

THE

STEMCrAfT PROJECT

SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS

The STEM Framework Kit



Australian Government
Department of Education

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About this document

This document has two sections:

- Section 1: The STEM Framework Guidelines, and
- Section 2: The STEM Framework

Together they make the STEM Framework Kit.

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The STEM Framework Guidelines

Introduction

The STEMCrAFT project has been funded through the Australian Department of Education, Australian Maths and Science Partnerships Program (AMSPP) and is managed by the University of Tasmania (UTAS).

The aim of the project is to build capacity for STEM (Science, Technology, Engineering and Mathematics) teachers using a peer support model and the Framework is the tool designed by STEM teachers to achieve this.

For the Framework to be a useful tool, now and into the future, it needs to be continuously evaluated by teachers of STEM as well as those working in the discipline of STEM and STEM teacher education.

The purpose of these guidelines is to provide information on how to apply the Framework and how to contribute to its evaluation.

Principles underpinning the Framework

The thinking underpinning the development of the Framework is that of reflective (Schon D, 1983) *reflection on, in and for practice*. The design of the Framework aims to application is to make pedagogical content knowledge (PCK) visible (Shulman, 1986); to do this, the process of applying the Framework should be documented.

What the STEM Framework is about

The STEM Framework is a decision making tool designed to assist with the selection of STEM resources. It assists in the consideration of the capacity and needs of a particular student group (early years through to secondary school) and the resources available in particular teaching contexts. It was designed by STEM teachers for use by STEM teachers, irrespective of level of experience.

Where the STEM Framework came from

The STEM Framework is the result of a series of workshops hosted by the UTAS Faculty of Education and Centre for University Pathways and Programs (CUPP) for rural and regional STEM teachers.

To construct the Framework, expert and less experienced STEM teachers, university academics and industry experts, worked together to identify the processes undertaken when selecting STEM resources appropriate to particular student groups in particular learning and teaching contexts.

Why the STEM Framework might be useful

The aim of the Framework is to assist teachers working with students on STEM curriculum. It can be used by expert STEM teachers mentoring less experienced STEM teachers, or by STEM teacher teams or by individual teachers (less experience or expert) alone. It is designed to help teachers focus, reflect and plan at all stages of the learning and teaching process:

- Planning
- Implementing, and

- Evaluating

Whilst STEM teachers with many years' experience have contributed to the Framework's development, it has been tested by less experienced STEM teachers to make it adaptable to their particular circumstances. The project team is interested in the ongoing validation and enhancement of the Framework by teachers of STEM from around Australia. The feedback received is utilised for the ongoing development of the Framework and thence shared via the project website. In this way it will truly represent a peer supported and developed tool, adaptable to the many teaching environments experienced by rural and regional teachers of STEM.

When and how to use the Framework

The Framework has been designed to be used by a range of people ([see page 9](#)) and to be adaptable to a variety of educational circumstances, many of which are listed on [page 10](#) of this Kit.

Instructions for anyone wishing to trial the Framework (including mentors where appropriate) follow ([see page 6](#)).

Evaluation of the Framework

The Framework has been conceived of as an iterative tool to be improved upon as it is used. In order to achieve this, the collaboration between STEM teachers is facilitated by the STEMCrAft Community of Practice (see below). Feedback can be provided by participating in online forums, discussions and postings on the [website](#).

For the Framework to also contribute to our understanding of its usefulness, a research project operating in parallel to implementation of the Framework has been initiated. Information on how you might contribute to the research project follows.

If you decide to use the STEM Framework to critique the STEM resources, under consideration, the project team would appreciate your feedback through both of these channels.

The STEMCrAft Community of Practice

As mentioned, in addition to the development of the Framework, the project team have also commenced the development of an online community of practice (CoP). As a key focus of this project is assisting teachers working in rural and regional Australia, online resources offer a practical way to stay informed, meet with peers and continue to develop professionally.

What is a Community of Practice?

A community of practice is a group of people informally bound together by shared expertise and passion for a joint enterprise, for example, a group who share a craft and/or a profession (Lave & Wenger, 1991; Etienne Wenger, 1998; Etienne Wenger, McDermott, & Snyder, 2002).

The group can evolve naturally because of the members' common interest in a particular domain or area, or it can be created specifically with the goal of gaining knowledge related to their field. It is through the process of sharing information and experiences with the group that the members learn from each other, and have an opportunity to develop themselves personally and professionally.

CoPs can exist in real life, such as in a lunch room at work, in a field setting, on a factory floor, or online. They are not new phenomena: this type of learning practice has existed for as long as people have been learning and sharing their experiences through storytelling.

One of the advantages of today's technology era is that it can facilitate people coming together. In particular it diminishes the "tyranny of distance" for people working and living in rural and regional Australia. Today's technology can facilitate communities of practice through virtual meeting or community spaces.

The role of the STEMCrAFT Community of Practice

Why would a community of practice be useful in our project? For a start, it turns the conversations we have into collaborations. It reduces our isolation and allows for the sharing of knowledge, experience and resources.

The role of the STEMCrAFT CoP is to provide an online community for people working in STEM teaching and learning, and where they can engage with each other, seek advice, offer expertise and exchange ideas concerning the teaching of STEM, how to do it better, smarter, differently.

You can use the CoP to:

- To provide an informal peer to peer learning environment, and
- To contribute to the evaluation of the practical application of the STEM Framework.

Research informing practice

The STEMCrAFT research project has three main objectives; these are to:

1. Provide a framework by which teachers can select STEM teaching resources (human expertise, online or material) that are best suited to their needs and context;
2. Raise the confidence and resilience of teachers in rural and regional schools in relation to maths/science knowledge and its application;
3. Assist teachers to inspire rural and regional students and improve their achievements in maths/science and inclination to continue its study beyond

Contributing to the project's research

Please consider contributing to the research through trialing the Framework and recording the processes you have undertaken whilst doing so. If you decide to participate in the research component of the STEM Framework, you will need to read the Information Sheet and give written consent (both documents are included in this kit), or you can complete this documentation on our website.

To assist in the project's collection of data, forms for mentors and participants are provided. Please complete and return these either by email to the STEMCrAFT Project Officer or mail to

The STEMCrAFT Project
University of Tasmania
Locked Bag 1354

Using the Framework

It is anticipated that the STEM Framework will be implemented by individuals alone and/or via a collaboration of more experienced and less experienced STEM.

The STEM Framework should be usable by all those involved in STEM education, whether they are experienced, less experienced STEM or non-teaching support staff. Follow this link for a [list of people](#) who could consider using the STEM Framework.

Whether you are a less experienced / teaching out of area STEM teacher or an experienced teacher of STEM mentoring someone with less experience, this section provides information on how to use the Framework and provide your feedback.

Mentoring a less experienced teacher of STEM

Process for the mentor

To apply the STEM Framework to resource selection, it will be useful to undertake the following:

1. Obtain a copy of the STEM Framework to work with (electronic or hard copy). It is electronically available at the [STEM Framework](#), or you can print off a copy from the end of this document.
2. Familiarise yourself with the contents of this kit and the Framework. If you have any questions you can contact the [project staff](#) or the STEMCrAft [Community of Practice](#) for assistance.
3. Think about who might benefit from using the STEM Framework and approach them about participating as a mentee.
4. The Framework asks a series of questions that require time for reflection; ensure you can each set time aside for this process
5. When you are familiar with the Framework and the project, meet with the mentee and discuss the purpose of the Framework with them. Introduce them to the [Community of Practice](#) where they can get assistance, advice and share their experiences with their peers.
6. Set up a meeting schedule to check on how they are progressing.
7. Be there for them when they need assistance or advice.
8. Encourage them to set a deadline for completion.

Process for the less experienced /out of area STEM teacher

To apply the STEM Framework to resource selection, give consideration to the following:

1. Obtain a copy of the STEM Framework to work with (electronic or hard copy). It is electronically available at the [STEM Framework](#), or you can print off a copy from the end of this document.
2. Familiarise yourself with the contents of this kit and the Framework. If you have any questions and you have a Mentor contact them. Or you can contact the [project staff](#) or the STEMCrAft [Community of Practice](#) for assistance.
3. The Framework asks a series of questions that require time for reflection. Make time to discuss your use of the Framework with colleagues in your school or via the [Community of Practice](#) and make sure to set aside sufficient time to work through this process.
4. Use the [Community of Practice](#) to get assistance, advice and share your experiences with your peers.

5. Set up a schedule including a deadline in order to monitor your progress.

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Project Team contact details

The project leaders are:

Sharon Fraser

Kim Beswick

Sue Kilpatrick

The Project Officer is Suzanne Crowley, and the Project Support Officer is Melissa Verschuren.

If you have any queries relating to the draft STEM Framework or the StemCrAft Project more generally, or you want to return your feedback, you can do so as follows:

STEMCrAft Project
University of Tasmania
Locked Bag 1354
LAUNCESTON TAS 7250
www.stemcraft.weebly.com

or post on the CoP.

For the period of the project, the project officers can be contacted on **+61363243268**

If you are making queries post August 2014, please contact Sharon Fraser. (+61363243083)

We hope you find this Framework useful and look forward to receiving your feedback.

People to consider using the STEM Framework:

Less experienced STEM teachers

- 1st & 2nd year-out teachers
- Teacher Education students
- Relief teachers/Rural and remote teachers
- Indigenous or English and Additional Language specialist teachers
- 'Out of area' teachers who are covering for more than a week
- Senior teachers who have moved up and now teaching out of area

Experienced teachers

In mentoring situations and when working with

- 'Out of area' teachers who are covering for more than a week
- Rural and remote teachers
- Indigenous or English and Additional Language specialist teachers
- STEM planning teams

Non-teaching staff

- Teachers' aides
- CSIRO staff
- Museum education officers
- Science road show staff
- Community members
- Industry partners

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Circumstances in which to consider using STEM Framework

When

- A new topic is being introduced
- Teaching teachers; it could be applied as a mentoring tool
- Undertaking an excursion; it could be applied individually or in collaboration with another teacher
- Planning a learning sequence, unit and /or lesson plans
- Comparing resources used by different teachers, and
- Checking for continuity from grade to grade
- Selecting resources for 'one-off' lessons
- **Planning for:**
 - visiting performers /presenters /guest speakers
 - museum visits
 - professional development events
 - competitions,
 - investigations
- **Selecting resources:**
 - Online resources
 - Game based learning resources
 - Text books
 - Manipulatives e.g. decipipes, counters
 - Visual displays, posters
 - Science kits
 - Applets/Apps
 - Tablet device including software
 - Software including for example:
 - Geogebra,
 - Bubbl.us,
 - TinkerPlots,
 - Inspiration,
 - Video and audio, youtube
- **Engaging with your Community of Practice**

STEM Framework – mentor data collection

Mentor – name

Person trialling the Framework – name

School

Name of resource

Reflections on the process

1. Most useful aspects of the process

2. How this process might be improved

3. Questions / concerns still remaining

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STEM Framework – Person trialling the Framework - data collection

Person trialling the Framework – name

Mentor – name (if applicable)

School

Name of resource

Planning – How did the Framework impact on my planning?

Usefulness	Suggested improvements	Questions / concerns

Context - How did the Framework assist in focussing on the teaching context?

Usefulness	Suggested improvements	Questions / concerns

Resource usability - How did the Framework aid in identifying the usability of the resource?

Usefulness	Suggested improvements	Questions / concerns

Support required - Did the Framework assist in identifying support staff requirements?

Usefulness	Suggested improvements	Questions / concerns

Evaluating the implementation - Did what I planned work? Does the Framework assist in identifying improvements?

Usefulness	Suggested improvements	Questions / concerns

References

Lave, J., & Wenger, E. (1991). *Situated learning : legitimate peripheral participation*. Cambridge [England]: Cambridge University Press.

Schon D. (1983). *The reflective practitioner: How professionals think in action* London: Temple Smith.

Shulman. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15((2)), 4-14.

Wenger, E. (1998). *Communities of practice : learning, meaning, and identity*. Cambridge: Cambridge University Press.

Wenger, E., McDermott, R., & Snyder, W. M. (2002). *Cultivating communities of practice : a guide to managing knowledge*. Boston Mass: Harvard Business School Press.

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Evaluating and selecting STEM resources: capacity building for teachers in rural and regional schools

Information sheet for Framework evaluation participants

Invitation

You are being invited to participate in the study, “Evaluating and selecting STEM (Science, technology, engineering and mathematics) resources: capacity building for teachers in rural and regional schools”. This study is funded by the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education and focuses on the need to build the capacity of rural and regional primary and junior secondary teachers in the areas of mathematics and science education. Staffing challenges in rural and regional schools can often mean that teachers have low capacities and expertise in Maths/Science that impact student achievement and their subsequent ability to engage in STEM pathways to tertiary learning.

This research is led by Professor Sue Kilpatrick, Director of the Centre for University Pathways and Partnerships and Associate Professor Sharon Fraser from the School of Education at the University of Tasmania who are joined by researchers from across UTAS, Edith Cowan, Deakin, Southern Cross Universities and the University of South Australia. A full list of project researchers is below.

University of Tasmania:

- Professor Sue Kilpatrick, Director of the Centre for University Pathways and Partnerships
- Associate Professor Sharon Fraser, School of Education
- Professor Kim Beswick, Dr Noleine Fitzallen, Dr Andrew Fluck, School of Education
- Dr Irene Penesis, Associate Professor Giles Thomas, Dr Christopher Chin, Associate Professor Dev Ranmuthugala, David Harte, Australian Maritime College
- Dr Bernardo A. Leon de la Barra, Lecturer, School of Engineering
- Dr Andrew Seen, School of Chemistry

Other Universities:

- Associate Professor Paul Newhouse and colleagues, Centre for Schooling and Learning Technologies, Edith Cowan University, Western Australia
- Associate Professor Bernadette Walker-Gibbs, School of Education, Warrnambool Campus, Deakin University, Victoria
- Professor Guy Robinson, Whyalla Campus, University of South Australia

- David Ellis and colleagues, School of Education, Southern Cross University, New South Wales

The project has the following partners:

Education system and teacher association partners

- Tasmanian Department of Education (Lead partner)
- Western Australian Department of Education
- Australian Association of Mathematics Teachers
- Australian Council for Computers in Education
- Society for the Provision of Education in Rural Australia (SPERA)

Industry partners

- Engineers Australia
- Australian Scientific & Engineering Solutions Pty Ltd
- Department of Defence

What is the purpose of this study?

This project has developed a Framework for the teacher analysis, critique, and evaluation of STEM resources developed and evaluated collaboratively to encompass contextual differences and which is consistent with the national maths and science curricula; links to maths and science resources (including human expertise, online and material) that rate highly on the analysis framework; and validated supporting materials for professional development leaders (e.g., lead and highly accomplished teachers to equip teachers effectively to use the Framework.

Why have I been invited to participate?

You have been selected to participate in this study because you are a teacher participant in one of three workshops that will develop and refine the Framework.

Participation in an interview is voluntary and there are no consequences for not participating. It will not affect your relationship with the participating universities or your ability to participate in the workshop.

What will I be asked to do?

Participants will be asked to participate in a short individual or small group interview of approximately 30 minutes. The interview will be focused on your experience of development of the Framework. The interview questions may include:

- Suitability of the content covered in the Framework,
- Suitability of the design of the Framework,
- Suitability of the Framework for a range of teaching contexts,
- The effectiveness of the workshop program and activities,
- Anticipated ease of implementation of the Framework.

With permission, all interviews will be recorded, transcribed and analysed for general themes at a later time. Individuals who participate in an interview will have the opportunity to review the themes and key points that emerged from the interviews.

You will also be asked to agree to the templates and/or surveys you have completed during the workshop to be used in research publications. All templates and/or surveys will be completed anonymously.

Are there any possible benefits from participation in this study?

By participating in this study, you are helping to develop a tool that will assist teachers of maths and science to select appropriate STEM resources for their classes. This will assist teachers to inspire students to achieve in STEM and continue into STEM related higher education courses.

Are there any possible risks from participation in this study?

There are no foreseeable risks to participating in this study.

What if I change my mind during or after the study?

All participants are free to withdraw at any time up to 30 days from the time of their interview. Interviews will then be removed from the study and transcripts of their interview will be destroyed.

What will happen to the information when this study is over?

All data will be kept in a confidential manner and stored at the University of Tasmania for a minimum of five years from the time the results are published and will then be destroyed. All hard copies of data, transcripts of interviews and survey results will be stored in a locked file cabinet.

How will the results of the study be published?

The Framework will be available via a project website to be established. This website will be linked to from the websites of education system, teacher associate and industry partners. A page will be added to the website with all results of this study.

What if I have questions about this study?

Any questions relating to this study can be directed to the project leader, Professor Sue Kilpatrick at sue.kilpatrick@utas.edu.au or at 03 6324 3632.

This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number **H13371**.

This information sheet is yours to keep, if you would like to be involved, please refer to the attached consent form.

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Consent Form

1. I agree to take part in the research study named above.
2. I have read and understood the Information Sheet for this study.
3. The nature and possible effects of the study have been explained to me.

I understand that the study involves providing my feedback on the Framework. The questions will be focused on my experience of using the STEM Framework for Evaluating and selecting STEM resources.

4. The questions I will respond to include my reflections on my experience of using the STEM Framework for evaluating and selecting STEM resources
 - The process
 - Planning
 - Context
 - Resource usability
 - Support required and
 - Implementation
5. I understand that the templates and/or surveys that I complete will remain anonymous.
6. I understand that participation involves no foreseeable risks.
7. I understand that all research data will be securely stored on the University of Tasmania's premises for a minimum of five years from the publication of the study results, and will then be destroyed.
8. Any questions that I have asked have been answered to my satisfaction.
9. I understand that the researchers will maintain confidentiality and that any information I supply to the researchers will be used only for the purposes of the research.
10. I understand that the results of the study will be published so that I cannot be identified as a participant.
11. I understand that my participation is voluntary and that I may withdraw at any time before 30 days from the time of the interview without any effect.
If I so wish, I may request at that time that any data I have supplied be withdrawn from the research.

Participant's name: _____

Participant's signature: _____

Date: _____

Statement by Investigator

I have explained the project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

If the Investigator has not had an opportunity to talk to participants prior to them participating, the following must be ticked.

The participant has received the Information Sheet where my details have been provided so participants have had the opportunity to contact me prior to consenting to participate in this project.

Investigator's name: _____

Investigator's signature: _____

Date: _____

The STEM Framework

The aim of this framework is to assist your decision making with regard to STEM teaching resources. It is a working document and to take full advantage you may need to consider the questions in a series of steps; read the questions, reflect, research, take your queries to your STEM Colleagues and the Community of Practice (CoP) and then revisit the Framework.

1. Resource needed for:

2. Resource name:

3. Resource recommended by:

4. What Australian Curriculum requirements(s) do you want to address?

5. Planning

Knowledge

5.1 Do you understand / have the knowledge and pedagogies that could be used to deliver this outcome?

Yes No Don't know

Comment:

5.2 Does this resource provide accurate, contemporary information?

Yes No Don't know

Comment:

5.3 Will this resource help you and your students understand this topic?

Yes No Don't know

Comment:

5.4 Does this resource suggest pedagogies that will enable you to achieve the outcomes you require?

Yes No Don't know

Comment:

5.5 If you are unsure of any of the above, consider putting your concerns to the CoP.

Feedback:

6. Context

6.1 Does this resource connect with your students' prior experience and interest and can it be linked to your students' familiar contexts?

Yes No Don't know

Comment:

6.2 Does your school have the additional resources to support this resource?
(Laboratory, funding OHS, materials, IT Support etc)

6.3 Can the resource be used and adapted for the diverse learner needs?

6.4 Have you got the time to understand how to effectively use this resource?

6.5 If you are unsure of any of the above, consider putting your concerns to the CoP.

Feedback:

7. Resource usability

7.1 Does this resource provide value for money? Is it suitable for a range of lessons / units of work?

Yes No Don't know

Comment:

7.2 What are the problems you might anticipate when you use this resource?

7.3 What are the OHS issues to consider?

7.4 How does this resource compare with resources you have used previously?

7.5 What are the numeracy and / or literacy demands of this resource?

7.6 Should you consider discussing any issues or concerns with the CoP?

Feedback:

8. Support Required

8.1 Do you need any support to use this resource? (eg Lab Technician, someone to assist with class management)

Yes No Don't know

Comment:

8.2 Is this resource self-contained, or do you need to order materials? (Think time, cost and availability etc)

8.3 Should you consider raising your questions with the CoP?

Feedback:

9. Evaluating the implementation.

9.1 Is this resource a long-term unit resource concept or a short-term unit applicable resource?

Long-term Short-term

As you use this resource consider the following:

- Is the resource assisting my students to achieve the intended learning outcome(s)?

Yes No Don't know

Comment:

- Do I have some formative assessment to support this?

Yes No Don't know

Comment:

- Have there been any problems?

Yes No Don't know

Comment:

If "yes" can you explain?

- Were there any unexpected OHS issues?

- What have you learned about using the resource for the future? (Did you meet with any unexpected problems?)

9.2 What have you learned that would allow you to use this resource better?

9.3 What have you learned about your own knowledge and pedagogies?

9.4 Having now used the resource it would be helpful to share what you have learned with your colleagues in the CoP.

Feedback:

Can you describe how this resource worked and place a post on the CoP?

Consider:

- What aspects worked well?

- Why did it work?
- Student feedback – what did they say?
- Advice for future users.

If the resource didn't work, can you consider why it didn't (this is valuable feedback to tell the CoP as it is in your context).

Feedback for CoP:

- I would use this resource again
- I would consider using this resource again
- I would never use this resource again