete the build and code for a small mechatronic game * determine and document requirements of a mechatronic system.   **Teaching and learning activities**  **Activity 31**: develop component specifications for sensor and servo game  Students find current requirements of all game components to determine total required battery capacity in mAh.  **Activity 32**: wiring diagrams  Students record purpose and circuit diagram symbols for standard components.  Students complete a provided wiring diagram and create a wiring diagram of their sensor and servo game.  **Activity 33**: specialist requirements in mechatronic design  Students watch video of a refreshable braille system to determine specialist requirements for people with a visual disability.  Students brainstorm and record ideas for inclusive adjustments to sensor and servo game for a specific type of disability. | Students can describe and calculate the power requirements of mechatronic devices or systems.  Students can use code to combine the operation of potentiometers and servos into a single mechatronic system.  Students can identify symbols on wiring diagrams for a range of electronic components.  Students can complete or create wiring diagrams using appropriate symbols for a mechatronic system.  Students can identify specialist requirements that influence the design and functions of mechatronic systems designed for people with a disability.  Students complete **Activities 30–33** of the TSR. |  |  |

## Week 6 – designing control algorithms

Table 6 – lesson sequence and details

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcomes and content | Teaching and learning activities | Evidence of learning | Differentiation/ adjustments | Registration and evaluation notes |
| **Outcomes**  **SE-11-01**  **SE-11-03**  **SE-11-09**  **Content**  Students:   * develop, modify, and apply algorithms to control a mechatronic system * explore the algorithmic patterns, code, and applications for open and closed control systems * outline the features of an algorithm and program code used for autonomous control. | **Learning intention**  Illustrate how different types of logic can be used to control mechatronic systems.  **Success criteria**  I can:   * design extended logic to control a more complex mechatronic system * understand how open and closed loop control can be used for autonomous systems.   **Teaching and learning activities**  As a class, watch a video showing motion with differing [control of a line following robot](https://youtu.be/t3R9cPq1aYk) (3:15). Teacher leads discussion on possible reasons for different behaviours exhibited from the different control algorithms used.  **Activity 34**: control algorithms  Students answer questions and complete a given structure chart relating to a line following robot.  **Activity 35**: modify sensor and servo game code  Students modify code from sensor and servo game to automate the avoidance of light.  **Activity 36**: open and closed loop control system research  Students watch a video and read information on open and closed loop systems.  Students diagrammatically represent open loop and closed loop control, answer questions and classify common systems as open or closed loop.  **Activity 37**: autonomous control algorithm research  Students research on/off, proportional and PID control and answer related questions. | Students can verbalise or diagrammatically represent the design of control algorithms.  Students can identify or predict differences in system behaviours based on the type of control algorithm used.  Students can describe features of on/off, proportional and PID control algorithms and system behaviours.  Students complete **Activities 34–37** of the TSR. |  |  |

## Weeks 7 and 8 – programming and building 1 – robotic arm

Table 7 – lesson sequence and details

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcomes and content | Teaching and learning activities | Evidence of learning | Differentiation/ adjustments | Registration and evaluation notes |
| **Outcomes**  **SE-11-06**  **SE-11-07**  **SE-11-08**  **SE-11-09**  **Content**  Students:   * design, develop and produce a mechatronic system for a real-world problem including software control, mechanical engineering, and electronics and mathematics * implement algorithms and design programming code to drive mechatronic devices * develop simulations and prototypes of a potential mechatronic system to test programming code * apply programming code to integrate sensors, actuators, and end effectors/manipulators * implement specific control algorithms that enhance the performance of a mechatronic system * design, develop and implement a user interface (UI) to control a mechatronic system * create and use unit tests to determine the effectiveness and repeatability of each component’s control algorithm. | **Learning intention**  Use a range of skills and tools to design, implement, test, and enhance an open loop robotic arm system.  **Success criteria**  I can:   * design, implement and enhance an open loop control algorithm * build and code an open loop robotic arm system.   **Teaching and learning activities**  As a class, watch [the 2 coolest robots in Tesla’s factory (1:24)](https://www.youtube.com/watch?v=WYnOGAvQEgk). Discuss and list the common features of articulated robotic arms.  Teacher introduces guided activity to build a user-programmable articulating robotic arm.  Students follow steps in guided activity to build and test user-programmable articulating robotic arm.  Students record code and answers to questions as they progress through the guided activity. | Students can follow guided activity to simulate, create and code a user-programmable articulated robotic arm. |  |  |

## Weeks 9 and 10 – programming and building 2 – self-balancing ball

Table 8 – lesson sequence and details

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcomes and content | Teaching and learning activities | Evidence of learning | Differentiation/ adjustments | Registration and evaluation notes |
| **Outcomes**  **SE-11-06**  **SE-11-07**  **SE-11-08**  **SE-11-09**  **Content**  Students:   * design, develop and produce a mechatronic system for a real-world problem including software control, mechanical engineering, and electronics and mathematics * implement algorithms and design programming code to drive mechatronic devices * develop simulations and prototypes of a potential mechatronic system to test programming code * design, develop and implement programming code for a closed loop control system * apply programming code to integrate sensors, actuators, and end effectors/manipulators * implement specific control algorithms that enhance the performance of a mechatronic system * design, develop and implement a user interface (UI) to control a mechatronic system * create and use unit tests to determine the effectiveness and repeatability of each component’s control algorithm. | **Learning intention**  Use a range of skills to design, implement, test, and enhance a closed loop self-balancing ball system.  **Success criteria**  I can:   * design, implement and enhance a closed loop PID control algorithm * build and code a closed loop self-balancing ball system.   **Teaching and learning activity**  As a class, watch a short video showing a [balancing ball on beam (0:53)](https://www.youtube.com/watch?v=tUDcpdTnhn4).  Teacher introduces guided activity to make a closed loop system to balance a ball on a moving beam.  Students follow steps in guided activity to build and test closed loop balance beam system.  Students record code and answers to questions as they progress through the guided activity. | Students can follow guided activity to simulate, create and code a self-stabilising ball balancing beam system.  Students demonstrate an iterative process of experimentation and enquiry by testing and retesting their balancing system and adjusting code. | Students should attempt to physically balance a ruler, broom, ball or stick to develop an awareness of the forces operating and the skills and techniques needed to balance the object.  Students speculate on any human action or activity that could not be replicated using a mechatronic or robotic device.  This could be delivered as a class discussion using Think-Pair-Share. |  |

# Additional information

For additional support or advice, contact the TAS curriculum team by emailing [TAS@det.nsw.edu.au](mailto:TAS@det.nsw.edu.au).

## Further implementation support

Curriculum design and implementation is a dynamic and contextually specific process. The department is committed to supporting teachers to meet the needs of all students. The advice below on assessment and planning for the needs of every student may be useful when considering the material presented in this sample program of learning.

## Assessment for learning

Possible formative assessment strategies that could be included:

* Learning intentions and success criteria assist educators to articulate the purpose of a learning task to make judgements about the quality of student learning. These help students focus on the task or activity taking place and what they are learning and provide a framework for reflection and feedback. [Online tools](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/622) can assist implementation of this formative assessment strategy.
* Eliciting evidence strategies allow teachers to determine the next steps in learning and assist teachers in evaluating the impact of teaching and learning activities. Strategies that may be added to a learning sequence to elicit evidence include all student response systems, [exit tickets](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/543), mini whiteboards (actual or [digital](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/575)), [hinge questions](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/560), [Kahoot](https://app.education.nsw.gov.au/digital-learning-selector/LearningTool/Card/621), [Socrative](https://app.education.nsw.gov.au/digital-learning-selector/LearningTool/Card/587), or quick quizzes to ensure that individual student progress can be monitored and the lesson sequence adjusted based on formative data collected.
* Feedback is designed to close the gap between current and desired performance by informing teacher and student behaviour (AITSL 2017). AITSL provides a [factsheet to support evidence-based feedback](https://www.aitsl.edu.au/teach/improve-practice/feedback#:~:text=FEEDBACK-,Factsheet,-A%20quick%20guide).
* [Peer feedback](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/549) is a structured process where students evaluate the work of their peers by providing valuable feedback in relation to learning intentions and success criteria. It can be supported by [online tools](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Browser?cache_id=1d29b).
* Self-regulated learning opportunities assist students in taking ownership of their own learning. A variety of strategies can be employed and some examples include reflection tasks, [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645), [KWLH charts](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/562), [learning portfolios](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/583) and [learning logs](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/583).

The primary role of assessment is to establish where individuals are in their learning so that teaching can be differentiated and further learning progress can be monitored over time.

Feedback that focuses on improving tasks, processes and student self-regulation is the most effective. Students engaging with feedback can take many forms including formal, informal, formative, summative, interactive, demonstrable, visual, written, verbal and non-verbal (CESE 2020a).

## Differentiation

Differentiated learning can be enabled by differentiating the teaching approach to content, process, product, and the learning environment. For more information on differentiation go to [Differentiating learning](https://education.nsw.gov.au/teaching-and-learning/professional-learning/teacher-quality-and-accreditation/strong-start-great-teachers/refining-practice/differentiating-learning) and [Differentiation](https://education.nsw.gov.au/campaigns/inclusive-practice-hub/primary-school/teaching-strategies/differentiation).

When using these resources in the classroom, it is important for teachers to consider the needs of all students in their class, including:

* **Aboriginal and Torres Strait Islander students**. Targeted [strategies](https://education.nsw.gov.au/teaching-and-learning/aec/aboriginal-education-in-nsw-public-schools) can be used to achieve outcomes for Aboriginal students in K–12 and increase knowledge and understanding of Aboriginal histories and cultures. Teachers should utilise students’ Personalised Learning Pathways to support individual student needs and goals.
* **EAL/D learners**. EAL/D learners will require explicit English language support and scaffolding, informed by the [EAL/D enhanced teaching and learning cycle](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/resources-for-schools/eald/enhanced-teaching-and-learning-cycle) and the student’s phase on the [EAL/D Learning Progression](https://education.nsw.gov.au/teaching-and-learning/curriculum/multicultural-education/english-as-an-additional-language-or-dialect/planning-eald-support/english-language-proficiency). In addition, teachers can access information about [supporting EAL/D learners](https://education.nsw.gov.au/teaching-and-learning/curriculum/multicultural-education/english-as-an-additional-language-or-dialect/planning-eald-support/english-language-proficiency) and [literacy and numeracy support specific to EAL/D learners](https://education.nsw.gov.au/teaching-and-learning/curriculum/literacy-and-numeracy/resources-for-schools/eald).
* **Students with additional learning needs**. Learning adjustments enable students with disability and additional learning and support needs to access syllabus outcomes and content on the same basis as their peers. Teachers can use a range of [adjustments](https://education.nsw.gov.au/teaching-and-learning/disability-learning-and-support/personalised-support-for-learning/adjustments-to-teaching-and-learning) to ensure a personalised approach to student learning. Subject specific curriculum considerations can be found on the [Inclusive Practice hub](https://education.nsw.gov.au/campaigns/inclusive-practice-hub).
* **High potential and gifted learners**. [Assessing and identifying high potential and gifted learners](https://education.nsw.gov.au/teaching-and-learning/high-potential-and-gifted-education/supporting-educators/assess-and-identify#Assessment1) will help teachers decide which students may benefit from extension and additional challenge. [Effective strategies and contributors to achievement](https://education.nsw.gov.au/teaching-and-learning/high-potential-and-gifted-education/supporting-educators/evaluate) for high potential and gifted learners help teachers to identify and target areas for growth and improvement. In addition, the [Differentiation Adjustment Tool](https://education.nsw.gov.au/teaching-and-learning/high-potential-and-gifted-education/supporting-educators/implement/differentiation-adjustment-strategies) can be used to support the specific learning needs of high potential and gifted students. The [High Potential and Gifted Education Professional Learning and Resource Hub](https://schoolsnsw.sharepoint.com/sites/HPGEHub/SitePages/Home.aspx) supports school leaders and teachers to effectively implement the High Potential and Gifted Education Policy in their unique contexts.

All students need to be challenged and engaged to develop their potential fully. A culture of high expectations needs to be supported by strategies that both challenge and support student learning needs, such as through appropriate curriculum differentiation (CESE 2020a:6).

## Support and alignment

**Resource evaluation and support**: all curriculum resources are prepared through a rigorous process. Resources are periodically reviewed as part of our ongoing evaluation plan to ensure currency, relevance, and effectiveness. For additional support or advice contact the TAS curriculum team by emailing [TAS@det.nsw.edu.au](mailto:TAS@det.nsw.edu.au).

**Alignment to system priorities and/or needs**: [School Excellence Policy](https://education.nsw.gov.au/policy-library/policies/pd-2016-0468)

**Alignment to the School Excellence Framework**: this resource supports the [School Excellence Framework](https://education.nsw.gov.au/teaching-and-learning/school-excellence-and-accountability/sef-evidence-guide/resources/about-sef) elements of curriculum (curriculum provision) and effective classroom practice (lesson planning, explicit teaching).

**Alignment to Australian Professional Teaching Standards**: this resource supports teachers to address [Australian Professional Teaching Standards](https://educationstandards.nsw.edu.au/wps/portal/nesa/teacher-accreditation/meeting-requirements/the-standards/proficient-teacher) 3.2.2, 3.3.2.

**Consulted with**: Curriculum and Reform and subject matter experts

**NSW syllabus**: Software Engineering 11–12

**Syllabus outcomes**: SE-11-01, SE-11-02, SE-11-03, SE-11-06, SE-11-07, SE-11-08, SE-11-09

**Author**: TAS curriculum team, Curriculum Secondary Learners

**Publisher**: State of NSW, Department of Education

**Resource**: Program of learning

**Related resources**: further resources to support Software Engineering 11–12 can be found on the [TAS curriculum page](https://education.nsw.gov.au/teaching-and-learning/curriculum/tas).

**Professional learning**: relevant professional learning is available through [HSC Professional Learning](https://education.nsw.gov.au/teaching-and-learning/professional-learning/hsc-pl) or in the TAS statewide staffroom.

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# Evidence base

[Software Engineering 11–12 Syllabus](https://curriculum.nsw.edu.au/learning-areas/tas/software-engineering-11-12-2022/overview) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2022.

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