Undergraduate learning	Atomistic undergraduate research development			Wholistic undergraduate research	
0	1	2	3	4	5
Units of study	Units of study	Units of study	Co-curricular engagement	Units of study	Co-curricular engagement
Individual work	Individual uncoordinated skills development	individual & group coordinated Skills development	Research-based scholarly experience/tasters	Scholarly practice within courses	Integration into the scholarly community
• students are an audience for academics to tell them about their own and others research. • Lectures on research methodology. • Assessment through Essays and/or reports	• essays and reports framed as research • Bibliographical exercises/ critical literature reviews • practicing individual research techniques, e.g. laboratory techniques, field work, etc.	• combined and scaffolded research techniques through the curriculum. • disciplinary techniques, e.g. setting hypotheses,, collecting data, practiced on unconnected topics	• working alongside staff, PhDs, Post Docs etc on existing research projects. • Engaged as research assistants and/or as part of a wider scheme e.g merit scholars • may be voluntary	• Program based approach to design of units of study • coordinated set of research skills and experiences • Engagement within units of study in whole process from question setting to publishing	• individually tailored research projects • working alongside academics • Engaging in whole process from question setting to publishing • summer/winter vacation scholarships, or internships.
Students: • develop basic student competency • largely unaware of research and research opportunities	Students: • develop skills of academic writing and critical analysis • develop knowledge of some techniques • research in the university unconnected • unaware of research and opportunities.	Students: • develop particular research techniques • lack understanding of relationship to chosen profession	Students: • introduced to research life and practices • typically paid a stipend or salary or may gain academic credit	Students: • develop disciplinary professional tool kit • gain a clear sense of the process of research • practice skills in coordinated manner • know how research relates to profession	Students: • fully integrated into the scholarly community • treated as equal with academics • ownership of a particular project • know how their research furthers the discipline. • Gain a stipend or academic credit
RED: Insufficient Undergraduate Research Development	AMBER: Some recognition of need to develop undergraduate research skills but practice is patchy and coordination across programs requires more work			GREEN: Some good recognition of the need for coordinated development and integration of students into the scholarly community.	

Forms of engagement in undergraduate research. (An edited version was published in: Brew, A., & Mantai, L. (2017). Academics' perceptions of the challenges and barriers to implementing research-based experiences for undergraduates. *Teaching in Higher Education*. 22:5, 551-568

0 - Undergraduate learning

Everything students do in university is research. There may be lectures where students are an audience for academics to tell them about their own and others research. They may have lectures on research methodology and assessment through essays and/or reports. Students develop basic student competency. They may be largely unaware of research and research opportunities.

> "For the vast majority of students the research they get in their undergraduate degree is how to write an essay (English, 1, p.15)
>
> "there's a built in assumption if we get you to write an essay on this topic … that the student is doing research. I mean we haven't been expected to spell that out." (Linguistics, 6, p.9)
>
> "see my view is that students every time they read a book and they are thinking about a question they are actually researching. So research is an activity that happens every hour of every day in university's cos people are thinking .. they get this interesting idea: I wonder why this happens, … Research is problem solving but you have to be able to come up with an interesting problem to solve and so that's what the basic teaching does. So it's a way of thinking." (Psychology, 10, p.4)

1 - Individual work, study and uncoordinated skills development

Students do "Research essays" or "research reports" i.e. essays and reports framed as research and linked to research/journal article writing. Students carry out bibliographical exercises and/or critical literature reviews and they practice individual research techniques, e.g. laboratory techniques, data mining, field work, questionnaire design etc. Students develop skills of academic writing and critical analysis. They develop knowledge of particular disciplinary techniques but these may appear unconnected with research in the university and professions. They may be largely unaware of research and research opportunities.

> *"every unit has some kind of research project. … Usually it is a library based research project, well yes I think probably all of them have some kind of library based research that culminates in an essay or other kind of assessment .. like a research portfolio. …*
>
> *Interviewer: So the students doing an essay – do you call that research?*
>
> *Respondent: Yeah I would call that research. If I tell them that … I want them to do research on debates about legalisation or decriminalisation of [topic], .. then I expect them to do a lot of research looking at the history of [topic] legalisation or decriminalisation in other contexts and the history of the legal prohibition of [topic] and so on. So yeah that is going to involve figuring out what to read and how to construct an argument. So in that sense it is research. … We call it a research essay" (Anthropology, 17, p.5)*

2 - Coordinated Skills development through individual and group work

Research techniques are combined and scaffolded throughout the curriculum. Students learn how to set hypotheses, generate questions, collect data, write reports, and engaged in disciplinary techniques etc. but these may be practiced on unconnected topics. Students develop knowledge and skills in particular research techniques but are unlikely to develop understanding of how the research they are doing relates to their chosen profession nor life afterwards.

> *"I think it is any learning activity or content that has some focus or element of research to it. So it could in fact be, students could .. interview each other to learn about interviewing. Students could engage with primary research. … I used to try and get them aware of a range of methods or give the class a set of data and then have them in groups interpret it using different approaches. … More actively … we could use the whole class … like a sample of respondents: get everybody to fill something in and then collectively collate that data and see what we would do to it, we've done that. … I've had them go out and interview or survey in the community and bring those results together. Look if you bring in a journal article or some other commentaries like that that's engaging with research. …I used to like to get guest speakers in: people who have published their research … And had the students quiz the author on how … they did their research. That's always really nice that they meet a real researcher. I used to love that. So there's endless possibilities and I've used all of those and I'm sure there's many more. " (Education, 13, p. 5)*
>
> *"it is that skills development in the scientific research method that's important in the undergraduate and that's what I define and the research component of it. So they're constantly developing research skills, analytical thinking being able to think about what data mean and interpreting it, being able to drill into papers and what not. So I guess for me*

undergraduate research is developing that critical analysis skill set that they need … for outside science later on in their life." (Geology, 14, p.6)

3 - Research-based scholarly experience/tasters

Students work alongside staff, PhDs, Post Docs etc. They are involved in data collection or analysis on existing research projects. Students may work as research assistants and/or as part of a wider scheme e.g merit scholars or projects individually set up by academics. Students are typically paid a stipend or salary or they may gain academic credit. Engagement may be voluntary. Students are introduced to research life and practices of scholarly engagement but the work does not relate to their learning in units of study.

"some labs are more accessible for undergraduate stuff than others. But for example my research group have had two undergraduate interns this year. And actually it was independent of the .. the formal internship program. And essentially these two students carried out field work with me and a PhD student of mine and spent considerable periods of time actually in the field learning how to capture, in this case [animal] and how to mark them and measure them and carry out population surveys and so we do get them involved. … One of the ones the I had this year was in his third year of advanced biology … It wasn't necessarily designed to integrate in with any particular knowledge base they might have developed as part of the undergraduate [course]… [It's] completely independent of that. They at the same time learn particular research skills. Knowing what the project was about. … (Biology, 9, p.5-6)

4 - Scholarly practice within courses

Units of study where students devise questions/hypotheses, set up experiments/ fieldwork to answer them, collect the data/do the experiments/analyse the resulting data and report on findings/results. Program based approach to the design of units of study ensures students acquire a coordinated set of research skills and experiences. Students develop their disciplinary "professional tool kit". They gain a clear sense of the process of research in the discipline, can practice skills needed and they know how research relates to their chosen profession and life afterwards.

"undergraduate research in order for it to be defined as research has to have sort of [a] trajectory that takes them on the path of what for an anthropologist or a qualitative researcher, what that involves. So formulation of the question, figuring out how to answer it, going out and interviewing people or serving people or doing whatever …… and then analysing it and then writing it in a presentable form. It doesn't have to be writing. I've seen students do documentary projects, media projects, presentations, you know somehow presenting it in a digestible form. So that trajectory I think that's what research is for me is. You can do parts of research you can teach methodology, but you're not teaching research if you just do methodology so you need the beginning to the end." (Anthropology, 18, p. 5-6)

5- Integration into the scholarly community

Students work alongside academics on individually tailored or devised research projects. They devise questions/hypotheses, set up experiments/ fieldwork to answer them, collect the data/do the experiments/ analyse the resulting data and report on/publish findings/results. Engagement may be as summer/winter vacation scholarships, or internships. Students are typically paid a stipend or may gain academic credit. Students are fully integrated into the scholarly community. They are treated as equals with academics/researchers and have ownership of particular projects. They know how the research they are doing furthers the discipline**.**

"I suppose very simply where an undergrad level student does some primary research where they have a project, where they, with the help of a supervisor, they develop an idea and then they do some reading to understand the context of the project. And then they develop with aid what they will do. So collection of rock analyses or measuring some geophysical attribute or whatever so the doing part of the research project and then all of these have an interpretational write up stage where they put it all together. So I would characterise it as students actually doing genuine research which in some cases could be publishable in a Journal. Having a student be able to get a scholarship to do this is helpful. … So there needs to be some sort of framework to fit them in. … And having post docs and PhD students who can in their lab mentor the more junior people: Masters students and especially undergraduates who are learning stuff can be very helpful. … And that sort of extra help from the broader group of researchers at the university I think is an important part. So the undergraduate feels they're fitting in to a broader team or group so I think that's an important part of it. (Geology, 15 p. 6-7)